PITTA DETECTION USING SECOND DERIVATIVE FEATURES OF FINGER PHOTO-PLETHYSMOGRAM

A Dissertation Submitted in Partial Fulfilment of the Requirements

For the Award of Degree of

Master of Engineering

in

Electronic Instrumentation and Control

Submitted by

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DECLARATION

I hereby certify that the work which is being presented in the dissertation entitled, **"PITTA DETECTION USING SECOND DERIVATIVE FEATURES OF FINGER PHOTO-PLETHYSMOGRAM"** in partial fulfilment of the requirements for the award of degree of Masters of Engineering in Electronic Instrumentation and Control, submitted in Electrical and Instrumentation Engineering Department, Thapar university, Patiala, is an authentic record of my own work carried out under the supervision of **Dr Mandeep Singh**, Associate Professor, Department of Electrical and Instrumentation Engineering, Thapar University, Patiala.

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I shall be failing my duties if I do not express my deep sense of gratitude towards **Dr.Smarajit Ghosh**, Professor and Head of the Department of Electrical and Instrumentation Engineering, Thapar University, Patiala. I am also thankful to the entire faculty of Electrical and Instrumentation Department who helped me in all the possible ways towards successful completion of this work.

I am greatly indebted to all my friends who were always there to support me morally and help with all there valuable suggestion throughout this work.

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ABSTRACT

The Human heart beats almost rhythmically, thereby producing pulse wave in different parts of the body. Such a pulse is sensed from finger tips using Photoplethysmography (PPG) technique and is analyzed for its diagnostic ability. The aim of this study is to analyze the features extracted from the second derivative of the pulse waveform and find such parameters that may directly link to the increased level of pitta. Pitta is an Ayurvedic dosha that may be the cause of a disease in the human body. Further it has been observed that pitta level increases after having mid-day meal.

In this work the second derivative of the finger PPG waveform has been studied and some prominent features have been extracted from it. The data has been recorded using BIOPAC MP System and AcqKnowledge software. The features thus extracted have been used to find a relation between increased pitta and the Second Derivative of Finger Photo Plethysmogram (SDPTG) wave. For this study data was acquired from 12 subjects. Finger PPG's of three fingers namely index, middle and ring of both left and right hands were acquired before and after lunch. Eight parameters extracted from each finger were first analysed for six subjects. From a total of 48 parameters 19 such parameters were found that were changing consistently for 5 or 6 subjects. Further analysis was done on so found 19 parameters. From the data analysis on all the 12 subjects for these 19 parameters, 5 parameters were found that consistently held for 10 out of 12 subjects. On these 5 parameters the test of significance, t test for checking the statistical significance of results obtained was applied. Further an Artificial Neural Network (ANN) classifier has been designed that detects the enhanced level of Pitta with an accuracy of 91.67%.

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LIST OF ABBREVIATIONS

ANN	Artificial Neural Network
APG	Acceleration PlethysmoGraph
PPG	PhotoPlethysmoGraph
PW	Pulse Wave
PWV	Pulse Wave Velocity
RCT	Relative Crest Time
SDPTG	Second Derivative of Finger photo PleThysmoGraph

CHAPTER 1
Introduction

1.1 Ayurveda - An Introduction

Ayurveda is an Indian medical science, originating over 5000 years ago. The written source of this science is ancient books of knowledge known as the Vedas. The Vedas contain practical and scientific information on a wide variety of topics including philosophy, logic, engineering, agriculture, economics politics and one that of health is Ayurveda.

Vedic knowledge has put forward the principle of natural balance within the body and harmony with the environment.

1.1.1 Meaning of Ayurveda

Ayurveda is derived from two words, Ayus and Veda. Understanding the meaning of both words is necessary to fully grasp the philosophy of this discipline.

Figure 1.1: Ayus

1.1.2 Definition of Ayus

In English ayus means “life”. In the Vedic context, the definition of life is broader than normal lifespan. It does not mean the age of a person; the number of years lived on Earth measured from birth until the present day. Ayus is a combination of the: Body (sarira), Senses (indriya), Mind (manas), Soul (atma). Together, these four factors are responsible for sustaining the life or force (prana) as shown in Fig 1.1 in the body, and each must be present in order to produce and sustain ayus. Everything on Earth has a physical body and a soul, but whether it also has a mind and senses determines whether it is alive.

1.1.3 Definition of Veda

Veda is a Sanskrit word which means “knowledge” or “science”. Vedic knowledge is enshrined in fourteen sacred texts. There are four Vedas (Rig, Yajur, Sama and Atharva), six Vedangas (auxiliaries), Meemamsa (interpretations), Nyaya (logic), Puranas and Shastras.

1.2 Behind Ayurveda

Ayurveda is not just a medicinal healthcare system where Fig 1.2 shows some of the herbs used in ayurvedic medicinal system, but a form of lifestyle adopted to maintain perfect balance and harmony within the human existence. According to Ayurveda, life represents a combination of the Atma (soul), Mana (mind), Indriyan (senses) and Sharira (body). It revolves around the five elements (Panchamahabhutas) namely, earth, water, fire, air, and vacuum (ether), which constitutes an individual's nature or Prakriti. This nature is determined by the vital balance of the three physical energies - Vata, Pitta and Kapha - and the three mental energies - Sattva, Rajas and Tamas.

Figure 1.2: Ayurvedic Medicinal System

Prakriti means "nature". When referring to the theory of creation, it is the unmanifested nature of cosmic matter. When referring to humans, prakriti means the unique physical and psychological nature displayed

1.3 Physical energies of the body- *dosha*

In Sanskrit, dosha is defined as "doosyati iti doshah." The simple and pure meaning of this is "that which contaminates is called dosha." So doshas may be considered the pathogenic factors, or disease-causing agents in the body. Dosha only refers to the three biological energies of *vata, pitta* and *kapha,* as shown in Fig 1.3 sometimes called as the tridosha. An imbalance of these elemental combinations is the direct cause of physical disease; they are the prime disease causing factors (the "contaminants"). Secondary factors in the disease process are the body tissues (dhatus), toxins (ama) and waste materials (malas) which are actually the product of, or dependent upon, an imbalance in the *doshas.*

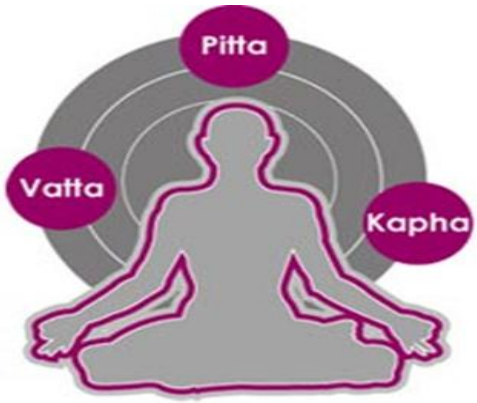


Figure 1.3: Physical Energies of body

Every human usually has different degrees of *vata*, *pitta* and *kapha*. In the same being also the doshas are usually not present in equal proportions. In most people there is a natural uneven distribution. Characteristics of *vata*, *pitta* or *kapha* are up to different levels, one of these elemental natures will dominate and that is the "main" *dosha*. The secondary *dosha* is the one present in the next highest proportion. Every *dosha* type or combination is acknowledged in Ayurveda, which lists seven separate physical constitution types based on the basic three: (1)*vata*, (2)*pitta*, (3)*kapha*, (4)*vata-pitta*, (5)*vata-kapha*, (6)*pitta-kapha*, (7)*vata-pitta-kapha*. The detection of imbalance in the dosha is the main way of diagnosing bad health in Ayurveda.

1.3.1 *Vata* Type

People with a predominant *vata dosha* display physical and emotional characteristics linked to the elemental qualities of space/*akasha* and air/*vayu* as shown in Fig 1.4.

Figure 1.4: Main Element of Vata - Air

They are very active - mobile, restless and energetic.Sleeping, eating and personal habits are irregular and erratic, with appetite varying between extremes. They sleep lightly, are easily disturbed and prone to insomnia. Their pulse is fast, weak and irregular. They dislike cold, windy or dry environments and feel chilled quickly or shiver easily.

People with *vata dosha* often feel anxious, worried or stressed - especially in unfamiliar, cramped or noisy environments. They are most likely to be loners, or non-conformists.

1.3.2 *Pitta* Type

People with a *pitta dosha* display an inherent fire/*agni* as shown in Fig 1.5 elemental character. They are of medium build, with greater muscular development than that displayed by *vata*. Their

skin is soft and warm, and they have a lot of body heat and often perspire excessively. Their hair is thin and often reddish or blond, and they may experience premature graying, baldness or excessive hair loss. Their skin flushes easily and they often have many freckles and moles. Their skin develops acne, rashes, bruises or sunburn easily.

Figure 1.5: Main Element of Pitta-Fire

Sleep is moderate and not easily disturbed. The pulse is strong and stable. Individuals with *pitta dosha* predominant speak loudly and passionately, and often dominate the conversation. They have an aversion to hot weather, sunlight and heat, and their eyes are sensitive.

1.3.3 *Kapha* Type

People with a predominant *kapha dosha* tend to have a heavy and solid, where main element of kapha dosha is water as shown in Fig 1.6 or large build. They are often overweight, gain weight easily and have high muscle development (plump and round). Their skin is thick, smooth and moist with few wrinkles. Their complexion is usually clear, fair or pale, and hair is oily, thick and wavy. Their teeth are strong, white and well formed.

Figure 1.6: Main Element of kapha – Water

People of the *kapha* type have a moderate or low appetite and slow digestion. They enjoy eating gourmet or luxury foods (that appeal to taste and smell) or buying and preparing food.

1.4 The Mind Types (*Gunas*)

Guna is simply defined as character or quality. The cosmic matter is made up of three gunas. Everything on Earth also has a predominant guna, as well as the more specific qualities obtained from their elemental makeup. Just as our bodies contain all of the elements, our minds have each of the *gunas*.

The three basic gunas/qualities are: *Sattva* (knowledge, purity) *Rajas* (action, passion), and*Tamas* (inertia, ignorance).

Foods, plants, animals and people can all be grouped according to their dominant quality/guna. All three types of guna are present in everyone, and each may be displayed in different contexts. People can alternate between gunas depending on the environmental context and their diet, as well as phase of life and other factors. This is because the guna of food consumed, and the surrounding social or physical environment directly influence the mind guna.

The mind is inherently connected to the body. Increasing our contact with, or consumption of, rajasic or tamasic things ultimately creates an imbalance in the mind and distress in the body. This is followed by disease and sickness in a variety of forms. If dosha is unbalanced it can similarly disturb the mind guna. This link between the mind and body can help in diagnosis of the origin of some diseases difficult.

1.5 The Five Element Theory - Panchamahabhutas

Earth, and everything on it, is the product of different combinations of the five basic elements: earth, water, fire, air, and space as shown in Fig 1.7 below. Everything found on Earth can be classified into one of these five categories, based on their innate characteristics.

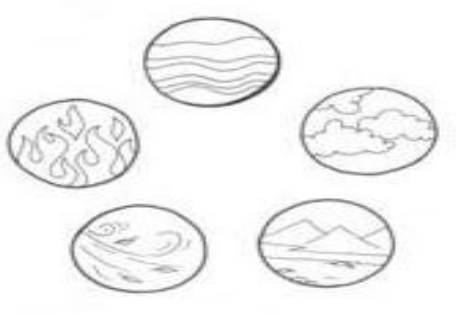


Figure 1.7: The Five basic Elements

Just as chemistry and physics use specific technical terms to classify matter, Ayurveda uses the characteristics of the five elements (pancha mahabhutas) to identify various objects. If something is classified as "fire" it does not mean that it is literally a fire. It means that the object displays the characteristics of fire, like combustion, heat and so on. Similarly, if an item is classified as "water" or "earth" it means it is moist, cool and sticky or heavy, solid and stable.

The human lifecycle is divided into childhood, where physical growth takes place (water and earth), adulthood where activity and change occur (fire), and old age where mobility becomes impaired and the body begins to weaken (space and air). The year is divided into four seasons – winter when it is cold and rainy (water, earth); spring when new growth occurs and it becomes warmer (water, fire); summer when it is hot and dry (fire, air); and autumn when it is windy and cool (air and space).

The elements (*mahabhutas*) have certain qualities, attributes and impacts on the body and mind. All objects and substances are a mixture of the five elements, but they have one dominant element that allows them to be identified and classified.

1.6 Composition of Human Beings

Humans are one of the many living organisms present on Earth. We are physically made up of exactly the same elements that form all of the other entities that live on Earth. When we die, our bodies return to the earth, water, fire, air and space. A person sustains the combination of elements already present in the body through breathing air and consuming food and liquids - taking in those elements found in the surrounding natural world.

The “five element” theory explains the similarity between humans and the natural world surrounding them. In our body, space/akasha is present wherever there is a cavity like in the nostrils, mouth, ears, throat, lungs, and stomach; air/vayu in movement of the lungs, heart, stomach, intestines and joints; fire/agni in all metabolic activity, the eyes, intelligence and body temperature; water/jala in all plasma, blood, mucus, and saliva; and earth/prithvi in any solid structure like fat, muscles, skin, nails and hair.

The basic elemental compatibility or similarity between Earth and humans justifies why substances found in the natural world (plants, herbs, foods) are usually harmonious with the human system. They can be easily absorbed and cause no adverse reactions or side effects (if taken in appropriate quantities) because they are fundamentally the same in character and composition. This is why foods and herbs are able to heal the human body.

CHAPTER 2
Wrist Pulse Analysis

2.1 Introduction

In the non-invasive Indian traditional system of *Ayurveda* it is believed that the function of entire human body is governed by three humors: *vata*, *pitta*, and *kapha*, called as *Tridosha*.

The standard position to obtain *Tridosha* is through a "pulse waveform" obtained on a wrist with the index, middle and the ring fingers respectively [27] as shown in Figure 2.1.

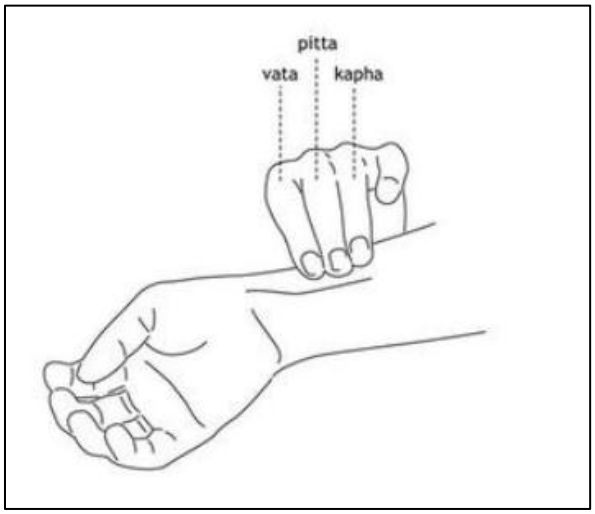


Figure 2.1: Ayurvedic Wrist Pulse Analysis System

Nadi sience is the science of nadi or nerves, which includes the study of life processes that are responsible for living and existence of man. Nadi gets influenced by various affects that influence the physiology of the body, especially the three doshas i.e vata, pitta, kapha. The nadi simply refers to the radial artery.

The *nadi* resembles the ECG which has been explored the most in the recent studies. By studying the gati or the motion of the nadi the convenient, inexpensive, painless, and noninvasive pulse-based diagnosis extracts the imbalances of *Tridosha*, which in turn identifies the presence and location of disorders in a patient's body [28]. Hence indicates the imbalance of the three doshas.

2.2 Method of Wrist Pulse Analysis (Nadi Pariksha)

The pulse is examined with three fingers by gently touching and giving mild pressure, so that the blood flow doesn't get obstructed.

This skill is not easily acquired by most. It requires a sharp intellect, keen sense of observation and in-depth Study of scriptures. To be an excellent pulse reader a thorough and accurate analysis of the pulse, perfected through years of practice is must. Calm mind and focused concentration is also essential. A doctor has to have determination of yogi to excel at pulse reading.

To learn pulse reading one has to examine a normal and healthy person's pulse many times at different intervals. example pulse reading during, pre and post meals, sleep, defecation etc. This is how excellence and perfection is achieved in the art of pulse reading. Since, this science is different and difficult to master; it is slowly & gradually fading into obscurity.

2.3 Various Levels of Understanding Nadi

Nadi is examined at 4 levels which help in achieving the diagnosis. These are:

- Immediate level
- Superficial level
- Deep level
- Subdosha level

2.3.1 Immediate Level

This is the level when the examiner arrives at exact location of the Nadi and without any botheration of the pressure exerted on the nadi tries to evaluate its properties such as nature(whether soft or pricking), gati i.e. speed(whether fast, moderate or slow), regularity etc.

2.3.2 Superficial Level

After immediate level all the three fingers are elevated in a single plane and taken to the uppermost level using the minimum pressure. The thing observed in this level denotes the happening in the body at that moment.

2.3.3 Deep Level

The deep level represents the prakrity of the person. In the humans the most constant non changing thing is prakrity, so it is understood at the base. The location and strength must be looked at fingertips representing the respective prakrity.

2.3.4 Subdosha Level

Subdosha are nothing but the sub types of dosha. Each one of these represents a particular organ or system of the body. Understanding the subdosha provides the knowledge about the happening in that particular organ or disease process being concentrated in that area. If this knowledge is combined with the information gathered in earlier levels it provides near correct directions for diagnosis [29].

The main aim of this dissertation work is to find out parameters which help in studying the changes in pitta level with the help of PhotoPlethysmoGraphy (PPG) technique. Thus reviving this dying art of Nadi Pariksha (Wrist Pulse Analysis).

CHAPTER 3
Plethymography and its Applications

3.1 Plethysmograghy

The word plethysmograph is a combination of two ancient Greek words ‘plethysmos’ which means increase and ‘graph’ which is the word for write, and is an instrument mainly used to determine and register the variations in blood volume or blood flow in the body which occur with each heartbeat.

Various types of plethysmograph exist, and each of them measures the changes in blood volume in a different manner with a specific transducer and has certain applications [12].

As shown in Table 3.1, the general plethysmograph types are: water, air, strain gauge, impedance, and photoelectric.

Table 3.1. Types of Plethysmograph and Its Application

Type	Transducer	Standard Applications
Water	• Water-filled cuff • Water-filled body • Water-filled chamber	• Measuring penile blood flow • Measuring Pulmonary Capillary Blood Flow • Measuring maximal blood flow
Air	Air-filled cuff	• Evaluation of venous hemodynamics • Measures parameters of global venous function like: ➢ calf venous volume ➢ venous filling index
Impedance	Electrodes	• Detection of blood flow disorders • Assessment of fat-free mass of the human body
Photoelectric	Photo detectors	• Monitoring of heart and respiratory rates • Monitoring of oxygen saturation • Assessment of blood vessel viscosity • Measuring blood pressure • Assessment of cardiac output

Photoelectric plethysmography, also known as photoplethysmography (PPG) is easy to set up, convenient, simple and economically efficient compared to the other types of plethysmograph mentioned in Table 3.1 [12].

It uses a probe which contains a light source and a detector to detect cardio-vascular pulse wave that propagates through the body. The PPG signal reflects the blood movement in the vessel, which goes from the heart to the fingertips and toes through the blood vessels in a wave-like motion [23], shown in Fig. (3.1a). It is an optical measurement technique that uses an invisible infrared light sent into the tissue and as the amount of the backscattered light corresponds with the variation of the blood volume [24]. Hertzman was the first to find a relationship between the intensity of backscattered light and blood volume in 1938 [1]. The low-cost and simplicity of this optical based technology could offer significant benefits to healthcare (e.g. in primary care where noninvasive, accurate and simple-to-use diagnostic techniques are desirable). Further development of PPG could place this methodology among other tools used in the management of vascular disease.

As shown in Fig. (3.1a), the wave contour of PPG signal is simple and has not been analyzed and investigated because of the difficulty in detecting changes in the phase of the inflections.

Therefore, Takazawa [26] introduced the first and the second derivative of the PPG signal, as shown in Fig. (3.1b) and Fig. (3.1c) respectively, to facilitate the interpretation of the original PPG waves. The first and second derivatives of the PPG signal were developed as methods which allow more accurate recognition of the inflection points and easier interpretation of the original PPG wave. The fingertip PPG signal reflects the blood movement in the vessel, which goes from the center (heart) to the end (fingertips) in a wave-like motion as shown in Fig. (3.1a). It is affected by the heartbeat, the hemodynamics and the physiological condition caused by the change in the properties of an arteriole. The effects can be observed as distortions in the wave profiles.

As shown in Fig. (3.2), any PPG diagnostic structure consists of three stages: Pre-processing, features extraction, diagnosis/classification.

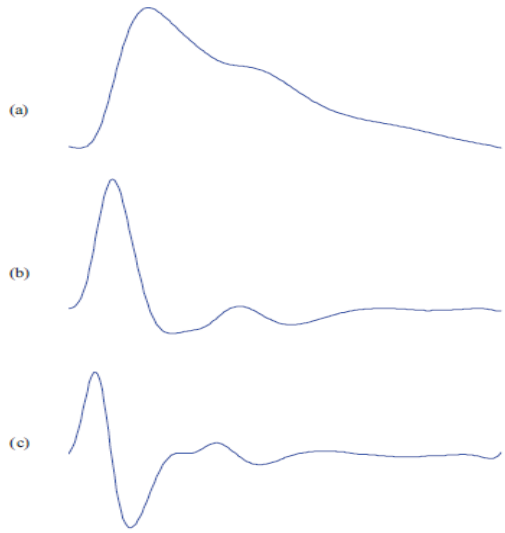


Figure 3.1: Signal Measurements (a) Original Finger Photoplethysmograph (b) First Derivative Wave of Photoplethysmograph (c) Second Derivative Wave of Photoplethysmograph

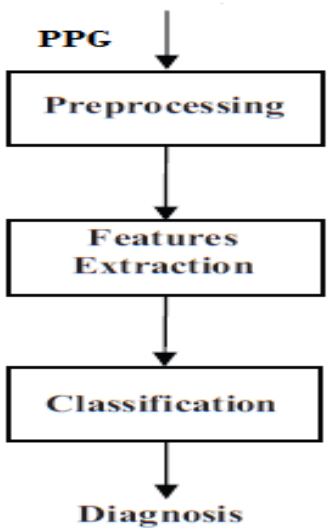


Figure 3.2: Common Structure for PPG Diagnostic System 1) Preprocessing stage to emphasized the desired wave 2) Feature Extraction stage to detect the desired wave 3) Calculate an index or a measure using the extracted features for classification and diagnosis

3.2 Photoplethysmography Instrumentation

Modern PPG sensors mostly utilize low cost semiconductor technology with LED and matched photodetector devices working at the red and/or near infrared wavelengths (IR-A near infrared band 0.8 to 1 μm). LEDs convert electrical energy into light energy and have a narrow single bandwidth (typically 50 nm). The main advantage of using LED‘s as light

source is that they are compact, with a long operating life usually greater than 105 hours, operate over a wide temperature range with small shifts in the peak-emitted wavelength, and are mechanically robust and reliable.

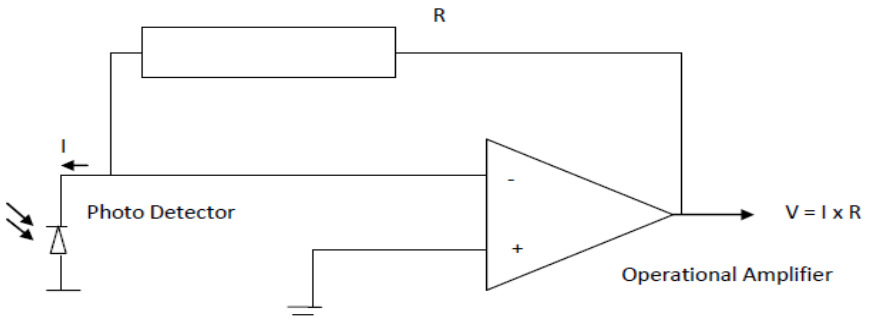


Figure 3.3: Transimpedance Amplifier stage of a PPG Sensor

However it must be taken care of that the average intensity of the LED is constant and preferably sufficiently low to minimize excessive local tissue heating and also to reduce the risk of a non-ionizing radiation hazard. The choice of photodetector depends on its spectral characteristics which are chosen to match that of the light source. A photodetector converts light energy into an electrical current. They are compact, low-cost, sensitive, and have fast response times. Near infrared devices can be encased with daylight filters. The photodetector connects to low noise electronic circuitry that includes a transimpedance amplifier and filtering circuitry.

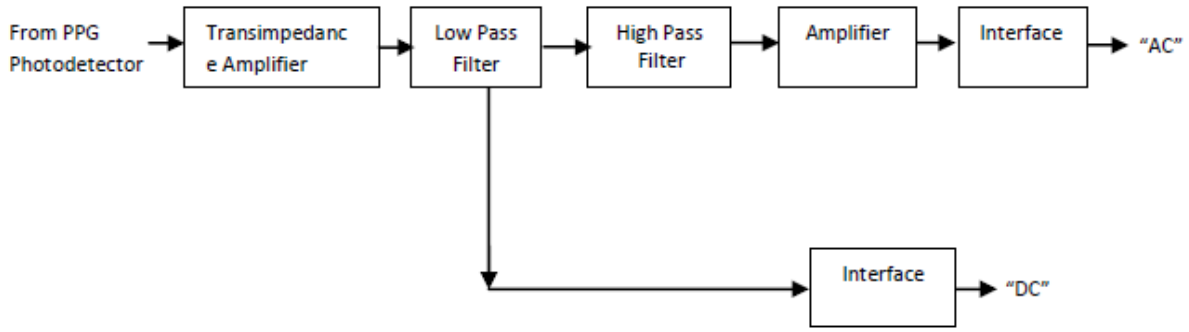


Figure 3.4: Block Diagram of Signal Conditioning Stages of a Standard PPG Sensor

3.3 Pre-Processing In PPG Signals

The quality of the PPG signal depends on the location and the properties of the subject's skin at measurement, including the individual skin structure, the blood oxygen saturation, blood flow rate, skin temperatures and the measuring environment.

These factors generate several types of additive artifact which may be contained within the PPG signals. This may affect the extraction of features and hence the overall diagnosis, especially, when the PPG signal and its derivatives will be assessed in an algorithmic fashion. The main challenges in processing the PPG signals are described as follows:

3.3.1 Power line Interference

This artifact could be due to the instrumentation amplifiers,the recording system picking up ambient electromagnetic signals and other artifact.

Moreover, high frequency artifact caused by mains power sources interference is induced onto the PPG recording probe or cable. This artifact introduces a sinusoidal component into the recording.

3.3.2 Motion Artifact

This artifact is may be caused by poor contact to the fingertip photo sensor. Variations in temperature and bias in the instrumentation amplifiers can sometimes cause baseline drift as well.

In our measurements, the body movement was limited due to the short time of measurement (30 seconds) and the fixed position of the arm during the fingertip PPG signal collection. It is hard to arrange a procedure to measure PPG signal without low frequency artifact. The low frequency artifact can be removed using a high pass filter or vice versa.

3.3.3 Low Amplitude PPG Signal

In general, the PPG waveform is subject to sudden amplitude changes due to the automatic gain controller which adjusts the gain of the amplifier automatically based on the amplitude of the input signal. This may cause amplitude saturation in the amplitude of the PPG waveform at a maximum or minimum value, or to rest at some random fixed value. However, the reduction of PPG amplitude can be directly attributable either to a loss of central blood pressure or to constriction of the arterioles perfusing the skin.

CHAPTER 4
Finger Pulse Feature Extraction

4.1 Pulse Wave

The pulse wave (PW) is a complex physiological phenomenon observed and detected in blood circulation. The amplitude of the pulsatile component of the finger pulse is influenced by respiration, sympathetic nervous system activity and other factors that influence local perfusion. The shape of the pulse, however, remains approximately same [5].

The features associated with the pulse signals are important from diagnostic point of view.

4.2 Physiology of Pulse Wave

The pulse pressure signal generated in the arterial structure exhibit certain characteristics which involve percussion wave, tidal wave, dicrotic notch and reflected wave. It is required to identify these characteristics points on the finger or the wrist pulse correctly for the analysis of the pulse series.

In the course of heart systole a certain amount of blood is ejected and it is moved into the arteries because of transformation between kinetic and potential energy of each segment of ejected blood. On each artery or venous section affected by a pulse wave, three coherent phenomena are observed: blood flow (flow pulse), the increase of blood pressure (pressure pulse) and extension of transverse profile (profile or volume pulse), the process is as shown in figure 4.1.

Several invasive methods are available to detect the PW. The PW contour varies in different parts of the circulation. It depends on physiological or pathophysiological conditions of the organism. The heart rate, the body height and the age, as well as BMI or body fat belong to important physiological phenomena. The pathological events like arteriosclerosis or diabetes have a great primary effect on the arterial elasticity.

Hypertension or some heart diseases influence the PW velocity.

In every region where the pulse wave runs, three related effects can be observed: liquid flow (flow wave), a pressure change (pressure wave), and a cross-section change (volume wave). The forward wave spreads to the periphery, where it does not dissipate, but is reflected back to central vascular system. This retrograde propagation causes an increase of blood pressure again. Standing waves arise. The resulting pulse waveform is determined by phase sum of forward and reflected waves.

The time differences of reflected pulse wave in each part of circulation are responsible for differences of central and peripheral pulse wave. The pressure in ascending aorta decreases after reaching the maximum and there is a typical incision at the end of diastole. This is caused by short regurgitation at the end of systole. It closes the semi lunar valves and the systole is finished.

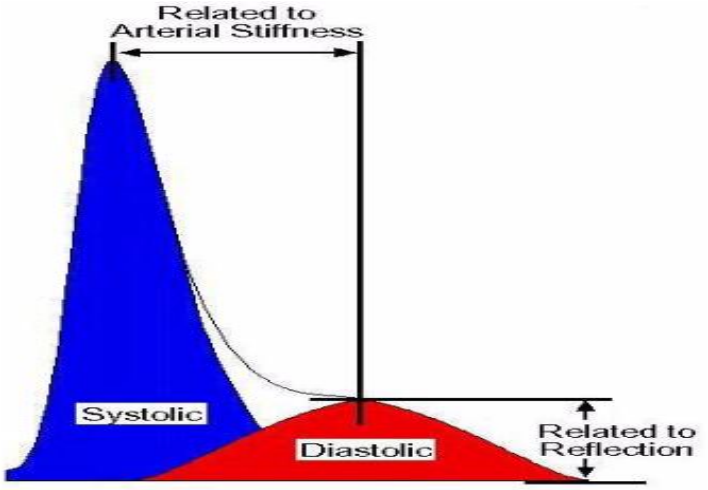


Figure 4.1 Cause of Generation of Pulse

These shapes of pressure pulse are typical for the arteries close to the heart, e.g. subclavian artery or carotid artery. In distal arteries, the pressure changes are different from those in the aorta. The pulse pressure increases there and there is no incision because of attenuation of higher frequencies.

4.3 The finger pulse contour

The typical volume pulse wave shape of the finger PPG is shown in Figure 4.2. The pulse acquired by finger PPG is first preprocessed for noise removal. The wave is analyzed in its original form by extracting the following features: (1)crest time (TP1), (2)dicrotic wave time (TP2), (3)total pulse duration (TPT), (4)interwave time (IWT) measured in two thirds of systolic peak, (5)systolic amplitude (AP1), (6)dicrotic wave amplitude (AP2).

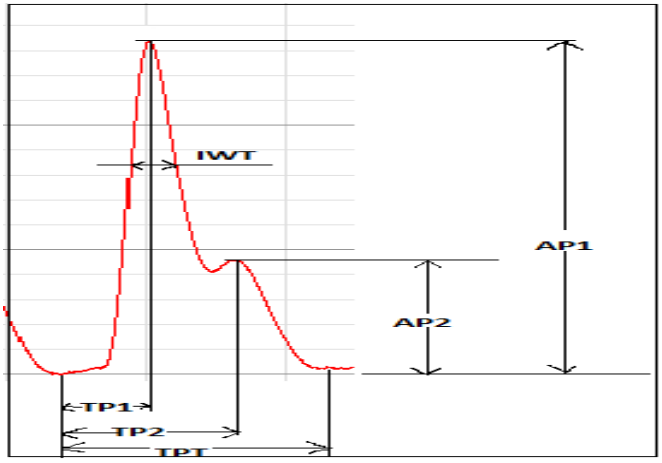


Figure 4.2: Typical Finger PPG Wave

From the above mentioned features, the following parameters can be derived: relative crest time (RCT) = TP1/TPT, relative interwave distance (IWD) =IWT/TPT, relative dicrotic wave amplitude (DWA) = AP2/AP1 (also called index of pressure wave reflection or reflection index (RI)) and relative dicrotic wave time (DWT) = TP2/TPT, all these parameters being dimensionless [3].

To derive yet more features from the wave form another technique that has been applied is the evaluation of derivatives of the waveforms. This allows the precise analysis of sudden changes in the waveform and time shifts. Figure 4.3 shows the second-order time derivative of the real volume pulse of finger PPG.

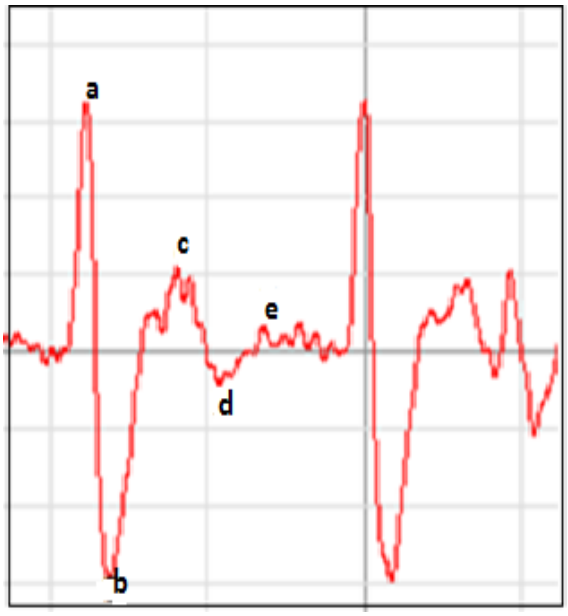


Figure 4.3: Typical 2nd derivate of the pulse wave

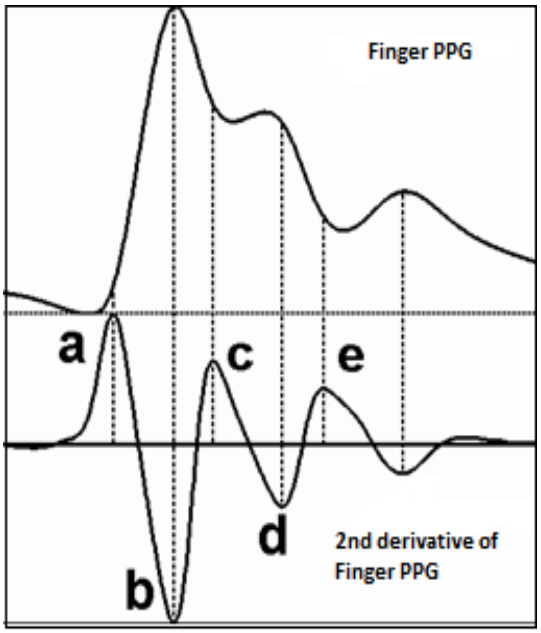


Figure4.4: Comparison of Finger Pulse Wave and SDPTG

The first-order derivative parameters have a non-acceptable variation and therefore are generally not used. However, the second-order derivative has been frequently talked about in literature using the abbreviations SDPTG (Second Derivative of Finger photo PleThysmoGraph) or Acceleration PlethysmoGraph(APG). The second-order derivative waveform comprises of five main parts as shown in figure 4.4, labeled from a to e: initial positive (a), early negative (b), re-increasing (c), late re-decreasing (d) and diastolic positive (e) [11]. From these determinants, the following parameters can be calculated: b/a ratio, c/a ratio, d/a ratio, e/a ratio and aging index AGI = (b-c-d-e)/a [3].

4.4 SDPTG waveform

The shape of the SDPTG or APG waveform has been categorized into seven types, A to G as shown in Figure 4.5. The shape of the SDPTG or APG waveform can be described as in Table 4.1.

Table 4.1: Types of SDPTG or APG waveform

Beat Type	Description
A	Good Circulation
B	Good Circulation but deteoriating
C	Poor Circulation
D-G	Distinctively bad Circulation

Type A is often observed in healthy young people indicating good circulation. Type B and C indicating deteoriating and poor circulation respectively, while, type D-G is often observed in patients with cerebrovascular disease, ischemic heart disease and uterine diseases. The changes from D to G reflect the disease development [26].

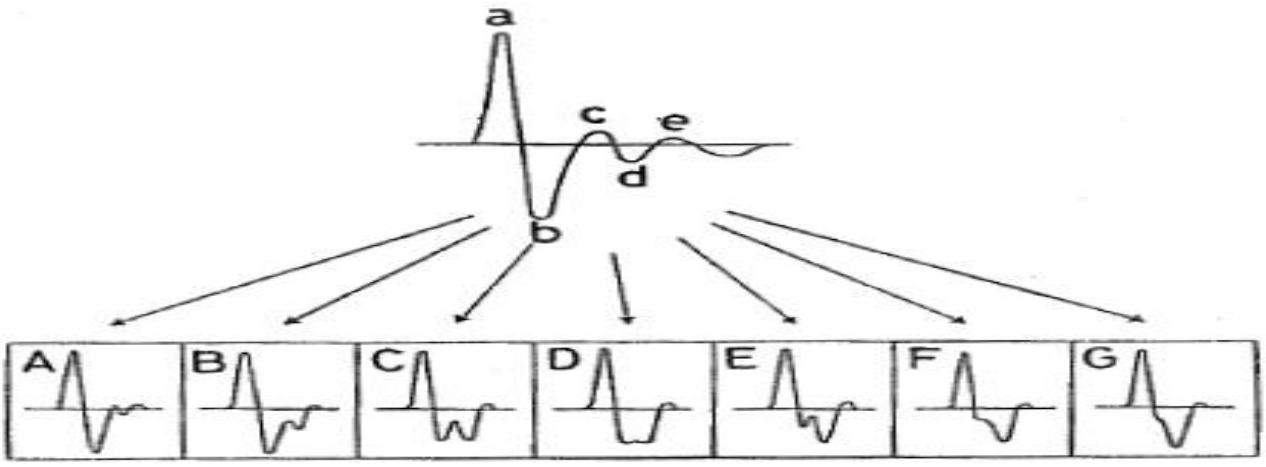


Figure 4.5: SDPTG waveforms and types of Photoplethysmogram. The first APG waveform A (far left) refers to good circulation, whereas the amplitude of *b* wave is lower than *c* wave. The last APG waveform G (far right) refers to distinctively bad circulation, whereas the amplitude of *c* wave is lower than *b* wave.

CHAPTER 5
State of the Art in Finger Plethysmography

5.1 The blood supply of various skin areas as estimated by the photoelectric plethysmograph

A. B. Hertzman was the first to design a 'photoelectric plethysmograph' in 1938. Photoplethysmograph is a noninvasive device for detecting blood volume changes in living tissue by optical means. The device consists of a light source, photo detector and alternating amplifier and can be used to detect flow variations in the periphery during the cardiac cycle. It was further described as a device that 'takes advantage of the fact that the absorption of light by a trans-illuminated tissue varies with its blood contents'. This is a consequence of the Lambert–Beer law, which relates light absorption to optical density. Hertzman's device illuminated the skin and measured back-scattered light with a photocell [1].

5.2 Reflection plethysmography of arterial-blood volume pulses

In 1977, J. Weinman, A. Hayat, and G. Raviv studied the optical signal of the photoplethysmograph in the reflective mode using an ***in*** *vitro* model. Reflection photoplethysmography allows noninvasive recording of arterial-blood-volume pulses. The method is based on monitoring backscattered infrared light and has promising diagnostic value: volume pulse shapes depend on cardiac performance and arterial elasticity. Two optical processes were observed: (a) Attenuation by the vessel of backscattered and back-reflected light, here vessel extension leads to 'less' light at the sensor;(b) Light reflection by the vessel wall proximal to the sensor, and vessel extension gives rise to 'more' light at the sensor, this counteracts the attenuation. The combined effects of (a) and (b) make the recorded pulse shape dependent on the transducer/artery position relationship. Volume-pulse transducers that monitor the displacement of arterial walls mechanically (e.g. piezoelectric crystals) are liable to produce similar artifacts. They concluded that scattering, reflection, absorption, and movement of the vessel wall all play a role in producing the signal and the prospects of minimizing these artifacts, by using improved transducer designs, are promising.

5.3 Parameters Describing the Pulse Wave

In July, 2008, D. Korpas, J. Hálek, L. Doležal from the Department of Medical Biophysics, Faculty of Medicine, Palacký University Olomouc, Czech Republic respectively presented a review article which overviewed pulse wave measurement parameters and main results obtained. The principles of pulse wave measurement and current experience in clinical practice are also discussed in brief. It shows the potential utilization and inaccuracy of clinical measurements. It establishes that the Pulse waveform is a real physiological signal. The measurement is sensitive to body motion as influenced by other physiological rhythms. Despite limitations, this technology represents a promising noninvasive tool for reflecting the status of cardiovascular system both experimental and in a clinical setting [1].

5.4 On the Analysis of Fingertip Photoplethysmogram Signals

In 2012, Mohamed Elgendi in his research discussed different types of artifact added to PPG signal, characteristic features of PPG waveform and existing indexes to evaluate for diagnoses.

The advantage of Photoplethysmography being a low cost, simple and portable technology which can be used in primary health care and remote clinics is also discussed. This review also described a number of features of the photoplethysmogram and their potential applications. It was concluded that a common structure of any PPG diagnostic system consists of three stages preprocessing, feature extraction and diagnosis where the main focus of this review was the preprocessing and feature extraction stages [4].

5.5 Contour analysis of the photoplethysmographic pulse measured at the finger

In 2006, Sandrine C. Millasseaua, James M. Rittera, Kenji Takazawab and Philip J. Chowienczyka described the background to digital volume pulse contour analysis and how the technique relates to contour analysis of the pressure pulse. It was concluded that Optical determination of the digital volume pulse (DVP) is a particularly simple method for performing pulse contour analysis. Like the pressure pulse, the DVP is influenced by large artery stiffness

and by pressure wave reflection in the systemic vasculature. Contour analysis of the DVP provides a rapid means of assessing vascular tone and arterial stiffness. Applications include the assessment of endothelial function, arterial stiffness and characterization of arterial ageing [5].

5.6 Frequency Analysis of the Peripheral Pulse Wave Detected in the Finger with a Photoplethysmograph

In 1990, M. H. Sherebrin and R. Z. Sherebrin, performed a frequency analysis of the peripheral pulse wave detected in finger PPG obtained with photoelectric plethysmography using a portable computer and studied how the pulse shape changes as a function of age and qualitative influence of heart rate and blood pressure. The experiment was performed using 54 subjects in three age groups, 10-29, 30-59, and 60-89 years. The youngest group had a larger power in the second harmonic, (normalized to the fundamental), with $p < 0.05$ than the older two groups. The decrease of power in the harmonics of the peripheral pulse wave with age may be a useful noninvasive measure of aging and vascular disease [6].

5.7 Analysis and Characterization of Photo-Plethysmographic Signal

In 2001, Joydeep Bhattacharya and Partha Pratim Kanjilal worked on the qualitative assessment of the overall clinical status of the subject and characterization of complex cardiovascular dynamics from digital blood volume pulsations which was measured non-invasively using a photo-plethysmographic device. They employed a novel concept to detect the dominant non sinusoidal periodicity embedded in the data series and to extract the associated periodic component. They also presented the characterization of the underlying system in the light of nonlinear dynamical analysis. It was concluded that the stable subjects are shown to behave as a low-dimensional system whereas the diseased subjects exhibit comparatively high dimensional activity [7].

5.8 Waveform Analysis of Peripheral Pulse Wave Detected in the Fingertip with Photoplethysmograph

In 2003, Irina Hlimonenko, Kalju Meigas and Rein Vahisalu studied the elastic properties of vascular tree in human subjects as a function of aging using the shape of peripheral pulse wave and established that the pulse wave must be analyzed as a superposition of two separate waves: the incident traveling wave from heart to periphery, and the reflected wave traveling from the periphery and the site of wave reflection to the heart. The incident wave depends on the left ventricular ejection and the arterial stiffness, whereas the reflected wave is related to arterial stiffness and the potential sites of wave reflection [8].

5.9 Correlation studies of finger pulse profiles for detecting Ayurvedic Doshas

In 2011, Dr. Mandeep Singh and Spiti Gupta explored the detection of tridoshas using modern PhotoPlethysmoGraphy (PPG). As per the ancient science of Ayurveda human beings suffer primarily on account of imbalance in the three basic human constituents (vatta, pitta, kapha) called doshas. These doshas are normally detected by the skilled masters simply by pressing the radial artery in the wrist with their three fingers. In this study the pulse profiles of all 10 fingers in 7 healthy subjects is acquired using Biopac MP150 data acquisition system. In all 70 cases without exception the autocorrelation for a given finger of subject is always higher than correlation with corresponding finger of any other subject [9].

5.10 Frequency Domain Analysis of Radial Pulse in Abnormal Health Conditions

In 2010, Bhaskar Thakker and Anoop Lal Vyas performed the frequency domain analysis of the radial pulse. The radial pulse signal in abnormal health conditions show variations in its morphology in comparison to that of the healthy subjects, resulting in changes in the pulse power spectrum. They made a comparison between the power spectrum of pulse signal for the subjects suffering from gastrointestinal disorders and healthy subjects. A frequency domain feature “Band Energy Ratio (BER)” was defined to identify the band of frequencies carrying significant

difference between the two groups. The abnormal bands showing significant elevation of energies was identified as 4Hz to 10Hz band. Based on Receiver Operating Characteristics (ROC) analysis, 8 Hz to 10 Hz band was identified carrying further significance giving 89.7% sensitivity, 90.5% specificity and 90% accuracy as optimum parameters to segregate the two groups.

5.11 Determinants of the second derivative of the finger photoplethysmogram and brachial-ankle pulse-wave velocity.

In 2005, J Hashimoto *et al.* examined different characteristics of the second derivative of the finger photoplethysmogram (SDPTG) and brachial-ankle pulse wave velocity (BAPWV) for assessing arterial function in a large general population, along with the alteration of SDPTG in hypertension. They used the univariate and multivariate analyses method to evaluate the determinants of SDPTG indices and BAPWV as well as differences between normotensive and hypertensive subjects. They found that BAPWV was independently and positively correlated with age, blood pressure (BP), heart rate (HR), and hemoglobin A1c. The d:a ratio and AGI showed a positive and the b:a ratio a negative independent correlation with age and BP. In contrast, the d:a ratio and AGI showed a negative and the b:a ratio a positive correlation with HR. The SDPTG indices, but not BAPWV, were independently associated with gender. It was concluded that the SDPTG depends on various factors in a manner different from BAPWV; it may be useful for detecting vascular aging accelerated by hypertension [11].

5.12 Second Derivative of the Finger Arterial Pressure Waveform: An Insight into Dynamics of the Peripheral Arterial Pressure Pulse

J. Simek *et al.* second derivative of the finger arterial pressure waveform (SDFAP) in 120 healthy middle-aged subjects and in 24 subjects with essential hypertension. In multivariate regression analysis, b/a and c/a correlated only they found that with age. d/a independently correlated with age, heart period, mean blood pressure (MBP), body height, and gender. e/a independently correlated with age and MBP. d/a and e/a were higher and while b/a and c/a were lower in hypertensives compared to sex- and age-matched controls. After the adjustment for MBP, heart period, and body mass index independent discriminative power was preserved only

for indices b/a and c/a (p = 0.001 and 0.021, respectively). Therefore, they concluded b/a and c/a provide additional information about simple clinical characteristics and might reflect the structural alteration of the arterial wall in hypertensive subjects [13].

5.13 Independent Determinants of Second Derivative of the Finger Photoplethysmogram among Various Cardiovascular Risk Factors in Middle-Aged Men

In 2007, Toshiaki OTSUKA *et al*. used the second derivative of the finger photoplethysmogram (SDPTG) as a non-invasive examination for arterial stiffness. They wanted to elucidate independent determinants of the SDPTG among various cardiovascular risk factors in middle-aged Japanese men. The SDPTG was obtained from the cuticle of the left-hand forefinger in 973 male workers during a medical checkup at a company. The SDPTG indices (b/a and d/a) were calculated from the height of the wave components. Multiple logistic regression analyses revealed that the independent determinants of an increased b/a were age, hypertension, dyslipidemia, impaired fasting glucose/diabetes mellitus, and a lack of regular exercise. Similarly, independent determinants of a decreased d/a were age, hypertension, and alcohol intake 6 or 7 days per week. It was concluded the SDPTG indices reflect arterial properties affected by several cardiovascular risk factors in middle-aged Japanese men [14].

5.14 Noninvasive assessment of arterial distensibility in adolescents using the second derivative of photoplethysmogram waveform

In 2001, Miyai N *et al.* in order to clarify the clinical usefulness of SDPTG waveform examined the relationship between the pattern of the SDPTG waveform and risk factors related to atherosclerosis in 1,495 subjects aged 9-17 years. They found that subjects with lower d/a ratios had significantly higher systolic (SBP) and diastolic blood pressures (DBP), atherogenic index (AI) and immunoreactive insulin concentrations (IRI) values compared to those with higher d/a ratios. Their findings suggested that differences in the length of the vascular system, which are related to increases in body height, may modify the SDPTG waveform pattern during adolescence. It was concluded that when the body height as well as age and sex is adequately

allowed for, the d/a ratio may be useful for the evaluation of arterial distensibilty and for identification of individuals at an increased risk of developing atherosclerosis [15].

5.15 Second Derivative of Photoplesthymography for estimating vascular Aging

In 2007, Hyun Jae Baek, Jung Soo Kim, Yun Sung Kim, Haet Bit Lee and Kwang Suk Park introduced second derivative of photoplethysmography (SDPTG) for monitoring arterial condition as an application of PPG technique. SDPTG consists of an a, b, c and d wave in systole and an e wave in diastole. The SDPTG wave pattern is determined by the proportions of the b, c, d, and e waves to the a wave. In their study, they confirmed that the b/a ratio and SDPTG-AI increased with age, and the c/a, d/a, and e/a ratios decreased with age. An informal method which substitutes formal SDPTG-AI was also suggested [16].

5.16 Measurement of a-a Intervals at Rest in the Second Derivative Plethysmogram

In 2009, Mohamed Elgendi, Mirjam Jonkman and Friso De Boer worked on the SDPTG waveform to find a new method to detect the heart rate using an algorithm for *a* wave detection. It was concluded that the accurate detection of *a* waves in the SDPTG gives a non-invasive method of evaluating cardiac rhythms. The usage of *aa* variability analysis in SDPTG can be useful for the cardiovascular functionality evaluation [17].

5.17 Applying the APG to measure Heart Rate Variability

In 2010, Mohamed Elgendi, Mirjam Jonkman and Friso De Boer, used the Accelartion Plethysmograph(APG) to find Heart Rate(HR) and heart Rate Variability(HRV). It was concluded that HRV indices that are normally used with ECG signals can also be used with APG signals. There was a strong positive correlation between the two HRV indices, SDNN(standard deviation of duration of heart beats) and rMSSD(root mean square of the difference of successive heart beats) indicating that the APG recordings were sufficient to measure the HRV [18].

5.18 Peripheral Hemodynamics Evaluated by Acceleration Plethysmography in Workers Exposed to Lead

Aiba Y, Ohshiba S, Horiguchi S, Morioka I, Miyashit K, Kiyota I, *et al.* in order to clarify the effects of lead exposure on peripheral hemodynamics performed acceleration plethysmography (APG) for 48 male subjects occupationally exposed to lead (exposure group) and 43 male subjects with no history of occupational exposure to lead (control group). In the exposure group, the blood lead concentration (Pb-B) was also measured. Each APG parameter was assessed by comparing measured data with the standard aging curves. A significant negative correlation was obtained between the parameter - b/a and Pb-B. The exposure group showed significantly lower values of parameters - b/a ($p<0.01$) and d/a ($p<0.05$) than the control group. It was concluded that lead exposure affects peripheral hemodynamics as evaluated by APG [19].

5.19 Construction of a General Physical Condition Judgment System Using Acceleration Plethysmogram Pulse-Wave Analysis

In 2009, Heizo Tokutaka, Yoshio Maniwa, Eikou Gonda, Masashi Yamamoto, Toshiyuki Kakihara, Masahumi Kurata, Kikuo Fujimura, Li Shigang and Masaaki Ohkita used the application of acceleration plethysmography to develop a diagnotic software that shows the state of the blood vessels using a Basic SOM (self organizing map) model, and performs synthetic plethysmogram analysis of 4 components using the map location (the state of the blood vessel, vascularity), looseness, pulse/minute, and pulse stability [20].

5.20 Evaluating the surgeon's stress when using surgical assistant robots

In 2007, **Kazuhiro Taniguchi** *et al.* proposed a method for using surgeon's biological information to evaluate the surgeon's stress using a surgical assistant system. They analyzed the acceleration plethysmogram variability as the indexes of autonomic nervous activity. It was concluded that the method had an ability to factually evaluate the surgeon's stress during surgery [21].

5.21 Finger Pulse Plethysmograph Feature Selection for Pitta Detection in Human Body

In 2012, Dr. Mandeep Singh and Tanushree Sharma have extracted and analysed the features of finger pulse plethysmogram to find a relation between increased pitta and the peripheral finger pulse. They acquired data from three subjects and extracted three parameters from both hands, before and immediately after lunch, namely, A2/A1, TP2/TPT, and TP1/TPT. It was found that the variance of A2/A1 in middle finger, and TP2/TPT in ring finger, decreased consistently for all the three subjects in both left and right hand [22].

CHAPTER 6
Problem Definition

In the non-invasive Indian traditional system of *Ayurveda* it is believed that the function of entire human body is governed by three humors: *vata*, *pitta*, and *kapha*, called as *Tridosha*. The tridoshas govern all the biological, psychological and physiopathological functions of the body, mind and consciousness. They act as basic constituents and protective barriers for the body in its normal and balanced sate. But when out of balance, they contribute to disease. Pitta, one of the tridoshas, which is a combination of fire and water, is responsible for digestion and transformation in our bodies. Further it is also stated in Ayurveda that the level of pitta in human body increases after having meals [31].

Ayurveda has used the palpation of the pulse at the wrist under the thumb to analyze physical health. In the nineteenth century, analysis of the contour of the peripheral pulse to assess arterial properties was first described. Also the peripheral artery is the extension of radial artery. Therefore the non-invasive evaluation of arterial indices can be done by analyzing the Finger Pulse wave, obtained using the technique of PhotoPlethysmoGraphy(PPG). Measurements taken directly from this finger PPG or from its second derivative can be used to assess these properties.

The aim of this dissertation is to analyze the features extracted from the second derivative of the pulse waveform and find such parameters that may directly link to the increased level of pitta.

CHAPTER 7
Proposed Solution

In this dissertation work the finger waveform pulse of both left and right hands for the three fingers (index, middle and ring) of 12 subjects have been acquired for some time, with the help of BIOPAC MP System and AcqKnowledge software. This data has been acquired before lunch and immediately after lunch for all the three subjects. Filtering operation was performed over the acquired waveform, the IIR band stop filter is used with a quality factor of 5. Then twice the derivative of the filtered waveform at a sampling of per 25 has been taken to get the second derivative of the plethysmograph or the acceleration plethysmograph. Then a set of 20 valid pulses has been selected from the acquired data, while pulses with undesired shape or pulse segments with more noise, have been discarded. From the selected 20 pulses, five features have been manually extracted. These features are the amplitude of the peaks (a,b,c,d,e) as shown in figure 7.1.

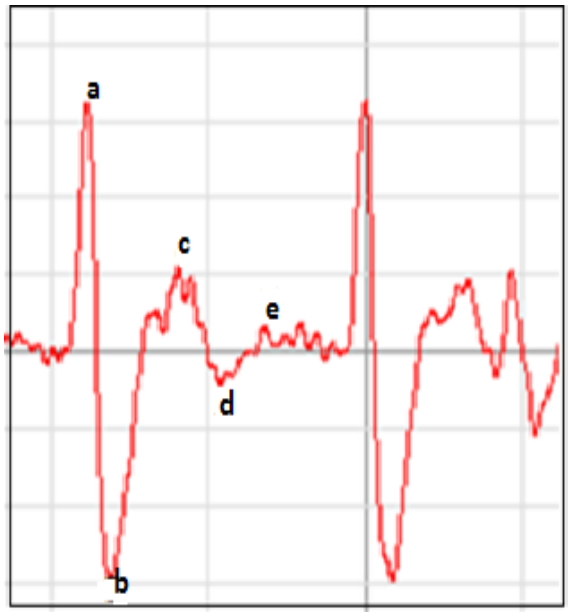


Figure 7.1: Typical 2nd derivate of the pulse wave

These features have then been normalized and hence a set of parameters have been considered, namely b/a, c/a, d/a, e/a. Next the mean and standard deviation of these features has been calculated and compared for the set of data collected before and after lunch by arranging them into data sheets. The process described above has been implemented and the results have been discussed in the proceeding chapters.

CHAPTER 8
Methodology

8.1 MP System

The MP System is a computer-based complete and expandable data acquisition system. It includes all the hardware and software required to turn any computer into a powerful data acquisition workstation specifically designed for life science applications.

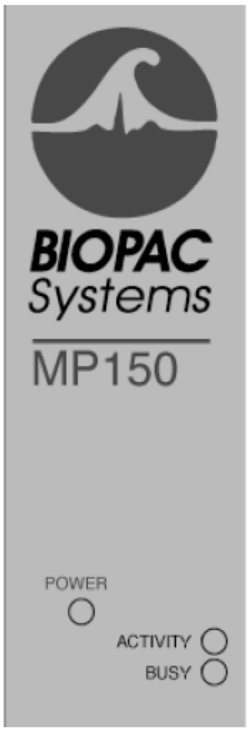
The MP data acquisition unit (MP150 or MP100) is the heart of the MP System. The MP unit takes incoming signals and converts them into digital signals that can be processed with your computer. Functions of this system are like an on-screen chart recorder, oscilloscope, and X/Y plotter, allowing to record, view, save, and print data (Figure 8.1). Data collection generally involves taking incoming signals (usually analog) and sending them to the computer, where they are (a) displayed on the screen and (b) stored in the computer's memory (or on the hard disk). These signals can then be stored for future examination. Graphical and numerical representations of the data can also be produced for use with other programs. MP System is as powerful as larger and more expensive data acquisition systems, but has a familiar, easy to use graphical interface. This System reduces the equipment setup time and increase the quality of results.

Figure 8.1: BIOPAC MP150 System and its Probes

8.2 MP100 Starter System

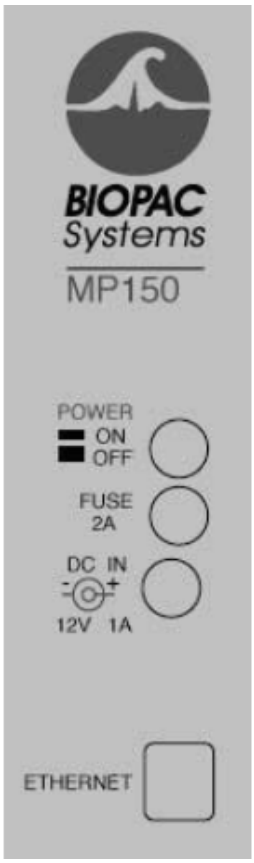
The MP100 system offers USB-ready data acquisition and analysis. Record multiple channels with differing sample rates. Record at speeds up to 70 kHz or 16 kHz (aggregate to disk).

MP100 System includes: (1) Data acquisition unit: MP100A-CE, (2) Transformer: AC100A (3) Universal interface module: UIM100C, (4) Cables: CBLSERA cable, CBLS100 cable set, (5)USB adapter: USB1W (PC) or USB1M (Macintosh), (6)AcqKnowledge® software CD



POWER	**Green light**	Indicates MP150 Power status.
ACTIVITY	**Amber light**	Indicates data traffic to or from MP150- similar to hard disk activity on any personal computer
BUSY	**Green light**	Indicates MP150 data acquisition

Figure 8.2: Front Panel



Power Switch — **ON** - Push in to power up the MP150. **OFF** - Pop out to cut the flow of power to the MP150. Like your personal computer does. To reset the MP150 for any reason, turn the MP150 *off*, wait a few seconds, then turn it back on.

Fuse 2A — 2 Amp fast-blow fuse holder; the maximum capacity of the fuse is 2 Amps.

- To remove the fuse, use a screwdriver to remove the fuse cover, which is located below the word **Fuse**.

DC Input — Use the **DC Input** to connect a battery, AC/DC converter or other power supply to the MP150.

- The MP150 requires 12 VDC @ 1 Amp (minimum), 2 Amp (nominal)
- The receptacle can accept a "+" (positive) input in the center of the connector and a "□" (negative) input on the connector housing.

Ethernet — The MP150 connects to the computer via the Ethernet port, located just to the right of the word **Ethernet**.

- Uses a standard RJ-Ethernet connector (10 base T).

Figure 8.3: Back Panel

Module connections: The two connector inputs are designed to connect directly to the UIM100C.

Analog signals are transmitted through the 37-pin connector (upper right side)

Digital signals are transmitted through the 25-pin connector (lower-right side)

Figure 8.4: Side Panel

Firmware Rollback Switch

The Firmware Rollback Switch is located on the bottom of the MP150 unit and is recessed to prevent accidental activation—it is NOT A RESET for the MP150 unit.

Figure 8.5: Bottom

8.3 IPS100C Isolated Power Supply Module

The IPS100C is used to operate 100-series amplifier modules independent of an MP data acquisition unit. The IPS100C module couples the 100-series amplifier outputs directly to any

other data acquisition system, oscilloscope or chart recorder. Amplifier modules snap onto the side of the IPS100C to receive the necessary isolated power and to direct the modules output to the front panel of the IPS100C. The IPS100C allows users to operate up to 16 amplifiers on a stand-alone basis. The analog channel outputs are provided via 3.5mm phone jacks on the front panel. The IPS100C is generally used with animal or tissue preparations. When collecting data from electrodes attached to humans, use the HLT100C module with INISO and OUTISO adapters to couple signals to external equipment.

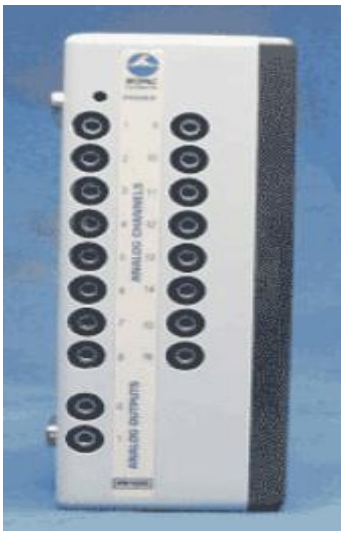


Figure 8.6: Isolated Power Supply Module

8.4 TSD200 Photoplethysmogram Transducer

The TSD200 shown in figure 8.7 consists of a matched infrared emitter and photo diode, which transmits changes in blood density (caused by varying blood pressure), in specific body locations. When the TSD200 is attached to the skin, the infrared light is modulated by blood pulsing through the tissue below. The modulated, reflected light results in small changes in the resistance of the photo resistor, which yields a proportional change in voltage output.

Figure 8.7: Plethysmogram Transducer

The TSD200 includes a shielded 2-meter cable and a stretchable Velcro® strap for easy attachment to the fingers, or it can be taped to other body parts. The TSD200 can also be placed on other body locations by employing ADD208 adhesive disks to hold the TSD200 in place. Use the TSD200C ear clip transducer for easy attachment to the ear. Place the transducer around the finger and adjust the Velcro® closure to provide only slight tension.

Blood density readings can vary considerably depending on transducer location and tension changes. The TSD200 connects to the PPG100C as shown in table 8.1:

Table 8.1: Connections between TDS200 Lead and PPG100C

TSD200 Lead	**PPG100C**
Red Lead	+VSUP
Black Lead	GND
Blue Lead	Input

8.5 PPG100C – Photoplethysmogram Amplifier Module

The photoplethysmogram amplifier module (PPG100C) is a single channel amplifier designed for indirect measurement of blood pressure or density. The PPG100C is designed for use in the applications like general pulse rate determination, blood pressure analysis, exercise physiology studies, and psycho physiological investigations.

Figure 8.8: Photoplethysmogram Amplifier Module

8.6 AcqKnowledge Overview

The MP System (MP150 or MP36R) software is called Acq*Knowledge* and performs two basic functions: acquisition and analysis. The acquisition settings determine the basic nature of the data to be collected, such as the amount of time data will be collected for and at what rate data will be collected. All of the acquisition parameters can be found under the MP150 menu. The other menu commands pertain to analysis functions such as viewing, editing, and transforming data.

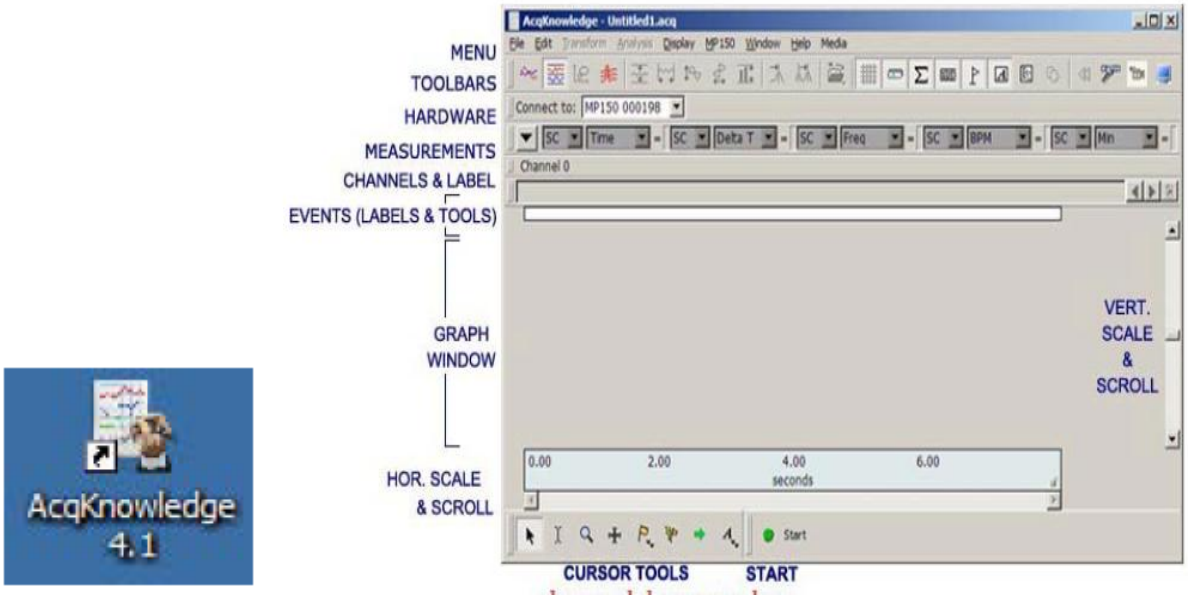


Figure 8.9: On the Left Software Launch Icon on the right Drag and Drop Menu

Acq*Knowledge* includes an "electronic notepad" or journal, which allows you to record notes and data associated with a graph file as shown in figure 8.10.

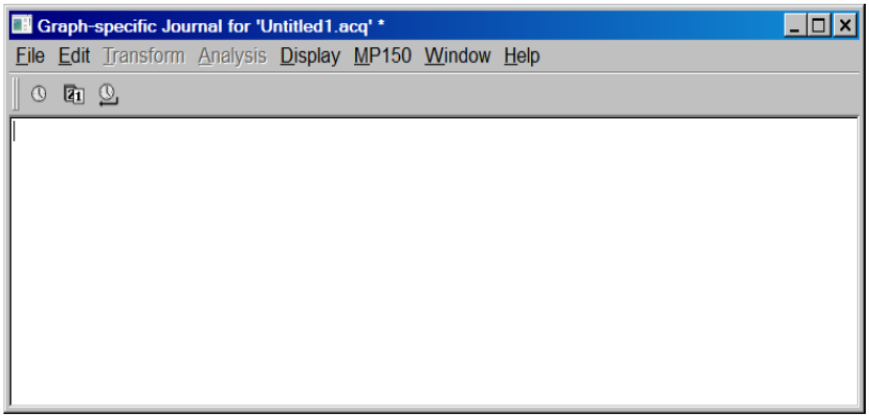


Figure 8.10: Electronic Notepad or Journal

8.7 Data Acquisition

The equipment is assembled and made ready to take the measurements. The sensor is placed on the tip of each finger one by one. The first step for data acquisition is to set up the channels, the sampling rate, and the acquisition length. _Set up channels' under the MP150 menu has the option for channel selection. In our study we selected one analog channel A1, for acquire, plot & value with sampling rate set at 10 kHz. Acquisition length can be set up in the _set up acquisition'tab under the same drop down menu. Alternatively it can be handled stopped by clicking on stop button at the bottom of the waveform window. Our acquisition was carried for almost 30 seconds (long enough to get 20 pulses for each waveform).

8.8 Data Analysis

Before feature extraction a band stop IIR filter for initial noise removal with its line frequency as default (50 Hz) and quality factor as 5, was applied to the pulse waveform.

The IIR digital filter is available in the transform menu as shown in figure 8.11. After applying the IIR filter the initial pulse waveform is transformed. The two graph windows below in figure 8.12 clearly show the difference in quality of waveforms before and after filtering.

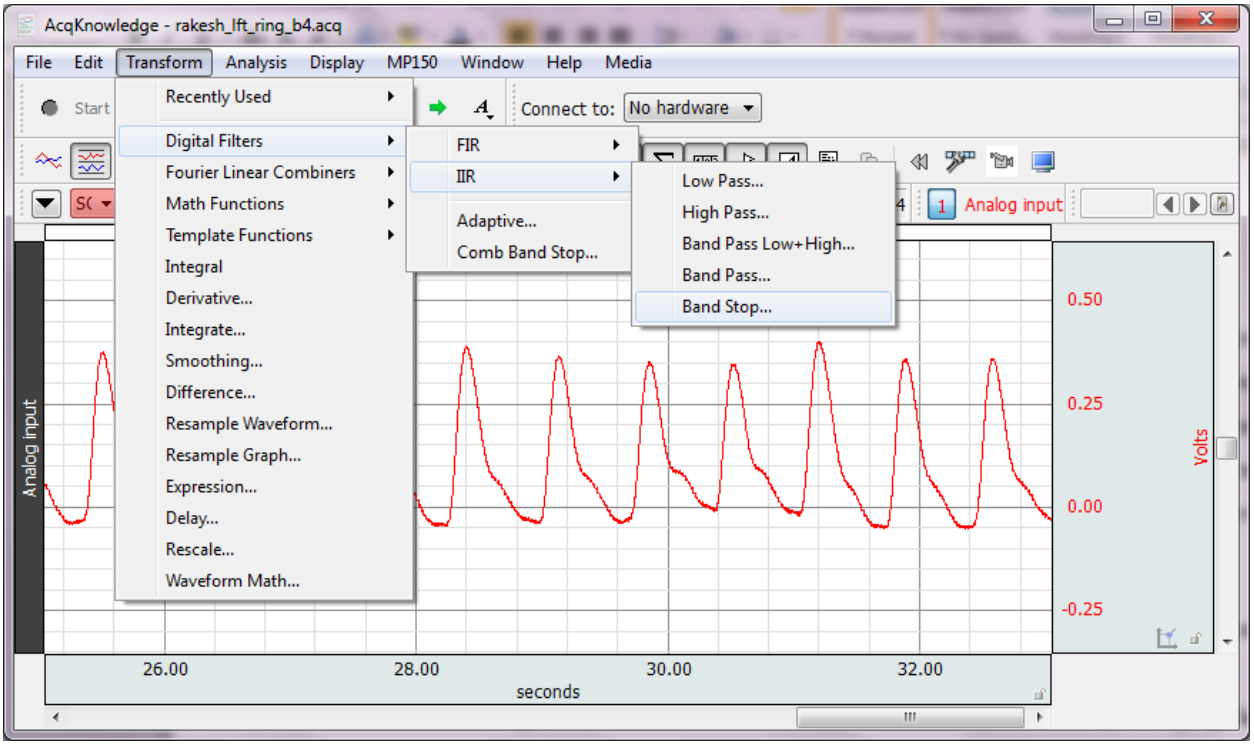


Figure 8.11: Filtering operation

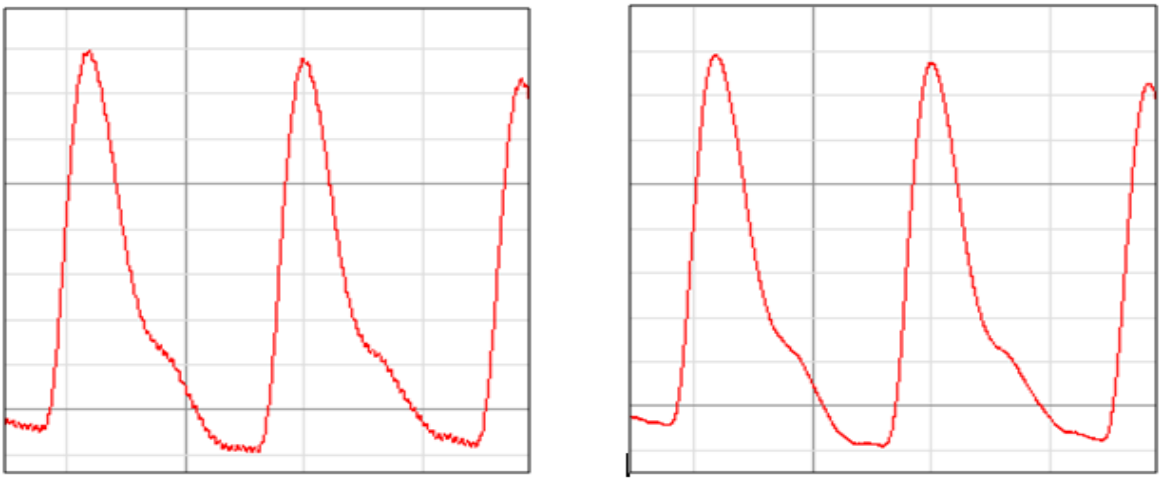


Figure 8.12: Difference between Unfiltered and Filtered Waveform

The pull-down measurement menu on the graph window, allows us to select from different types of values for measurement and recording. For our study we choose _value‘ (in place of bpm), to obtain amplitudes at different point in the waveform.

8.9 Feature Extraction

After getting the filtered waveform, we took the derivative of the pulse. Two times the derivative of the filtered waveform at a sampling of per 25 was taken to get the second derivative or we can the acceleration plethysmograph.

Then a set of 20 pulses has been selected from the acquired data, while pulses with undesired shape or pulse segments with more noise, have been discarded. From the selected 20 pulses, five features have been manually extracted. These features are the amplitude of the peaks (a,b,c,d,e).

These features have then been normalized and hence a set of parameters has been considered, namely b/a, c/a, d/a, e/a. Next the mean and standard deviation of these features has been calculated and compared for the set of data collected before and after lunch by arranging them into column graphs.

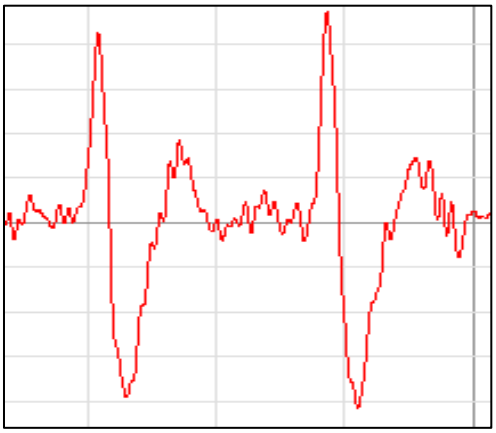


Figure 8.12: 2nd Derivative of the pulse Waveform

CHAPTER 9
Results

9.1 Features Extracted from the SDPTG Wave

The waveform of finger pulse was first acquired using MP150 system and AcqKnowledge software. The second derivative of the PPG was taken and already discussed features a, b, c, d, e were manually extracted and normalized to b/a, c/a, d/a, e/a. This was initially done first for 6 subjects. Data was arranged in the form of datasheets and is given in Appendix A.

9.2 Check for Consistency in Change

After acquiring this data the 48 parameters were analyzed for comparison before and after lunch. Table 9.1 concisely describes the 48 parameters of second derivate of Finger PPG compared before and after lunch for a set of first 6 subjects.

Table 9.1: Comparative results of SDPTG Parameters for initial 6 subjects

	Right hand Index Finger	Right hand Middle Finger	Right hand Ring Finger	Left hand Index Finger	Left hand Middle Finger	Left hand Ring Finger
b/a average	4(↑)*	**5(↑)****	**5(↑)****	**5(↑)****	**5(↓)****	---
b/a std. Deviation	4(↓)*	4(↓)*	---	---	4(↓)*	**5(↓)****
c/a average	4(↓)*	**6(↑)*****	**5(↑)****	**5(↑)****	**5(↓)****	4(↓)*
c/a std. Deviation	4(↓)*	4(↑)*	4(↓)*	4(↑)*	**5(↓)****	**5(↓)****
d/a average	4(↓)*	**5(↓)****	---	4(↓)*	**5(↓)****	**6(↓)*****
d/a std. Deviation	4(↓)*	---	---	**5(↓)****	**5(↓)****	**5(↓)****
e/a average	4(↓)*	4(↓)*	---	**5(↓)****	**5(↓)****	4(↓)*
e/a std. Deviation	4(↓)*	4(↓)*	---	4(↓)*	---	---

***** -** Result consistently changed in all six subjects

**** -** Result consistently changed in five subjects

*** -** Result consistently changed in four subjects

From this set of 48 parameters, those parameters that consistently showed a change in 5 or 6 subjects were chosen. As shown in the table 9.1, we found 19 such parameters that showed a consistent change in 5 or 6 subjects. By taking into consideration these 19 parameters further analysis was carried in next 6 subjects. The results are for total 12 subjects and the 19 parameters are summarized in the table 9.2.

Table 9.2: Comparative results of SDPTG Parameters for 12 subjects

	Right hand Index Finger	Right hand Middle Finger	Right hand Ring Finger	Left hand Index Finger	Left hand Middle Finger	Left hand Ring Finger
b/a average	---	**10(↑)*** **	**9(↑)** **	**9(↑)** **	**8(↓)***	---
b/a std. Deviation	---	---	---	---	---	**8(↓)***
c/a average	---	**10(↑)*** **	**8(↑)***	**6(↑)**	**7(↓)**	---
c/a std. Deviation	---	---	---	---	**8(↓)***	**8(↓)***
d/a average	---	**9(↓)** **	---	---	**9(↓)** **	**10(↓)*** **
d/a std. Deviation	---	---	---	**10(↓)*** **	**9(↓)** **	**9(↓)** **
e/a average	---	---	---	**10(↓)*** **	**9(↓)** **	---
e/a std. Deviation	---	---	---	---	---	---

***** -** Result consistently changed in 10 out of 12 subjects

**** -** Result consistently changed in 9 out 12 subjects

*** -** Result consistently changed in 8 out 12 subjects

Further those parameters were chosen that consistently changed for 10 out of 12 subjects.

9.3 Application of the Statistical Significance Test

The t-test of one tail was applied on these 5 parameters to check whether the data obtained was statistical or marginal. It was found that 4 out the 5 parameters had p value less than 0.05. Hence the reported 4 parameters passed the test of significance. Table 9.3 shows the results of the t-test.

Table 9.3: Results obtained after the t-test

Parameters	**1-Right Middle (b/aAvg)**		**2-Right Middle (c/a Avg)**		**3-Left Index (d/a std. dev)**		**4-Left Index (e/a avg)**		**5-Left Ring (d/a avg)**	
Subjects	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
1	0.865901	1.07604	0.2618534	0.4449123	0.0655773	0.0607672	0.2252104	0.1630903	0.1613827	0.0795518
2	1.0871635	1.7090037	0.2820267	0.3646123	0.0352059	0.0186615	0.1076046	0.075165	0.2898444	0.1809331
3	1.2308579	1.2910504	0.2266239	0.3286606	0.0856813	0.0463071	0.2869322	0.198198	0.2937745	0.2548864
4	1.0368524	0.872113	0.3681955	0.3708997	0.0325822	0.050342	0.0317874	0.0577796	0.2813157	0.2149349
5	1.0596019	1.2636831	0.4179485	0.4686492	0.0494328	0.0364383	0.0461023	0.032686	0.3098679	0.2665835
6	0.9693451	1.2727283	0.4286581	0.4370279	0.0551249	0.02392	0.0306302	0.0236299	0.2594203	0.1229713
7	1.0910572	1.2992308	0.1941479	0.3904739	0.0620656	0.0340424	0.2086439	0.1775897	0.1194657	0.1806984
8	0.9676763	1.4417171	0.2010552	0.5422643	0.1623612	0.0555216	0.3277505	0.1979482	0.1640674	0.1352595
9	0.8345486	1.2567854	0.1286038	0.4531362	0.0564317	0.0407143	0.271128	0.0907853	0.1933573	0.230646
10	0.9338371	1.062652	0.5538648	0.1858497	0.1167576	0.040526	0.4381056	0.2225514	0.1475812	0.0821165
11	1.1533862	1.1081286	0.4371053	0.2754793	0.1618333	0.0447822	0.6340235	0.3777616	0.3553104	0.1988482
12	1.0068978	1.0255951	0.3286291	0.3296663	0.0345664	0.0388505	0.1564671	0.1684199	0.1283075	0.1030985
p value(1 tail)		**0.0049347**		0.143661		**0.0074667**		**0.0058575**		**0.0065464**

From the table 9.3 the minimum and maximum values for each parameter were calculated for both before and after lunch readings as shown in table 9.4. Figure 9.1 depicts the overlapping in the range of each parameter obtained before and after lunch.

Table 9.4: Min and Max values before and after lunch for the 5 Parameters

		Min	Max
Parameter 1	**Before**	0.834549	1.230858
	After	0.872113	1.709004
Parameter 2	**Before**	0.128604	0.553865
	After	0.18585	0.542264
Parameter 3	**Before**	0.032582	0.162361
	After	0.018662	0.060767
Parameter 4	**Before**	0.03063	0.634024
	After	0.02363	0.377762
Parameter 5	**Before**	0.119466	0.35531
	After	0.079552	0.266584

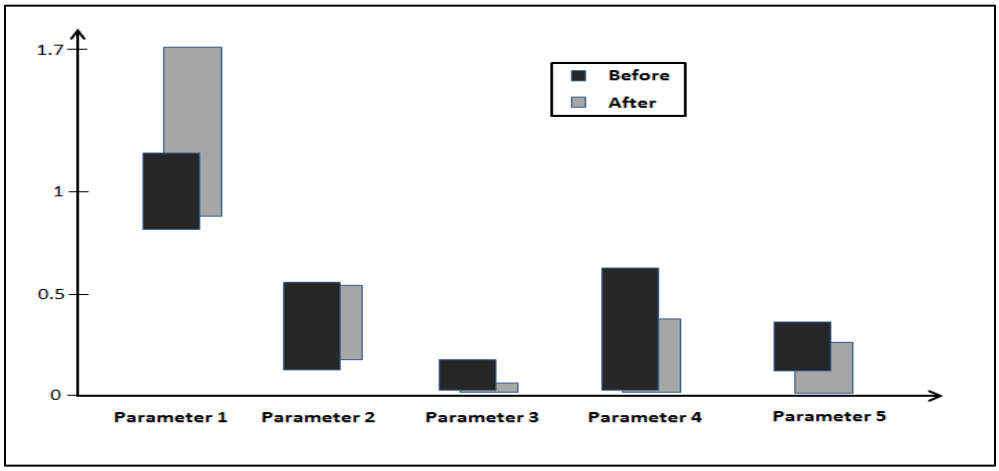


Figure 9.1: Graph showing Overlapping of the Before and After Lunch Parameters

9.4 Design of ANN based Classifier

As seen the minimum and maximum values of the before and after lunch readings overlap so a threshold value could not be found which could directly classify low and high pitta levels. This calls for a multi input classifier. So we further we used a three layered feed forward back propagation ANN (Artificial Neural Network) having 2 hidden layers [32]. The topology for this ANN is as shown:

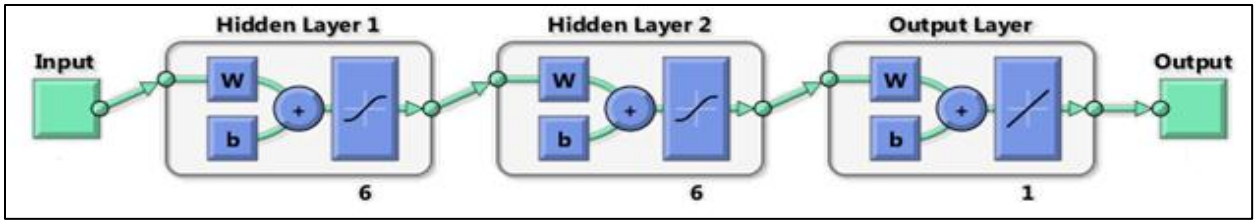


Figure 9.2: ANN Model used for Classification

Classification was performed once with 4 parameters as input (with p value less than 0.05) and then with all the 5 parameters as input. The output has 2 classes (normal pitta and high pitta) and single output. The accuracy improved using 5 parameters. Figure 9.3 shows the confusion matrix for 5*24 inputs ANN and figure 9.4 shows the confusion matrix for 4*24 input ANN.

		Predicted Class	
		Normal Pitta	High Pitta
Actual Class	Normal Pitta	**11 TN**	**1 FP**
	High Pitta	**1 FN**	**11 TP**

Figure 9.3: Confusion matrix for 5*24 inputs ANN

		Predicted Class	
		Normal Pitta	High Pitta
Actual Class	Normal Pitta	**8 TN**	**4 FP**
	High Pitta	**2 FN**	**10 TP**

Figure 9.4: Confusion matrix for 4*24 inputs ANN

Further the accuracy, sensitivity and specificity can be calculated from the confusion matrix using the formulas: Accuracy = TP + TN / (TP + TN + FP + FN), Sensitivity = TP / (TP + FN), Specificity = TN / (TN + FP) where, TP = True positive, FP = False positive, TN = True negative, FN = False negative.

The complete results for accuracy, sensitivity and specificity are given in the table 9.5 as:

Table 9.5: Value of Accuracy, Sensitivity and Specificity Calculated from the Confusion Matrix

No. of Inputs	**Classification Accuracy**	**Sensitivity**	**Specificity**	**Classification Error**
5*24	91.67%	91.67%	91.67%	8.33%
4*24	75%	83.33%	66.67%	25%

CHAPTER 10
Conclusion and Future Scope

In this dissertation work five parameters from SDPTG features are found that consistently changed in 10 out of 12 subjects. These parameters are (1) right hand middle finger b/a average, (2) right hand middle finger c/a average (3) left index d/a standard deviation, (4) left index e/a average, (5) left ring d/a average. Further the application of statistical analysis test for significance strengthened the result for four parameters- (1) right hand middle finger b/a average, (2) left index d/a standard deviation, (3) left index e/a average, (4) left ring d/a average.

It was seen that the minimum and maximum values of the before and after lunch readings of all the resulting parameters overlap so a threshold value could not be found which could directly classify low and high pitta levels. Therefore an ANN classifier was used for analysis. Further from the result of classification it can be seen that five input network gave an accuracy of 91.67% as compared to an accuracy of 75% obtained by a four input network. Therefore it can be concluded that although the parameter- right hand middle finger c/a average failed the t-test still had a p value of 14 which is not that bad. So all the five parameters obtained can be taken as indicative of pitta level.

There are still certain limitations in this work that can be worked upon in future. In the first case we have considered 12 subjects in this study. This number needs to be increased to at least 36 for more reliable results. Secondly, in our study the data was acquired from six fingers in a sequential manner. It is further proposed that this data be acquired simultaneously using six sensors, one for each finger. Thirdly the SDPTG parameters a, b, c, d, e has been extracted manually. This task is very tedious and error prone hence needs to be automated.

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List of Publications from this Research

1. Mandeep Singh and Shivangi Nagpal, "Features Extraction in Second Derivative of Finger PPG Signal: A Review", *International Journal of Computer Science and Communication,* Vol. 4, No. 2, September 2013 (In Press).

2. Mandeep Singh and Shivangi Nagpal, "Analysis of Second Derivate of Finger PPG Signal for Pitta Detection", *International Journal of Computer Science and Communication,* Vol. 4, No. 2, September 2013 (In Press).

3. Mandeep Singh and Shivangi Nagpal, "Pitta Detection Using ANN Based Classifier", *International Journal of Computer Science and Communication,* Vol. 4, No. 2, September 2013 (In Press).

Appendix A

A.1 Subject 1 –Before Lunch

Table A.1: Index Finger features of subject 1 for right hand before lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	130.095	102.809	25.431	10.54	11.562	0.790261	0.19548	0.081018	0.088874
2	135.002	90.953	23.829	19.845	11.224	0.673716	0.176508	0.146998	0.08314
3	151.239	126.39	25.218	7.3	6.22	0.835697	0.166743	0.048268	0.041127
4	140.594	114.71	30.379	11.398	9.346	0.815895	0.216076	0.08107	0.066475
5	132.411	100.438	29.537	11.249	6.142	0.758532	0.223071	0.084955	0.046386
6	137.8	112.209	22.896	8.608	9.579	0.814289	0.166154	0.062467	0.069514
7	135.164	113.838	30.122	13.884	10.432	0.842221	0.222855	0.10272	0.07718
8	130.013	101.36	23.152	8.527	11.544	0.779614	0.178075	0.065586	0.088791
9	135.7	99.58	28.683	10.03	11.202	0.733825	0.211371	0.073913	0.08255
10	160.072	134.191	27.495	11.868	5.842	0.838317	0.171766	0.074142	0.036496
11	140.3	117.704	22.366	9.704	11.597	0.838945	0.159416	0.069166	0.082659
12	132.412	110.745	26.514	13.83	7.4	0.836367	0.200239	0.104447	0.055886
13	136.429	105.583	24.301	11.038	8.479	0.773904	0.178122	0.080907	0.06215
14	122.512	98.198	23.075	7.32	11.654	0.801538	0.188349	0.059749	0.095125
15	146.743	110.753	25.339	15.471	9.472	0.754741	0.172676	0.105429	0.064548
16	152.231	119.989	23.583	9.496	8.286	0.788203	0.154916	0.062379	0.05443
17	131.638	108.584	25.101	5.59	8.228	0.824868	0.190682	0.042465	0.062505
18	132.785	107.389	26.247	8.462	9.736	0.808743	0.197665	0.063727	0.073322
19	153.879	119.113	25.127	15.66	8.358	0.774069	0.163291	0.101768	0.054315
20	143.196	111.271	24.504	5.699	8.443	0.777054	0.171122	0.039799	0.058961
Mean						0.79304	0.185229	0.077549	0.067222
Standard Deviation						0.04241	0.021145	0.025497	0.016579

Table A.2: Middle Finger features of subject 1 for right hand before lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	70.369	53.387	15.68	9.6	8.809	0.758672	0.222825	0.136424	0.125183
2	48.855	53.875	17.087	11.12	8.984	1.102753	0.349749	0.227612	0.183891
3	67.88	54.737	16.117	11.907	10.246	0.806379	0.237434	0.175412	0.150943
4	62.025	49.009	16.803	10.519	6.307	0.790149	0.270907	0.169593	0.101685
5	61.846	51.738	15.21	13.332	7.864	0.836562	0.245933	0.215568	0.127155
6	60.908	46.473	17.486	12.519	12.522	0.763003	0.287089	0.20554	0.205589

7	67.219	60.938	18.493	12.302	10.227	0.906559	0.275116	0.183014	0.152144
8	61.771	60.981	14.603	7.993	7.171	0.987211	0.236405	0.129397	0.11609
9	62.993	65.709	13.636	4.435	5.918	1.043116	0.216468	0.070405	0.093947
10	73.474	57.999	12.708	6.113	7.487	0.789381	0.172959	0.083199	0.1019
11	76.599	66.98	14.904	4.205	8.625	0.874424	0.194572	0.054896	0.112599
12	69.984	53.375	17.369	10.798	11.303	0.762674	0.248185	0.154292	0.161508
13	68.676	62.719	19.294	5.706	9.292	0.913259	0.280942	0.083086	0.135302
14	65.282	52.297	16.453	9.118	8.006	0.801094	0.25203	0.139671	0.122637
15	62.155	52.688	13.131	9.931	9.343	0.847687	0.211262	0.159778	0.150318
16	62.403	53.783	19.638	8.512	8.435	0.861866	0.314696	0.136404	0.13517
17	55.789	47.49	16.954	10.414	9.146	0.851243	0.303895	0.186668	0.163939
18	63.358	56.468	17.676	5.649	9.783	0.891253	0.278986	0.08916	0.154408
19	58.181	46.821	16.705	11.682	14.778	0.804747	0.287121	0.200787	0.254
20	67.528	62.53	23.668	12.752	9.424	0.925986	0.350492	0.18884	0.139557
Mean						0.865901	0.261853	0.149487	0.144398
Standard Deviation						0.093944	0.047398	0.051294	0.038078

Table A.3: Ring Finger features of subject 1 for right hand before lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	57.321	51.866	18.019	10.895	13.073	0.904834	0.314353	0.19007	0.228067
2	62.723	54.647	23.146	20.594	15.593	0.871243	0.369019	0.328333	0.248601
3	62.865	47.992	16.617	11.964	8.452	0.763414	0.264328	0.190313	0.134447
4	54.824	47.64	18.736	19.835	10.22	0.868962	0.341748	0.361794	0.186415
5	49.88	46.861	16.372	17.063	11.518	0.939475	0.328228	0.342081	0.230914
6	66.737	51.843	16.069	14.91	13.295	0.776825	0.240781	0.223414	0.199215
7	68.057	61.424	18.044	15.099	15.142	0.902538	0.265131	0.221858	0.22249
8	62.103	54.607	16.472	9.978	10.148	0.879297	0.265237	0.160669	0.163406
9	54.95	47.471	14.995	9.495	8.675	0.863894	0.272884	0.172793	0.157871
10	56.504	45.621	14.851	14.689	10.884	0.807394	0.262831	0.259964	0.192624
11	74.961	63.614	20.196	17.752	11.867	0.848628	0.26942	0.236816	0.158309
12	64.851	55.284	17.127	15.548	8.19	0.852477	0.264098	0.23975	0.126289
13	61.964	53.067	19.979	12.651	12.47	0.856417	0.322429	0.204167	0.201246
14	61.736	54.382	25.522	14.791	15.344	0.88088	0.413405	0.239585	0.248542
15	64.817	62.638	19.871	12.553	9.457	0.966382	0.306571	0.193668	0.145903
16	59.45	53.712	25.27	12.876	6.914	0.903482	0.425063	0.216585	0.116299
17	58.63	49.459	15.441	12.237	8.515	0.843578	0.263363	0.208716	0.145233
18	61.15	50.461	20.663	15.502	12.726	0.8252	0.337907	0.253508	0.208111
19	57.093	56.832	15.121	9.677	10.364	0.995429	0.264849	0.169495	0.181528
20	53.027	46.856	19.695	12.182	11.132	0.883625	0.371415	0.229732	0.209931

Mean	0.871699	0.308153	0.232166	0.185272
Standard Deviation	0.056768	0.054235	0.055645	0.040321

Table A.4: Index Finger features of subject 1 for left hand before lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	58.276	54.31	9.725	4.944	9.3	0.931945	0.166878	0.084838	0.159585
2	45.998	44.947	12.051	2.807	12.192	0.977151	0.26199	0.061024	0.265055
3	48.295	43.308	9.488	6.764	15.685	0.896739	0.196459	0.140056	0.324775
4	55.711	46.721	10.861	1.678	9.262	0.838632	0.194953	0.03012	0.166251
5	51.319	53.672	7.182	8.996	14.266	1.04585	0.139948	0.175296	0.277987
6	50.6	53.969	11.854	2.882	12.231	1.066581	0.234269	0.056957	0.241719
7	49.604	54.897	10.731	3.076	13	1.106705	0.216333	0.062011	0.262076
8	47.255	53.22	11.114	1.753	9.766	1.12623	0.235192	0.037097	0.206666
9	57.781	54.535	13.173	7.733	15.157	0.943822	0.227982	0.133833	0.262318
10	56.307	59.495	11.26	4.955	11.407	1.056618	0.199975	0.088	0.202586
11	56.271	53.524	12.787	5.953	10.834	0.951183	0.22724	0.105792	0.192533
12	61.938	50.386	15.216	3.72	8.457	0.813491	0.245665	0.06006	0.13654
13	48.92	49.043	9.119	3.181	13.651	1.002514	0.186406	0.065025	0.279047
14	56.464	49.681	13.844	2.379	10.597	0.87987	0.245183	0.042133	0.187677
15	46.667	47.286	13.562	5.419	7.982	1.013264	0.290612	0.116121	0.171042
16	48.671	47.196	10.445	14.276	18.051	0.969694	0.214604	0.293316	0.370878
17	52.677	47.072	12.482	9.866	13.821	0.893597	0.236954	0.187292	0.262373
18	60.671	54.726	12.477	10.311	8.289	0.902012	0.20565	0.169949	0.136622
19	60.029	61.635	14.502	2.68	9.965	1.026754	0.241583	0.044645	0.166003
20	53.657	50.266	12.235	5.442	12.474	0.936802	0.228022	0.101422	0.232477
Mean						0.968973	0.219795	0.102749	0.22521
Standard Deviation						0.086192	0.033716	0.065577	0.063292

Table A.5: Middle Finger features of subject 1 for left hand before lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	35.473	34.52	11.22	9.106	8.007	0.973134	0.316297	0.256702	0.225721
2	37.682	34.478	11.083	7.042	6.472	0.914973	0.294119	0.18688	0.171753
3	31.358	35.888	7.737	4.782	7.869	1.144461	0.246731	0.152497	0.250941
4	34.951	27.515	14.918	5.397	10.843	0.787245	0.426826	0.154416	0.310234
5	32.399	32.498	7.222	6.908	5.274	1.003056	0.222908	0.213216	0.162783
6	30.721	34.543	7.838	4.492	4.657	1.12441	0.255135	0.146219	0.15159
7	41.086	30.805	8.675	8.759	9.763	0.749769	0.211142	0.213187	0.237624
8	30.789	37.205	10.224	4.314	5.337	1.208386	0.332067	0.140115	0.173341

9	39.076	35.111	13.339	9.673	7.321	0.898531	0.34136	0.247543	0.187353
10	33.378	30.774	9.397	3.405	9.952	0.921985	0.281533	0.102013	0.29816
11	26.696	31.984	12.796	8.216	6.401	1.198082	0.479323	0.307761	0.239774
12	29.344	30.499	11.62	6.509	7.829	1.039361	0.395992	0.221817	0.266801
13	31.643	31.494	8.604	3.477	6.262	0.995291	0.271908	0.109882	0.197895
14	32.464	32.749	7.8	5.81	8.828	1.008779	0.240266	0.178967	0.271932
15	27.012	31.028	9.2	5.516	3.105	1.148675	0.340589	0.204206	0.114949
16	30.569	30.389	8.412	9.27	11.426	0.994112	0.275181	0.303248	0.373777
17	31.901	29.438	10.33	10.554	8.7	0.922792	0.323814	0.330836	0.272719
18	28.734	30.507	9.007	3.978	5.423	1.061704	0.313461	0.138442	0.188731
19	29.429	31.773	11.539	6.872	7.158	1.079649	0.392096	0.233511	0.243229
20	30.113	32.083	8.722	3.201	6.132	1.06542	0.289642	0.1063	0.203633
Mean						1.011991	0.31252	0.197388	0.227147
Standard Deviation						0.124083	0.069717	0.068216	0.062014

Table A.6: Ring Finger features of subject 1 for left hand before lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	37.328	35.679	7.888	4.03	7.289	0.955824	0.211316	0.107962	0.195269
2	39.84	34.866	9.763	9.735	7.472	0.875151	0.245055	0.244352	0.18755
3	40.698	42.201	11.443	13.431	9.233	1.036931	0.281169	0.330016	0.226866
4	35.217	35.716	13.604	10.974	10.276	1.014169	0.386291	0.311611	0.291791
5	44.124	37.1	9.332	4.444	7.794	0.840812	0.211495	0.100716	0.176639
6	50.859	41.028	7.222	1.317	3.605	0.806701	0.142	0.025895	0.070882
7	49.5	39.497	14.536	6.084	8.525	0.797919	0.293657	0.122909	0.172222
8	44.974	45.692	8.501	3.409	10.546	1.015965	0.18902	0.075799	0.234491
9	40.315	35.977	9.416	5.528	7.314	0.892397	0.233561	0.13712	0.181421
10	49.306	39.241	10.846	7.218	8.646	0.795867	0.219973	0.146392	0.175354
11	43.416	37.295	11.581	6.3	9.829	0.859015	0.266745	0.145108	0.226391
12	48.393	39.593	10.621	7.944	10.11	0.818156	0.219474	0.164156	0.208915
13	39.969	41.037	9.783	8.004	11.138	1.026721	0.244765	0.200255	0.278666
14	37.06	41.065	8.497	9.764	10.898	1.108068	0.229277	0.263465	0.294064
15	56.962	47.676	15.716	8.127	8.058	0.836979	0.275903	0.142674	0.141463
16	46.806	40.849	8.193	2.736	6.179	0.87273	0.175042	0.058454	0.132013
17	58.691	40.867	11.203	7.649	6.27	0.696308	0.190881	0.130327	0.106831
18	45.873	42.512	9.886	9.765	8.653	0.926733	0.215508	0.21287	0.188629
19	53.308	45.945	11.86	11.213	14.998	0.861878	0.222481	0.210344	0.281346
20	40.852	44.194	11.07	3.972	5.942	1.081808	0.270978	0.097229	0.145452
Mean						0.906006	0.236229	0.161383	0.195813
Standard Deviation						0.110246	0.051839	0.08133	0.061288

A.2 Subject 1 – After Lunch

Table A.7: Index Finger features of subject 1 for right hand after lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	35.509	46.759	20.898	13.323	12.483	1.316821	0.588527	0.375201	0.351545
2	35.591	46.811	22.367	18.254	10.768	1.315248	0.628445	0.512882	0.302548
3	33.165	38.883	15.468	12.915	11.794	1.172411	0.466395	0.389417	0.355616
4	32.115	37.459	18.836	13.799	9.494	1.166402	0.586517	0.429675	0.295625
5	41.348	43.583	19.282	19.9	13.333	1.054053	0.466335	0.481281	0.322458
6	35.113	39.689	14.254	10.009	7.778	1.130322	0.405947	0.285051	0.221513
7	36.637	38.866	18.225	12.517	9.247	1.06084	0.497448	0.341649	0.252395
8	46.349	38.261	14.881	15.738	7.23	0.825498	0.321064	0.339554	0.15599
9	35.459	48.999	18.415	13.734	10.554	1.381849	0.519332	0.387321	0.29764
10	46.507	45.49	11.549	8.591	12.162	0.978132	0.248328	0.184725	0.261509
11	39.356	41.163	18.157	10.877	11.727	1.045914	0.461353	0.276375	0.297972
12	44.225	36.477	19.311	11.834	11.58	0.824805	0.436653	0.267586	0.261843
13	45.959	47.142	20.004	12.626	11.271	1.02574	0.435258	0.274723	0.24524
14	37.093	39.257	14.517	11.869	10.386	1.05834	0.391368	0.31998	0.279999
15	39.862	38.204	12.731	14.078	8.767	0.958407	0.319377	0.353168	0.219934
16	37.933	35.226	14.65	9.917	7.216	0.928637	0.386207	0.261435	0.19023
17	40.345	43.977	15.78	11.041	10.457	1.090024	0.391127	0.273665	0.259189
18	45.48	39.051	17.668	14.478	9.239	0.858641	0.388478	0.318338	0.203144
19	46.435	42.27	12.956	17.488	9.496	0.910305	0.279014	0.376612	0.204501
20	44.245	48.051	14.315	8.74	7.584	1.086021	0.323539	0.197536	0.171409
Mean						1.059421	0.427036	0.332309	0.257515
Standard Deviation						0.157968	0.103498	0.08478	0.056594

Table A.8: Middle Finger features of subject 1 for right hand after lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	32.325	32.589	9.305	7.669	9.365	1.008167	0.287858	0.237247	0.289714
2	25.925	29.242	9.403	7.475	4.908	1.127946	0.3627	0.288332	0.189315
3	33.566	32.731	10.551	9.134	10.675	0.975124	0.314336	0.272121	0.31803
4	28.239	30.513	11.099	4.739	4.478	1.080527	0.393038	0.167818	0.158575
5	19.555	25.435	10.039	6.929	2.548	1.30069	0.513373	0.354334	0.130299
6	26.578	30.872	12.524	7.562	11.363	1.161562	0.471217	0.284521	0.427534
7	25.129	28.749	10.876	7.777	4.728	1.144057	0.432807	0.309483	0.188149
8	24.45	29.109	18.385	9.365	10.384	1.190552	0.751943	0.383027	0.424703
9	31.062	25.907	11	9.705	9.093	0.834042	0.35413	0.31244	0.292737
10	25.727	34.257	12.304	12.822	9.059	1.331558	0.478252	0.498387	0.35212

11	32.388	35.326	13.333	13.388	3.96	1.090713	0.411665	0.413363	0.122268
12	31.461	33.228	15.488	12.727	12.272	1.056165	0.492292	0.404533	0.39007
13	30.242	33.928	11.777	13.671	7.691	1.121883	0.389425	0.452053	0.254315
14	31.376	32.728	15.243	5.582	7.707	1.04309	0.485817	0.177907	0.245634
15	35.422	29.31	13.919	11.933	13.384	0.827452	0.392948	0.336881	0.377844
16	35.249	32.028	13.412	8.695	4.469	0.908622	0.380493	0.246674	0.126784
17	32.529	34.228	17.378	12.248	8.755	1.05223	0.534231	0.376526	0.269144
18	33.464	38.944	16.576	13.308	9.718	1.163758	0.495338	0.397681	0.290402
19	36.696	35.713	17.97	5.827	7.838	0.973212	0.489699	0.158791	0.213593
20	31.711	35.816	14.799	11.166	4.312	1.12945	0.466683	0.352118	0.135978
	Mean					1.07604	0.444912	0.321212	0.25986
	Standard Deviation					0.132226	0.099542	0.093773	0.100675

Table A.9: Ring Finger features of subject 1 for right hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	27.465	30.633	13.214	10.026	6.329	1.115347	0.481121	0.365046	0.230439
2	26.627	28.178	16.967	12.105	11.465	1.058249	0.63721	0.454614	0.430578
3	27.181	27.221	13.018	6.81	7.041	1.001472	0.478937	0.250543	0.259041
4	30.576	28.757	10.5	8.804	9.262	0.940509	0.343407	0.287938	0.302917
5	28.662	32.699	13.797	7.577	3.289	1.140849	0.481369	0.264357	0.114751
6	29.242	26.641	11.793	11.083	5.865	0.911053	0.40329	0.37901	0.200568
7	34.171	31.837	14.31	10.402	9.774	0.931696	0.418776	0.30441	0.286032
8	29.363	30.876	13.919	12.626	10.371	1.051527	0.474032	0.429997	0.3532
9	33.118	29.974	12.764	9.516	5.879	0.905067	0.38541	0.287336	0.177517
10	28.971	31.066	15.103	11.673	6.447	1.072314	0.521314	0.40292	0.222533
11	26.152	32.133	18.889	9.401	7.496	1.228701	0.722277	0.359475	0.286632
12	33.391	30.697	11.834	10.744	6.196	0.91932	0.354407	0.321763	0.185559
13	24.755	31.446	11.558	11.196	6.958	1.270289	0.466896	0.452272	0.281075
14	28.484	36.21	13.729	10.77	8.53	1.27124	0.48199	0.378107	0.299466
15	28.279	28.013	15.632	11.711	7.032	0.990594	0.552778	0.414124	0.248665
16	30.016	30.921	16.985	7.356	9.586	1.030151	0.565865	0.245069	0.319363
17	27.335	27.464	12.566	10.136	4.791	1.004719	0.459704	0.370807	0.17527
18	36.843	31.386	13.473	12.34	8.505	0.851885	0.365687	0.334935	0.230844
19	32.075	31.832	11.117	11.068	9.345	0.992424	0.346594	0.345066	0.291348
20	37.975	36.512	14.75	6.044	8.611	0.961475	0.388413	0.159157	0.226754
	Mean					1.032444	0.466474	0.340347	0.256128
	Standard Deviation							0.076363	0.070984

Table A.10: Index Finger features of subject 1 for left hand after lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	58.569	50.465	12.626	7.661	8.271	0.861633	0.215575	0.130803	0.141218
2	68.755	53.078	17.695	8.099	10.708	0.771987	0.257363	0.117795	0.155741
3	66.607	56.029	19.018	12.537	10.851	0.841188	0.285526	0.188223	0.162911
4	65.917	58.22	15.473	20.412	11.947	0.883232	0.234735	0.309662	0.181243
5	64.43	59.279	16.606	5.623	8.398	0.920053	0.257737	0.087273	0.130343
6	72.274	61.191	13.871	10.803	12.672	0.846653	0.191922	0.149473	0.175333
7	72.734	61.829	20.488	11.929	13.516	0.85007	0.281684	0.164009	0.185828
8	54.813	53.136	17.409	7.327	12.794	0.969405	0.317607	0.133673	0.233412
9	67.381	59.983	17.2	14.492	9.786	0.890206	0.255265	0.215075	0.145234
10	72.767	62.975	15.577	5.795	14.416	0.865434	0.214067	0.079638	0.198112
11	66.151	59.087	13.247	11.489	10.068	0.893214	0.200254	0.173678	0.152197
12	72.496	60.48	19.021	12.032	15.021	0.834253	0.262373	0.165968	0.207198
13	60.964	57.468	19.936	9.139	9.057	0.942655	0.327013	0.149908	0.148563
14	75.288	69.425	13	8.847	7.507	0.922126	0.17267	0.117509	0.09971
15	60.827	62.075	13.028	15.037	11.747	1.020517	0.214181	0.247209	0.193121
16	79.067	74.214	15.816	3.772	10.628	0.938622	0.200033	0.047706	0.134418
17	70.666	60.39	17.12	10.585	9.804	0.854584	0.242266	0.149789	0.138737
18	66.727	61.33	15.53	5.27	10.899	0.919118	0.232739	0.078979	0.163337
19	69.317	68.438	16.134	7.961	10.831	0.987319	0.232757	0.114849	0.156253
20	69.297	62.893	14.865	9.291	11.011	0.907586	0.214511	0.134075	0.158896
	Mean					0.895993	0.240514	0.147765	0.16309
	Standard Deviation					0.058907	0.040713	0.060767	0.030578

Table A.11: Middle Finger features of subject 1 for left hand after lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	37.845	38.421	7.489	10.011	4.036	1.01522	0.197886	0.264526	0.106646
2	34.998	30.096	3.813	4.302	6.355	0.859935	0.108949	0.122921	0.181582
3	36.974	25.675	5.955	7.814	9.888	0.694407	0.161059	0.211338	0.267431
4	37.888	26.472	6.223	7.422	8.72	0.698691	0.164247	0.195893	0.230152
5	35.692	26.909	8.044	5.91	8.957	0.753922	0.225373	0.165583	0.250953
6	35.651	30.196	8.185	6.032	4.791	0.846989	0.229587	0.169196	0.134386
7	42.91	33.904	6.686	10.914	4.599	0.790119	0.155814	0.254346	0.107178
8	34.707	28.679	5.614	6.086	7.668	0.826317	0.161754	0.175354	0.220935
9	37.831	28.029	7.856	6.286	7.601	0.7409	0.20766	0.16616	0.20092
10	28.519	28.316	6.366	5.92	6.804	0.992882	0.22322	0.207581	0.238578
11	29.511	31.865	10.851	7.346	11.534	1.079767	0.367693	0.248924	0.390837

12	38.526	31.224	8.036	4.326	6.119	0.810466	0.208586	0.112288	0.158828
13	38.844	29.215	5.984	6.514	9.096	0.752111	0.154052	0.167696	0.234167
14	34.344	33.773	4.974	7.557	9.024	0.983374	0.144829	0.220038	0.262753
15	35.009	33.51	8.472	9.041	8.555	0.957182	0.241995	0.258248	0.244366
16	34.409	31.791	4.388	7.81	9.436	0.923915	0.127525	0.226976	0.274231
17	38.718	27.775	8.842	6.262	10.279	0.717367	0.228369	0.161734	0.265484
18	40.986	33.466	9.861	7.326	3.946	0.816523	0.240594	0.178744	0.096277
19	41.586	31.604	9.484	4.128	11.615	0.759967	0.228058	0.099264	0.279301
20	37.996	28.859	9.252	5.032	3.935	0.759527	0.243499	0.132435	0.103564
Mean						0.838979	0.201038	0.186962	0.212428
Standard Deviation						0.115042	0.057169	0.04922	0.076157

Table A.12: Ring Finger features of subject 1 for left hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	75.192	70.844	18.329	5.818	16.85	0.942175	0.243763	0.077375	0.224093
2	73.001	69.735	18.003	3.823	10.707	0.955261	0.246613	0.052369	0.146669
3	78.877	64.123	15.527	7.539	14.049	0.812949	0.196851	0.095579	0.178113
4	73.892	70.364	14.799	3.685	13.699	0.952255	0.200279	0.04987	0.185392
5	79.957	74.325	20.512	10.912	12.449	0.929562	0.256538	0.136473	0.155696
6	86.094	80.38	19.162	6.666	9.306	0.933631	0.222571	0.077427	0.108091
7	93.908	87.968	18.962	10.341	14.617	0.936747	0.201921	0.110118	0.155652
8	95.272	87.622	16.694	6.575	13.028	0.919704	0.175225	0.069013	0.136745
9	89.328	78.576	13.064	14.797	11.263	0.879635	0.146248	0.165648	0.126086
10	92.786	80.111	15.775	2.466	11.585	0.863395	0.170015	0.026577	0.124857
11	79.383	82.363	14.729	6.875	17.581	1.03754	0.185544	0.086605	0.221471
12	86.319	75.657	15.772	4.871	13.039	0.876481	0.182718	0.05643	0.151056
13	85.132	76.382	17.79	7.535	9.353	0.897218	0.20897	0.08851	0.109865
14	88.862	82.718	15.076	3.482	9.42	0.930859	0.169656	0.039184	0.106007
15	85.511	84.523	15.872	11.54	11.469	0.988446	0.185614	0.134953	0.134123
16	92.982	85.123	21.585	2.237	16.828	0.915478	0.232142	0.024058	0.180981
17	92.503	81.692	17.566	8.225	15.716	0.883128	0.189897	0.088916	0.169897
18	96.086	91.833	17.957	9.303	13.629	0.955738	0.186885	0.09682	0.141842
19	88.951	88.333	17.713	2.555	12.179	0.993052	0.199132	0.028724	0.136918
20	94.507	93.57	17.337	8.164	12.561	0.990085	0.183447	0.086385	0.132911
Mean						0.929667	0.199201	0.079552	0.151323
Standard Deviation						0.052161	0.028557	0.038285	0.033641

A.3 Subject 2 Before Lunch

Table A.13: Index Finger features of subject 2 for right hand before lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	96.706	140.627	40.921	22.532	21.648	1.45417	0.423149	0.232995	0.223854
2	98.528	143.607	28.995	14.051	19.058	1.457525	0.294282	0.142609	0.193427
3	100.604	148.153	32.989	17.458	16.571	1.472635	0.327909	0.173532	0.164715
4	92.07	136.377	33.063	19.142	17.754	1.481232	0.359107	0.207907	0.192832
5	84.568	135.79	38.355	18.86	6.871	1.60569	0.45354	0.223016	0.081248
6	95.797	129.808	37.135	13.517	15.783	1.355032	0.387643	0.1411	0.164755
7	90.248	128.622	32.277	17.373	15.357	1.425206	0.357648	0.192503	0.170164
8	110.681	128.341	32.148	13.576	14.171	1.159558	0.290456	0.122659	0.128035
9	99.747	113.36	40.65	19.616	15.279	1.136475	0.407531	0.196658	0.153178
10	94.705	107.486	43.061	19.596	22.831	1.134956	0.454686	0.206916	0.241075
11	88.173	112.648	36.838	25.352	17.498	1.277579	0.417792	0.287526	0.198451
12	106.94	126	38.916	21.896	11.808	1.178231	0.363905	0.20475	0.110417
13	99.58	124.784	37.906	17.403	16.338	1.253103	0.380659	0.174764	0.164069
14	95.561	116.409	29.482	16.526	1.507	1.218164	0.308515	0.172937	0.01577
15	89.135	92.921	31.805	20.908	7.342	1.042475	0.356818	0.234566	0.082369
16	67.769	75.31	22.678	14.484	15.347	1.111275	0.334637	0.213726	0.22646
17	66.697	79.156	14.61	16.482	12.513	1.1868	0.21905	0.247118	0.18761
18	66.199	76.111	24.045	12.408	12.526	1.14973	0.363223	0.187435	0.189217
19	68.967	76.564	23.84	12.094	15.661	1.110154	0.345673	0.175359	0.22708
20	83.622	88.667	28.211	11.525	9.938	1.060331	0.337363	0.137823	0.118844
Mean						1.263516	0.359179	0.193795	0.161678
Standard Deviation						0.166307	0.057393	0.040884	0.057682

Table A.14: Middle Finger features of subject 2 for right hand before lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	206.834	257.747	56.742	29.818	19.732	1.246154	0.274336	0.144164	0.0954
2	215.591	255.053	56.742	22.881	27.784	1.183041	0.263193	0.106132	0.128874
3	207.744	253.22	60.334	22.239	25.137	1.218904	0.290425	0.10705	0.121
4	191.133	233.792	53.564	28.787	28.991	1.22319	0.280245	0.150612	0.15168
5	215.972	250.294	55.162	25.697	29.359	1.158919	0.255413	0.118983	0.135939
6	214.899	256.787	70.465	26.784	21.265	1.194919	0.327898	0.124635	0.098953
7	227.63	246.75	67.501	32.234	22.395	1.083996	0.296538	0.141607	0.098383
8	232.253	247.168	62.023	32.794	26.767	1.064219	0.267049	0.141199	0.115249
9	240.414	224.742	84.415	46.186	27.296	0.934812	0.351123	0.19211	0.113537

10	240.761	231.489	68.826	44.32	26.684	0.961489	0.285869	0.184083	0.110832
11	263.317	233.152	66.185	32.425	26.278	0.885442	0.251351	0.123141	0.099796
12	241.716	227.229	79.781	42.685	24.062	0.940066	0.330061	0.176592	0.099547
13	231.348	218.697	79.094	40.152	23.905	0.945316	0.341883	0.173557	0.103329
14	223.534	224.683	57.174	39.701	23.178	1.00514	0.255773	0.177606	0.103689
15	217.701	208.498	53.106	27.293	15.788	0.957726	0.24394	0.125369	0.072521
16	212.28	219.104	47.561	24.429	23.447	1.032146	0.224048	0.115079	0.110453
17	189.288	223.719	55.182	36.688	21.831	1.181897	0.291524	0.193821	0.115332
18	195.945	224.283	42.523	29.602	21.378	1.144622	0.217015	0.151073	0.109102
19	198.436	230.721	51.113	26.149	26.469	1.162697	0.257579	0.131775	0.133388
20	200.871	244.776	67.346	27.24	22.474	1.218573	0.33527	0.135609	0.111883
	Mean					1.087164	0.282027	0.14571	0.111444
	Standard Deviation							0.028243	0.017227

Table A.15: Ring Finger features of subject 2 for right hand before lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	78.047	74.816	16.27	9.922	15.203	0.958602	0.208464	0.127129	0.194793
2	66.495	82.546	20.427	9.288	7.437	1.241387	0.307196	0.13968	0.111843
3	66.615	75.929	20.342	11.728	8.126	1.139818	0.305367	0.176056	0.121985
4	80.5	84.188	14.162	5.904	13.482	1.045814	0.175925	0.073342	0.167478
5	79.241	97.856	19.122	0.253	19.331	1.234916	0.241314	0.003193	0.243952
6	87.262	104.794	17.409	0.563	20.815	1.200912	0.199503	0.006452	0.238535
7	98.491	124.636	25.914	14.063	23.511	1.265456	0.26311	0.142785	0.238712
8	96.137	115.272	36.42	19.52	16.284	1.199039	0.378834	0.203044	0.169383
9	88.867	115.784	30.976	19.986	8.266	1.302891	0.348566	0.224898	0.093015
10	89.826	116.095	30.603	13.082	7.573	1.292443	0.340692	0.145637	0.084307
11	84.716	102.151	29.234	17.428	14.752	1.205805	0.345082	0.205723	0.174135
12	89.535	106.621	28.383	20.06	8.929	1.19083	0.317005	0.224046	0.099726
13	83.223	29.029	16.25	10.979	0	0.34881	0.195259	0.131923	0
14	87.241	108.334	27.274	12.945	9.15	1.241779	0.312628	0.148382	0.104882
15	95.472	112.761	32.438	7.767	15.407	1.18109	0.339765	0.081354	0.161377
16	101.106	122.818	31.522	11.361	0	1.214745	0.311772	0.112367	0
17	94.626	130.424	35.778	16.297	18.275	1.37831	0.378099	0.172225	0.193129
18	104.707	138.812	40.063	21.07	13.599	1.325718	0.38262	0.201228	0.129877
19	106.532	138.56	32.724	20.255	10.77	1.300642	0.307175	0.190131	0.101096
20	108.121	149.83	40.026	19.561	19.065	1.385762	0.370196	0.180918	0.17633
	Mean					1.182738	0.301429	0.144526	0.140228
	Standard Deviation					0.220676	0.065704	0.06406	0.069108

Table A.16: Index Finger features of subject 2 for left hand before lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	162.968	177.883	45.151	31.054	3.634	1.091521	0.277054	0.190553	0.022299
2	170.788	166.895	55.106	20.273	17.836	0.977206	0.322657	0.118703	0.104434
3	158.439	151.326	40.155	16.54	10.934	0.955106	0.253441	0.104393	0.069011
4	159.922	149.123	36.047	16.342	15.622	0.932473	0.225404	0.102187	0.097685
5	166.461	150.857	32.368	13.545	14.158	0.90626	0.194448	0.08137	0.085053
6	164.072	152.077	34.169	18.102	7.068	0.926892	0.208256	0.11033	0.043079
7	166.796	153.952	38.317	12.554	15.018	0.922996	0.229724	0.075266	0.090038
8	171.142	152.066	37.033	18.27	12.276	0.888537	0.216388	0.106753	0.07173
9	160.584	140.932	39.485	18.325	12.954	0.877622	0.245884	0.114115	0.080668
10	151.161	125.142	32.267	9.111	9.699	0.827872	0.213461	0.060273	0.064163
11	128.175	111.612	23.008	12.604	11.75	0.870778	0.179505	0.098334	0.091672
12	123.312	100.218	28.718	11.252	9.601	0.812719	0.232889	0.091248	0.077859
13	129.286	103.044	24.518	13.632	10.247	0.797024	0.189642	0.105441	0.079258
14	122.981	105.58	27.839	11.709	8.479	0.858507	0.226368	0.09521	0.068946
15	128.311	105.437	28.306	15.359	8.191	0.82173	0.220605	0.119701	0.063837
16	127.028	114.551	29.286	13.275	9.668	0.901778	0.230548	0.104505	0.076109
17	132.196	116.922	33.091	15.055	10.812	0.884459	0.250318	0.113884	0.081788
18	126.536	118.777	34.937	15.686	8.46	0.938681	0.276103	0.123965	0.066858
19	115.195	117.613	33.283	17.594	11.966	1.02099	0.288927	0.152732	0.103876
20	118.864	121.87	29.18	9.881	9.711	1.025289	0.245491	0.083129	0.081698
Mean						0.911922	0.236356	0.107605	0.076003
Standard Deviation						0.076094	0.035206	0.027795	0.019383

Table A.17: Middle Finger features of subject 2 for left hand before lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	67.98	79.081	17.159	6.3114	6.07	1.163298	0.252412	0.092842	0.089291
2	68.516	85.734	19.825	12.465	11.255	1.251299	0.289348	0.181928	0.164268
3	80.575	96.01	30.59	3.11	11.726	1.191561	0.379646	0.038598	0.145529
4	75.323	101.077	22.092	3.415	5.672	1.341914	0.293297	0.045338	0.075302
5	73.39	85.997	30.59	16.163	7.516	1.171781	0.416814	0.220234	0.102412
6	71.98	86.893	21.424	14.918	5.625	1.207183	0.297638	0.207252	0.078147
7	80.121	94.638	24.06	8.606	15.4	1.181188	0.300296	0.107413	0.192209
8	81.961	100.425	27.497	9.618	3.438	1.225278	0.335489	0.117348	0.041947
9	75.758	86.949	28.15	6.338	8.415	1.14772	0.371578	0.083661	0.111077
10	82.804	105.736	28.688	13.93	9.088	1.276943	0.346457	0.168229	0.109753

11	85.745	110.289	28.607	11.414	3.401	1.286244	0.333629	0.133116	0.039664
12	77.574	93.091	26.711	8.032	6.951	1.200028	0.344329	0.10354	0.089605
13	66.568	85.431	28.007	14.1006	8.313	1.283364	0.420728	0.211822	0.12488
14	67.984	73.161	16.851	10.493	6.099	1.07615	0.247867	0.154345	0.089712
15	67.068	86.179	19.381	4.487	11.134	1.28495	0.288975	0.066902	0.166011
16	65.381	82.042	20.199	8.592	6.698	1.254829	0.308943	0.131414	0.102446
17	55.39	59.12	22.757	6.909	8.43	1.067341	0.41085	0.124734	0.152194
18	66.854	82.442	22.97	9.358	8.5	1.233165	0.343585	0.139977	0.127143
19	63.63	95.49	22.717	7.789	7.34	1.500707	0.357017	0.122411	0.115354
20	81.237	106.501	19.417	7.67	6.683	1.310991	0.239017	0.094415	0.082265
Mean						1.232797	0.328896	0.127276	0.10996
Standard Deviation						0.095851	0.054293	0.051947	0.039977

Table A.18: Ring Finger features of subject 2 for left hand before lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	9.512	5.942	1.541	2.662	0.736	0.624685	0.162006	0.279857	0.077376
2	10.153	5.74	2.88	3.214	2.738	0.56535	0.28366	0.316557	0.269674
3	8.095	7.4	3.385	2.233	2.108	0.914145	0.418159	0.275849	0.260408
4	8.911	8.213	4.616	4.314	4.577	0.92167	0.518011	0.484121	0.513635
5	6.738	7.212	2.831	1.517	3.16	1.070347	0.420154	0.225141	0.468982
6	10.589	7.736	2.544	0.979	2.514	0.730569	0.240249	0.092454	0.237416
7	10.238	7.162	2.262	0.674	1.858	0.699551	0.220942	0.065833	0.181481
8	8.263	6.56	2.831	1.127	3.235	0.793901	0.342612	0.136391	0.391504
9	9.101	7.276	2.137	2.627	2.664	0.799473	0.234809	0.28865	0.292715
10	9.332	6.539	2.347	2.454	2.601	0.700707	0.2515	0.262966	0.278718
11	10.347	10.483	0.861	4.94	1.155	1.013144	0.083213	0.477433	0.111627
12	7.375	5.406	2.407	1.652	2.313	0.733017	0.326373	0.224	0.313627
13	6.998	6.19	2.382	2.445	3.137	0.884538	0.340383	0.349386	0.448271
14	9.005	8.208	1.433	1.766	2.161	0.911494	0.159134	0.196113	0.239978
15	10.605	8.15	3.235	2.73	3.579	0.768505	0.305045	0.257426	0.337482
16	7.258	8.199	1.885	1.372	2.359	1.12965	0.259713	0.189033	0.325021
17	8.401	5.947	1.953	3.768	3.328	0.707892	0.232472	0.448518	0.396143
18	7.56	8.258	0.941	2.508	2.689	1.092328	0.124471	0.331746	0.355688
19	7.15	8.466	1.903	3.097	3.124	1.184056	0.266154	0.433147	0.436923
20	9.382	8.341	1.916	4.337	6.111	0.889043	0.204221	0.462268	0.651354
Mean						0.856703	0.269664	0.289844	0.329401
Standard Deviation						0.174075	0.105525	0.124947	0.136426

A.4 Subject 2 After Lunch

Table A.19: Index Finger features of subject 2 for right hand after lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	210.77	254.639	58.659	19.194	18.073	1.208137	0.278308	0.091066	0.085747
2	229.038	271.142	46.281	16.488	23.324	1.18383	0.202067	0.071988	0.101835
3	226.791	269.108	49.625	16.146	23.606	1.18659	0.218814	0.071193	0.104087
4	206.706	260.477	51.609	17.564	21.287	1.260133	0.249673	0.084971	0.102982
5	223.538	259.837	45.196	22.983	23.972	1.162384	0.202185	0.102815	0.107239
6	226.457	266.177	48.379	11.302	23.949	1.175398	0.213634	0.049908	0.105755
7	225.924	281.745	40.317	14.084	14.311	1.247079	0.178454	0.06234	0.063344
8	227.745	277.384	45.013	17.29	25.6	1.217959	0.197646	0.075918	0.112406
9	224.206	283.257	51.449	18.931	17.279	1.263378	0.229472	0.084436	0.077068
10	219.432	269.202	57.953	16.495	18.892	1.226813	0.264105	0.075171	0.086095
11	248.715	275.095	51.495	15.373	12.238	1.106065	0.207044	0.06181	0.049205
12	252.071	260.923	50.933	15.19	13.473	1.035117	0.202058	0.060261	0.053449
13	221.629	249.707	54.53	15.978	14.334	1.126689	0.246042	0.072093	0.064676
14	236.309	260.9	53.811	13.138	20.53	1.104063	0.227715	0.055597	0.086878
15	251.253	274.634	44.109	13.182	17.873	1.093058	0.175556	0.052465	0.071135
16	242.099	279.003	48.292	13.137	18.667	1.152434	0.199472	0.054263	0.077105
17	228.083	263.386	46.14	19.314	18.336	1.154781	0.202295	0.08468	0.080392
18	205.857	247.11	56.021	24.765	27.923	1.200396	0.272136	0.120302	0.135643
19	206.719	249.181	42.55	16.21	24.349	1.205409	0.205835	0.078416	0.117788
20	199.53	238.548	49.047	20.35	20.032	1.19555	0.245813	0.10199	0.100396
Mean						1.175263	0.220916	0.075584	0.089161
Standard Deviation						0.059631	0.029672	0.018677	0.022572

Table A.20: Middle Finger features of subject 2 for right hand after lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	87.379	146.699	37.301	16.965	8.285	1.678882	0.426887	0.194154	0.094817
2	95.594	162.451	33.916	12.693	11.387	1.699385	0.354792	0.13278	0.119118
3	93.912	162.382	37.783	10.233	11.323	1.729087	0.402323	0.108964	0.12057
4	86.802	165.525	32.458	12.809	9.915	1.906926	0.373931	0.147566	0.114225
5	93.158	161.563	37.729	20.407	8.943	1.73429	0.405	0.219058	0.095998
6	92.806	162.381	36.636	10.633	10.286	1.749682	0.394759	0.114572	0.110833
7	99.697	170.318	33.051	15.737	9.618	1.708356	0.331514	0.157848	0.096472
8	100.493	171.012	36.744	12.571	13.153	1.70173	0.365637	0.125093	0.130885
9	104.251	178.335	40.091	12.302	10.827	1.710631	0.384562	0.118004	0.103855

10	113.455	189.005	32.65	15.535	11.94	1.665903	0.287779	0.136927	0.10524
11	114.21	201.909	32.33	12.993	14.978	1.767875	0.283075	0.113764	0.131144
12	120.636	217.527	41.608	19.39	9.631	1.803168	0.344905	0.160731	0.079835
13	126.249	217.843	37.742	17.977	14.503	1.725503	0.298949	0.142393	0.114876
14	135.927	213.924	53.24	17.242	16.404	1.573815	0.391681	0.126847	0.120682
15	132.617	221.204	53.011	18.676	14.338	1.667991	0.39973	0.140827	0.108116
16	132.46	219.595	57.052	17.299	15.395	1.657821	0.430711	0.130598	0.116224
17	125.13	215.488	52.736	17.782	14.089	1.722113	0.42145	0.142108	0.112595
18	119.214	204.084	44.732	20.014	15.644	1.711913	0.375224	0.167883	0.131226
19	116.485	191.08	38.452	25.925	17.322	1.640383	0.330103	0.222561	0.148706
20	113.397	184.227	32.798	12.048	11.305	1.62462	0.289232	0.106246	0.099694
Mean						1.709004	0.364612	0.145446	0.112756
Standard Deviation						0.069576	0.04775	0.033613	0.015839

Table A.21: Ring Finger features of subject 2 for right hand after lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	75.484	102.823	28.776	14.335	8.072	1.362183	0.38122	0.189908	0.106937
2	72.438	94.52	27.451	11.183	7.692	1.30484	0.378959	0.15438	0.106187
3	72.529	99.62	29.581	9.287	6.53	1.37352	0.407851	0.128045	0.090033
4	67.993	91.089	25.661	7.102	11.546	1.339682	0.377406	0.104452	0.169812
5	68.577	87.348	22.503	9.455	6.434	1.273722	0.328142	0.137874	0.093822
6	66.038	88.122	23.188	12.365	6.554	1.334414	0.351131	0.187241	0.099246
7	64.382	85.991	24.411	12.923	7.193	1.335637	0.379159	0.200724	0.111724
8	62.464	90.015	18.767	12.29	5.946	1.44107	0.300445	0.196753	0.095191
9	65.965	86.169	23.878	9.128	7.23	1.306284	0.36198	0.138376	0.109604
10	61.664	84.91	23.53	12.409	7.252	1.376978	0.381584	0.201236	0.117605
11	55.847	81.855	23.243	11.417	9.679	1.465701	0.416191	0.204434	0.173313
12	58.006	81.858	21.958	9.094	4.975	1.411199	0.378547	0.156777	0.085767
13	56.208	79.615	30.439	10.315	6.235	1.416435	0.541542	0.183515	0.110927
14	66.892	89.653	22.676	9.545	7.766	1.340265	0.338994	0.142693	0.116098
15	65.698	88.842	22.968	11.465	7.277	1.352279	0.3496	0.174511	0.110764
16	73.702	94.301	25.726	13.679	9.471	1.27949	0.349054	0.185599	0.128504
17	68.004	96.796	23.537	8.148	8.038	1.423387	0.346112	0.119816	0.118199
18	64.517	88.844	22.628	10.383	7.342	1.377063	0.350729	0.160934	0.113799
19	60.653	81.417	27.419	12.101	6.625	1.342341	0.452063	0.199512	0.109228
20	62.608	81.299	25.591	12.044	6.981	1.29854	0.40875	0.192372	0.111503
Mean						1.357751	0.378973	0.167958	0.113913
Standard Deviation						0.053453	0.051268	0.030867	0.022258

Table A.22: Index Finger features of subject 2 for left hand after lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	258.534	282.989	59.684	28.078	16.11	1.094591	0.230856	0.108605	0.062313
2	254.191	286.431	62.585	28.43	18.765	1.126834	0.246212	0.111845	0.073822
3	236.255	258.387	67.141	33.219	19.768	1.093678	0.284189	0.140607	0.083672
4	246.543	260.798	67.274	26.471	16.321	1.05782	0.272869	0.107369	0.066199
5	254.313	279.894	50.778	19.308	15.037	1.100589	0.199667	0.075922	0.059128
6	254.011	269.19	62.738	21.33	20.559	1.059757	0.246989	0.083973	0.080937
7	241.095	272.529	59.219	22.784	16.939	1.13038	0.245625	0.094502	0.070259
8	247.041	273.318	62.495	26.456	16.006	1.106367	0.252974	0.107092	0.064791
9	242.82	267.895	66.784	25.542	19.485	1.103266	0.275035	0.105189	0.080245
10	228.816	255.017	72.217	27.885	19.551	1.114507	0.315612	0.121866	0.085444
11	244.692	259.63	61.753	19.884	18.308	1.061048	0.25237	0.081261	0.074821
12	246.049	281.229	62.553	19.942	14.96	1.14298	0.25423	0.081049	0.060801
13	253.167	273.33	59.55	23.595	18.352	1.079643	0.23522	0.093199	0.07249
14	234.535	265.985	63.595	31.301	16.578	1.134095	0.271154	0.13346	0.070685
15	255.866	272.583	63.608	25.329	20.526	1.065335	0.248599	0.098993	0.080222
16	253.584	283.4	67.043	19.156	19.441	1.117578	0.264382	0.075541	0.076665
17	252.272	285.152	57.147	26.576	21.021	1.130336	0.226529	0.105347	0.083327
18	254.022	274.383	62.084	23.565	20.908	1.080154	0.244404	0.092768	0.082308
19	237.126	260.666	81.608	26.726	17.095	1.099272	0.344155	0.112708	0.072092
20	240.746	271.474	61.826	30.576	24.816	1.127637	0.25681	0.127005	0.10308
Mean						1.101293	0.258394	0.102915	0.075165
Standard Deviation						0.027018	0.031252	0.018662	0.010365

Table A.23: Middle Finger features of subject 2 for left hand after lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	90.274	92.912	16.846	11.567	8.434	1.029222	0.18661	0.128132	0.093427
2	79.078	93.021	17.771	15.608	19.566	1.17632	0.224727	0.197375	0.247427
3	88.12	91.284	18.582	13.186	15.482	1.035906	0.210872	0.149637	0.175692
4	74.436	82.186	27.759	11.086	12.723	1.104116	0.372924	0.148933	0.170925
5	82.268	93.078	27.034	13.982	15.204	1.1314	0.328609	0.169957	0.184811
6	89.86	99.885	25.41	10.726	10.473	1.111562	0.282773	0.119363	0.116548
7	86.626	98.456	26.703	14.658	12.492	1.136564	0.308256	0.16921	0.144206
8	99.063	90.626	29.612	8.033	10.758	0.914832	0.298921	0.08109	0.108598
9	91.596	84.471	32.137	19.235	14.317	0.922213	0.350856	0.209998	0.156306

10	87.204	90.403	26.57	14.506	12.757	1.036684	0.304688	0.166346	0.146289
11	81.11	91.669	39.134	13.324	10.726	1.130181	0.482481	0.164271	0.13224
12	85.812	91.032	26.722	17.351	11.63	1.060831	0.311402	0.202198	0.135529
13	98.44	90.374	34.145	10.393	8.037	0.918062	0.346861	0.105577	0.081644
14	95.545	97.74	24.213	10.577	10.904	1.022973	0.25342	0.110702	0.114124
15	94.377	96.963	27.478	16.215	10.341	1.027401	0.291151	0.171811	0.109571
16	90.048	96.916	29.96	8.317	9.683	1.07627	0.332711	0.092362	0.107532
17	86.569	88.72	31.372	13.561	12.285	1.024847	0.362393	0.15665	0.14191
18	92.848	97.597	24.899	8.801	7.999	1.051148	0.268169	0.094789	0.086152
19	91.026	99.889	24.3	10.477	10.747	1.097368	0.266957	0.115099	0.118065
20	90.408	94.656	21.624	11.179	10.58	1.046987	0.239182	0.123651	0.117025
Mean						1.052744	0.301198	0.143857	0.134401
Standard Deviation						0.072846	0.066566	0.038072	0.039221

Table A.24: Ring Finger features of subject 2 for left hand after lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	11.351	16.22	3.162	1.558	6.006	1.428949	0.278566	0.137257	0.529116
2	9.388	13.959	3.238	0.565	5.244	1.486898	0.344908	0.060183	0.558585
3	10.205	13.868	2.849	1.336	5.055	1.358942	0.279177	0.130916	0.495345
4	9.998	15.761	4.429	0.893	5.12	1.576415	0.442989	0.089318	0.512102
5	12.7	12.606	4.681	1.22	4.664	0.992598	0.368583	0.096063	0.367244
6	8.787	14.093	5.016	1.721	4.663	1.603847	0.570843	0.195858	0.53067
7	10.883	13.584	4.795	1.734	5.611	1.248185	0.440595	0.159331	0.515575
8	10.705	14.1	6.851	1.414	6.572	1.317142	0.639981	0.132088	0.613919
9	11.183	13.088	5.012	3.5	1.598	1.170348	0.44818	0.312975	0.142895
10	12.342	14.018	3.094	0.225	4.375	1.135796	0.250689	0.01823	0.354481
11	10.352	13.869	5.283	3.975	3.425	1.339741	0.510336	0.383984	0.330854
12	11.145	15.43	5.493	1.901	4.792	1.384477	0.492867	0.17057	0.429969
13	13.025	14.26	1.751	1.76	5.06	1.094818	0.134434	0.135125	0.388484
14	10.412	13.891	3.876	1.898	4.927	1.334134	0.372263	0.18229	0.473204
15	9.867	15.261	5.684	1.392	5.711	1.546671	0.576062	0.141076	0.578798
16	10.563	17.087	5.096	3.786	2.293	1.617628	0.482439	0.358421	0.217078
17	10.61	13.918	6.508	2.356	1.815	1.311781	0.613384	0.222055	0.171065
18	8.229	12.093	3.591	0.397	6.581	1.469559	0.436384	0.048244	0.799733
19	8.4	11.968	4.285	1.131	2.313	1.424762	0.510119	0.134643	0.275357
20	10.96	13.171	5.786	5.59	3.328	1.201734	0.52792	0.510036	0.30365
Mean						1.352221	0.436036	0.180933	0.429406
Standard Deviation						0.17446	0.131293	0.123084	0.163069

A.5 Subject 3 Before Lunch

Table A.25: Index Finger features of subject 3 for right hand before lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	38.703	52.01	18.792	6.85	10.348	1.343823	0.485544	0.176989	0.267369
2	37.605	47.606	15.649	13.291	13.274	1.265949	0.416141	0.353437	0.352985
3	42.455	52.387	15.332	10.118	15.932	1.233942	0.361135	0.238323	0.375268
4	41.162	52.274	17.341	4.801	10.943	1.269958	0.421287	0.116637	0.265852
5	40.98	57.563	12.898	10.452	6.705	1.404661	0.314739	0.255051	0.163616
6	35.513	54.099	17.509	4.231	6.469	1.523358	0.493031	0.119139	0.182159
7	39.885	53.768	13.176	4.954	12.067	1.348076	0.33035	0.124207	0.302545
8	48.652	69.796	18.53	10.323	15.988	1.434597	0.380868	0.21218	0.32862
9	46.696	66.37	17.969	12.596	12.227	1.421321	0.384808	0.269745	0.261843
10	44.855	68.083	19.964	17.127	15.751	1.517846	0.445079	0.38183	0.351154
11	43.974	61.735	25.118	14.573	14.675	1.403898	0.571201	0.3314	0.33372
12	46.046	52.05	15.082	6.146	14.636	1.130391	0.327542	0.133475	0.317856
13	48.014	62.704	15.78	6.518	16.482	1.305952	0.328654	0.135752	0.343275
14	46.588	54.687	9.225	7.13	9.029	1.173843	0.198012	0.153044	0.193805
15	44.374	55.784	32.798	11.839	16.116	1.257133	0.739127	0.2668	0.363186
16	45.269	59.317	17.533	14.271	16.608	1.310323	0.387307	0.315249	0.366874
17	42.363	58.985	23.249	15.583	10.434	1.392371	0.548804	0.367845	0.2463
18	55.39	61.503	25.934	12.559	11.958	1.110363	0.468207	0.226738	0.215887
19	46.131	61.153	20.142	16.989	10.85	1.325638	0.436626	0.368277	0.2352
20	49.556	56.331	17.443	11.226	11.146	1.136714	0.351986	0.226532	0.224917
Mean						1.315508	0.419522	0.238633	0.284621
Standard Deviation						0.120581	0.115025	0.091682	0.067366

Table A.26: Middle Finger features of subject 3 for right hand before lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**D**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	64.243	74.085	16.501	17.34	13.737	1.1532	0.256853	0.269913	0.213829
2	56.267	77.804	19.952	16.503	18.615	1.382764	0.354595	0.293298	0.330833
3	66.567	79.239	16.917	8.372	15.176	1.190365	0.254135	0.125768	0.227981
4	57.769	82.193	14.429	12.024	12.042	1.422787	0.249771	0.208139	0.208451
5	57.145	76.092	14.449	12.905	14.456	1.33156	0.252848	0.225829	0.252971
6	62.097	82.27	11.641	11.523	23.594	1.324863	0.187465	0.185565	0.379954
7	71.948	80.278	14.458	12.109	19.025	1.115778	0.200951	0.168302	0.264427
8	68.212	87.336	13.955	16.156	21.232	1.280361	0.204583	0.23685	0.311265
9	62.506	78.534	10.136	9.318	16.643	1.256423	0.16216	0.149074	0.266262
10	67.403	87.004	19.328	17.284	14.895	1.290803	0.286753	0.256428	0.220984

11	66.054	85.756	11.068	13.327	13.184	1.298271	0.16756	0.201759	0.199594
12	61.36	79.585	9.53	15.203	11.303	1.297018	0.155313	0.247767	0.184208
13	50.198	59.404	10.438	12.202	16.892	1.183394	0.207937	0.243077	0.336507
14	54.701	70.537	7.816	11.073	14.246	1.289501	0.142886	0.202428	0.260434
15	54.955	55.192	15.549	18.957	25.084	1.004313	0.282941	0.344955	0.456446
16	51.754	68.101	10.841	16.892	22.186	1.31586	0.209472	0.32639	0.428682
17	47.028	56.893	17.349	17.66	13.997	1.209769	0.368908	0.375521	0.297631
18	60.11	69.325	10.484	23.644	17.392	1.153302	0.174414	0.393346	0.289336
19	57.116	58.82	13.147	23.474	13.005	1.029834	0.230181	0.410988	0.227695
20	57.257	62.238	10.464	17.79	14.986	1.086994	0.182755	0.310704	0.261732
Mean						1.230858	0.226624	0.258805	0.280961
Standard Deviation						0.114071	0.06242	0.081149	0.0748

Table A.27: Ring Finger features of subject 3 for right hand before lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	84.572	100.139	29	15.366	14.765	1.184068	0.342903	0.181691	0.174585
2	76.353	94.289	17.694	8.913	8.684	1.234909	0.231739	0.116734	0.113735
3	81.654	97.467	14.263	11.415	9.01	1.193659	0.174676	0.139797	0.110344
4	70.376	84.289	16.674	16.281	18.349	1.197695	0.236927	0.231343	0.260728
5	68.94	90.384	17.473	12.24	13.154	1.311053	0.253452	0.177546	0.190804
6	79.87	95.407	20.721	10.357	13.097	1.194529	0.259434	0.129673	0.163979
7	83.209	98.409	20.368	10.193	13.811	1.182673	0.244781	0.122499	0.16598
8	79.399	94.747	19.65	9.314	15.605	1.193302	0.247484	0.117306	0.196539
9	74.283	94.923	15.784	8.393	15.019	1.277856	0.212485	0.112987	0.202186
10	77.813	88.527	23.375	12.846	11.664	1.137689	0.3004	0.165088	0.149898
11	81.486	91.646	18.584	15.794	23.153	1.124684	0.228064	0.193825	0.284135
12	82.081	93.696	22.691	21.196	21.482	1.141507	0.276446	0.258233	0.261717
13	86.984	102.869	18.207	18.5	15.703	1.18262	0.209314	0.212683	0.180527
14	79.589	101.098	17.832	11.167	20.935	1.270251	0.224051	0.140308	0.263039
15	83.958	95.113	17.598	17.589	23.134	1.132864	0.209605	0.209498	0.275543
16	89.952	108.101	23.693	21.684	19.575	1.201763	0.263396	0.241062	0.217616
17	91.353	103.972	24.569	18.052	16.089	1.138134	0.268946	0.197607	0.176119
18	84.774	90.037	25.752	18.203	14.578	1.062083	0.303772	0.214724	0.171963
19	87.094	104.856	26.913	27.223	16.855	1.203941	0.309011	0.31257	0.193527
20	93.286	101.958	23.308	21.204	17.189	1.092961	0.249855	0.227301	0.184261
Mean						1.182912	0.252337	0.185124	0.196861
Standard Deviation						0.061342	0.040285	0.054822	0.050046

Table A.28: Index Finger features of subject 3 for Left hand before lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	56.523	58.024	12.246	5.699	13.04	1.026556	0.216655	0.100826	0.230703
2	49.477	57.61	7.902	14.872	14.269	1.164379	0.159711	0.300584	0.288397
3	48.701	62.864	8.471	13.454	11.534	1.290815	0.173939	0.276257	0.236833
4	56.575	71.72	8.382	13.912	16.509	1.267698	0.148157	0.245904	0.291807
5	63.131	67.056	15.354	27.837	17.429	1.062172	0.243209	0.44094	0.276077
6	59.756	72.877	5.314	10.806	12.073	1.219576	0.088928	0.180835	0.202038
7	59.754	58.629	6.612	8.993	15.918	0.981173	0.110654	0.1505	0.266392
8	63.601	67.48	9.696	9.041	20.473	1.06099	0.15245	0.142152	0.321897
9	61.159	65.515	12.944	20.786	18.244	1.071224	0.211645	0.339868	0.298304
10	63.793	66.099	8.108	19.035	16.026	1.036148	0.127099	0.298387	0.251219
11	66.089	76.026	7.666	12.902	17.629	1.150358	0.115995	0.195222	0.266746
12	52.329	78.599	8.544	7.87	17.848	1.502016	0.163275	0.150395	0.341073
13	68.637	73.413	10.981	17.681	25.097	1.069583	0.159987	0.257602	0.365648
14	83.036	74.962	7.958	20.106	24.626	0.902765	0.095838	0.242136	0.29657
15	66.105	78.393	3.318	15.53	19.536	1.185886	0.050193	0.234929	0.29553
16	68.402	75.697	4.599	11.136	14.346	1.106649	0.067235	0.162802	0.209731
17	66.815	82.644	11.798	19.38	19.967	1.236908	0.176577	0.290055	0.29884
18	68.295	80.044	13.767	20.9	28.721	1.172033	0.201581	0.306025	0.420543
19	62.797	78.573	8.187	8.856	15.074	1.251222	0.130372	0.141026	0.240043
20	56.708	70.571	11.119	18.446	19.295	1.244463	0.196075	0.32528	0.340252
Mean						1.150131	0.149479	0.239086	0.286932
Standard Deviation						0.133605	0.051533	0.085681	0.05369

Table A.29: Middle Finger features of subject 3 for Left hand before lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	35.901	27.988	15.219	4.02	6.938	0.779588	0.423916	0.111975	0.193254
2	23.685	29.78	11.057	7.233	13.41	1.257336	0.466836	0.305383	0.566181
3	21.592	32.942	10.749	4.786	14.527	1.525658	0.497823	0.221656	0.672795
4	21.922	26.111	6.045	5.279	13.136	1.191087	0.27575	0.240808	0.599215
5	28.647	26.187	8.334	9.62	17.43	0.914127	0.290921	0.335812	0.608441
6	27.717	36.877	23.109	5.74	6.942	1.330483	0.833748	0.207093	0.25046
7	26.653	35.905	5.695	10.697	15.813	1.347128	0.213672	0.401343	0.593292
8	35.656	30.11	7.943	5.982	7.184	0.844458	0.222768	0.16777	0.201481
9	37.813	33.3	10.667	7.473	7.426	0.88065	0.282099	0.19763	0.196387
10	26.615	30.11	12.601	8.23	11.323	1.131317	0.473455	0.309224	0.425437
11	31.525	34.047	13.714	9.757	11.328	1.08	0.43502	0.3095	0.359334

12	26.959	34.421	11.605	6.147	12.62	1.276791	0.430468	0.228013	0.468118
13	30.245	31.73	19.74	12.668	10.223	1.049099	0.65267	0.418846	0.338006
14	28.605	28.566	11.798	7.332	12.884	0.998637	0.412445	0.256319	0.450411
15	22.208	34.09	4.158	11.315	13.724	1.535032	0.18723	0.509501	0.617976
16	30.045	37.487	15.734	9.159	5.93	1.247695	0.523681	0.304843	0.197371
17	32.074	26.321	9.353	5.673	11.948	0.820634	0.291607	0.176872	0.372514
18	31.125	36.087	12.983	10.015	6.421	1.159422	0.417124	0.321767	0.206297
19	30.371	32.255	13.496	6.293	9.009	1.062033	0.444371	0.207204	0.296632
20	27.316	28.213	18.678	3.125	9.127	1.032838	0.683775	0.114402	0.334127
Mean						1.123201	0.422969	0.267298	0.397386
Standard Deviation						0.219136	0.16642	0.10151	0.166

Table A.30: Ring Finger features of subject 3 for Left hand before lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	29.983	35.003	16.429	9.266	10.141	1.167428	0.547944	0.309042	0.338225
2	30.056	39.042	9.421	11.118	11.974	1.298975	0.313448	0.36991	0.39839
3	35.898	37.072	11.813	15.634	14.749	1.032704	0.329071	0.435512	0.410859
4	30.99	38.053	12.969	6.51	11.129	1.227912	0.41849	0.210068	0.359116
5	35.943	42.982	10.209	6.367	8.796	1.195838	0.284033	0.177142	0.244721
6	30.413	43.365	12.113	12.478	5.655	1.425871	0.398284	0.410285	0.18594
7	30.496	40.16	19.018	13.199	11.175	1.316894	0.623623	0.432811	0.366442
8	32.191	39.923	13.748	6.266	10.203	1.240191	0.427076	0.194651	0.316952
9	33.614	41.19	14.608	10.585	14.788	1.225382	0.434581	0.314899	0.439936
10	32.375	44.012	7.556	6.479	8.603	1.359444	0.23339	0.200124	0.26573
11	36.808	41.557	7.924	10.87	10.183	1.129021	0.215279	0.295316	0.276652
12	34.738	35.89	14.188	18.964	10.431	1.033163	0.408429	0.545915	0.300276
13	34.244	40.992	10.895	12.019	12.011	1.197056	0.318158	0.350981	0.350748
14	33.381	40.451	6.844	9.04	12.155	1.211797	0.205027	0.270813	0.364129
15	27.382	35.929	11.04	7.724	10.131	1.312139	0.403185	0.282083	0.369988
16	34.74	36.958	9.026	6.124	15.598	1.063846	0.259816	0.176281	0.448993
17	29.082	46.64	13.009	4.637	12.372	1.603741	0.447321	0.159446	0.425418
18	32.601	46.781	12.357	9.143	10.152	1.434956	0.379037	0.280452	0.311401
19	34.632	39.228	17.168	9.188	15.627	1.13271	0.495726	0.265304	0.45123
20	43.269	35.158	11.962	8.414	9.091	0.812545	0.276457	0.194458	0.210104
Mean						1.221081	0.370919	0.293774	0.341762
Standard Deviation						0.171696	0.111604	0.104854	0.0777

A.6 Subject 3 After Lunch

Table A.31: Index Finger features of subject 3 for Right hand after lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	75.925	102.186	32.643	17.449	19.203	1.345881	0.429937	0.229819	0.252921
2	66.679	89.059	19.226	12.73	13.348	1.335638	0.288337	0.190915	0.200183
3	68.07	90.15	28.427	15.479	18.801	1.324372	0.417614	0.227398	0.276201
4	69.906	90.262	32	19.33	10.927	1.291191	0.457758	0.276514	0.15631
5	68.33	91.478	22.005	20.681	11.305	1.338768	0.32204	0.302664	0.165447
6	82.616	98.663	28.987	14.258	11.485	1.194236	0.350864	0.172582	0.139017
7	74.072	97.617	29.182	12.424	18.2	1.317866	0.393968	0.167729	0.245707
8	74.083	93.894	32.792	12.631	11.995	1.267416	0.442639	0.170498	0.161913
9	81.877	93.222	31.513	8.665	14.58	1.138562	0.384882	0.105829	0.178072
10	82.667	108.114	23.967	6.722	14.507	1.307825	0.289922	0.081314	0.175487
11	86.211	101.46	26.113	11.366	17.477	1.17688	0.302896	0.131839	0.202724
12	89.095	106.134	31.445	7.66	16.502	1.191245	0.352938	0.085976	0.185218
13	79.687	96.204	28.46	9.513	17.834	1.207273	0.357147	0.11938	0.223801
14	90.076	108.359	26.663	21.503	17.516	1.202973	0.296006	0.238721	0.194458
15	92.114	111.127	37.896	13.185	12.592	1.206407	0.411403	0.143138	0.1367
16	101.826	122.866	32.985	6.19	15.456	1.206627	0.323935	0.06079	0.151788
17	91.812	118.82	36.942	11.21	14.728	1.294166	0.402366	0.122097	0.160415
18	102.251	130.596	36.434	10.701	11.876	1.27721	0.356319	0.104654	0.116146
19	103.391	124.239	37.012	13.24	16.713	1.201642	0.357981	0.128058	0.161648
20	102.085	126.632	40.04	17.404	18.144	1.240456	0.392222	0.170485	0.177734
Mean						1.253332	0.366559	0.16152	0.183094
Standard Deviation						0.063632	0.051955	0.066327	0.041074

Table A.32: Middle Finger features of subject 3 for Right hand after lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	68.514	86.511	25.026	8.641	17.071	1.262676	0.365268	0.12612	0.249161
2	61.759	85.505	18.237	5.472	10.5	1.384495	0.295293	0.088602	0.170016
3	69.541	90.882	16.176	3.847	12.744	1.306884	0.232611	0.05532	0.183259
4	73.987	84.584	28.761	13.077	13.168	1.143228	0.38873	0.176747	0.177977
5	72.393	93.506	17.379	8.549	17.907	1.291644	0.240065	0.118092	0.247358
6	60.043	96.4	21.808	11.994	16.543	1.605516	0.363206	0.199757	0.275519
7	67.027	83.613	36.79	7.033	17.258	1.247453	0.548883	0.104928	0.257478
8	63.457	79.013	23.322	8.37	13.928	1.245142	0.367524	0.1319	0.219487
9	69.906	86.678	23.816	12.684	18.951	1.239922	0.340686	0.181444	0.271093
10	66.512	84.764	22.129	6.889	15.746	1.274417	0.332707	0.103575	0.236739

11	63.298	86.411	21.249	8.18	11.409	1.365146	0.335698	0.12923	0.180243
12	65.975	87.154	24.368	11.747	12.195	1.321016	0.369352	0.178052	0.184843
13	59.314	81.851	21.09	4.782	16.882	1.379961	0.355565	0.080622	0.284621
14	64.339	85.482	22.603	8.518	8.849	1.328619	0.351311	0.132392	0.137537
15	72.428	84.127	15.779	11.068	15.774	1.161526	0.217858	0.152814	0.217789
16	64.331	86.312	21.62	11.739	22.342	1.341686	0.336074	0.182478	0.347298
17	62.933	85.052	19.549	6.613	20.067	1.351469	0.310632	0.10508	0.318863
18	76.336	94.99	20.777	4.05	8.019	1.244367	0.272178	0.053055	0.105049
19	76.875	85.222	21.316	5.494	23.309	1.108579	0.277281	0.071467	0.303207
20	75.549	91.963	20.571	6.48	14.432	1.217263	0.272287	0.085772	0.191028
Mean						1.29105	0.328661	0.122872	0.227928
Standard Deviation						0.10688	0.072223	0.044374	0.062444

Table A.33: Ring Finger features of subject 3 for Right hand after lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	70.741	103.038	33.352	5.91	10.551	1.456553	0.471466	0.083544	0.14915
2	74.331	112.619	41.833	9.708	13.216	1.515101	0.562793	0.130605	0.177799
3	76.279	104.658	45.849	20.105	11.66	1.372042	0.60107	0.263572	0.15286
4	77.173	98.247	31.953	9.77	12.324	1.273075	0.414044	0.126599	0.159693
5	76.379	106.893	48.675	11.943	16.166	1.399508	0.637282	0.156365	0.211655
6	79.12	106.018	36.993	8.961	14.431	1.339965	0.467556	0.113258	0.182394
7	82.965	111.492	48.434	6.363	10.777	1.343844	0.583788	0.076695	0.129898
8	61.484	110.66	43.69	7.71	13.145	1.799818	0.710591	0.125398	0.213795
9	66.692	99.028	40.745	8.791	14.86	1.484856	0.610943	0.131815	0.222815
10	85.997	101.531	39.668	7.051	17.433	1.180634	0.461272	0.081991	0.202716
11	78.814	106.473	42.287	9.997	15.451	1.35094	0.536542	0.126843	0.196044
12	76.26	102.287	40.437	9.674	8.569	1.341293	0.530252	0.126855	0.112366
13	79.413	91.543	38.571	8.274	17.308	1.152746	0.485701	0.104189	0.217949
14	74.56	99.777	32.953	17.112	13.046	1.338211	0.441966	0.229506	0.174973
15	69.858	105.965	40.104	16.164	13.669	1.516863	0.574079	0.231384	0.195668
16	69.925	103.849	33.655	9.9	15.387	1.485148	0.481301	0.14158	0.22005
17	77.233	99.294	40.918	8.785	10.342	1.285642	0.529799	0.113747	0.133906
18	73.537	109.01	37.792	5.013	10.884	1.482383	0.513918	0.06817	0.148007
19	87.415	112.026	42.542	7.986	15.149	1.281542	0.486667	0.091357	0.1733
20	86.459	107.309	32.819	6.711	10.157	1.241155	0.37959	0.077621	0.117478
Mean						1.382066	0.524031	0.130055	0.174626
Standard Deviation						0.145037	0.080559	0.054038	0.035382

Table A.34: Index Finger features of subject 3 for Left hand after lunch

Index Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	70.856	88.497	25.746	9.443	17.625	1.24897	0.363357	0.13327	0.248744
2	64.823	85.16	26.694	9.999	13.768	1.313731	0.411798	0.154251	0.212394
3	70.366	87.016	31.004	11.984	7.806	1.23662	0.440611	0.17031	0.110934
4	76.258	86.304	27.856	10.957	21.082	1.131737	0.365286	0.143683	0.276456
5	62.001	98.212	28.685	5.416	17.896	1.584039	0.462654	0.087353	0.288641
6	70.918	92.156	29.536	3.979	9.309	1.299473	0.416481	0.056107	0.131264
7	62.996	93.338	25.147	6.277	15.382	1.48165	0.399184	0.099641	0.244174
8	77.496	94.138	22.568	6.319	9.321	1.214747	0.291215	0.08154	0.120277
9	72.953	85.403	24.221	10.394	25.04	1.170658	0.332008	0.142475	0.343235
10	74.265	98.231	27.188	10.651	14.976	1.322709	0.366094	0.143419	0.201656
11	68.393	86.266	23.425	11.898	11.759	1.261328	0.342506	0.173965	0.171933
12	78.346	89.893	27.549	4.242	19.627	1.147385	0.351633	0.054144	0.250517
13	71.432	86.965	28.495	16.032	12.447	1.217452	0.398911	0.224437	0.17425
14	78.868	90.421	27.686	13.983	14.977	1.146485	0.351042	0.177296	0.1899
15	75.918	91.962	34.461	15.278	13.958	1.211333	0.453924	0.201243	0.183856
16	66.217	97.963	31.551	8.765	8.568	1.479424	0.476479	0.132368	0.129393
17	70.904	89.006	31.712	12.666	17.494	1.255303	0.447253	0.178636	0.246728
18	60.453	85.161	24.856	7.972	8.228	1.408714	0.411162	0.131871	0.136106
19	67.148	92.792	29.078	9.354	9.847	1.381903	0.433043	0.139304	0.146646
20	72.971	82.97	29.32	6.463	11.446	1.137027	0.401803	0.088569	0.156857
Mean						1.282534	0.395822	0.135694	0.198198
Standard Deviation						0.127634	0.049228	0.046307	0.064062

Table A.35: Middle Finger features of subject 3 for Left hand after lunch

Middle Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	43.791	58.821	13.219	13.512	11.021	1.343221	0.301866	0.308557	0.251673
2	58.343	59.918	17.412	13.798	14.411	1.026996	0.298442	0.236498	0.247005
3	55.058	58.18	17.922	7.863	11.328	1.056704	0.325511	0.142813	0.205747
4	42.771	54.449	17.155	3.83	9.737	1.273035	0.40109	0.089547	0.227654
5	50.666	64.735	17.326	5.998	6.381	1.277681	0.341965	0.118383	0.125942
6	48.163	68.14	15.336	9.765	11.132	1.414779	0.318419	0.202749	0.231132
7	52.626	74.193	15.55	8.13	10.529	1.409816	0.295481	0.154486	0.200072
8	49.968	66.183	16.694	11.409	14.263	1.324508	0.334094	0.228326	0.285443
9	53.731	69.087	14.346	8.55	12.617	1.285794	0.266997	0.159126	0.234818
10	58.6	71.333	16.549	10.795	13.065	1.217287	0.282406	0.184215	0.222952
11	60.195	72.342	24.205	7.147	9.265	1.201794	0.40211	0.118731	0.153916

12	56.356	65.28	17.428	3.658	21.352	1.15835	0.309248	0.064909	0.378877
13	45.445	68.063	18.152	10.331	16.401	1.497701	0.399428	0.22733	0.360898
14	62.277	63.75	15.984	12.39	11.421	1.023652	0.25666	0.19895	0.18339
15	59.708	61.021	24.338	12.724	14.478	1.02199	0.407617	0.213104	0.24248
16	56.802	67.474	19.626	12.523	10.298	1.187881	0.345516	0.220468	0.181296
17	58.616	67.018	15.642	4.553	15.314	1.14334	0.266855	0.077675	0.26126
18	59.797	79.975	18.537	7.213	14.92	1.337442	0.309999	0.120625	0.249511
19	50.291	59.563	18.601	9.076	16.15	1.184367	0.369867	0.18047	0.321131
20	67.574	73.969	24.577	6.04	10.419	1.094637	0.363705	0.089383	0.154187
Mean						1.224049	0.329864	0.166817	0.235969
Standard Deviation						0.139706	0.048007	0.064114	0.065176

Table A.36: Ring Finger features of subject 3 for Left hand after lunch

Ring Finger									
Sr. No.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	22.908	21.347	7.958	5.366	4.535	0.931858	0.34739	0.234241	0.197966
2	24.464	23.1	7.196	5.624	6.257	0.944245	0.294147	0.229889	0.255764
3	23.076	22.483	8.927	4.496	5.334	0.974302	0.386852	0.194834	0.231149
4	19.15	23.827	7.6	7.123	7.741	1.24423	0.396867	0.371958	0.40423
5	16.951	22.199	9.924	6.782	6.687	1.309598	0.585452	0.400094	0.39449
6	21.289	23.132	7.017	4.043	10.708	1.086571	0.329607	0.18991	0.502983
7	23.291	22.632	7.519	6.211	6.193	0.971706	0.322829	0.26667	0.265897
8	24.706	22.807	7.527	6.157	6.509	0.923136	0.304663	0.249211	0.263458
9	19.951	27.623	8.097	5.074	5.038	1.384542	0.405844	0.254323	0.252519
10	22.589	27.694	5.814	7.284	9.336	1.225995	0.257382	0.322458	0.413299
11	21.422	26.142	8.21	7.681	6.474	1.220334	0.383251	0.358557	0.302213
12	23.565	24.027	9.919	4.518	7.539	1.019605	0.420921	0.191725	0.319924
13	24.408	24.097	8.125	4.935	7.755	0.987258	0.332883	0.202188	0.317724
14	25.488	24.162	6.261	3.647	5.533	0.947976	0.245645	0.143087	0.217083
15	19.374	24.855	8.171	3.998	7.143	1.282905	0.421751	0.206359	0.36869
16	22.402	22.6	7.692	6.025	4.191	1.008838	0.343362	0.268949	0.187082
17	22.759	22.566	6.471	6.654	9.107	0.99152	0.284327	0.292368	0.400149
18	24.652	25.978	5.568	4.829	4.608	1.053789	0.225864	0.195887	0.186922
19	19.394	23.196	6.329	2.881	5.003	1.19604	0.326338	0.148551	0.257966
20	21.452	22.394	8.639	8.076	6.675	1.043912	0.402713	0.376468	0.31116
Mean						1.087418	0.350904	0.254886	0.302533
Standard Deviation						0.144998	0.080322	0.07676	0.087459

A.7 Subject 4 Before Lunch

Table A.37: Index Finger features of subject 4 for Right hand before lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	88.623	86.996	22.373	12.119	12.756	0.981641	0.252451	0.136748	0.143936
2	91.132	96.452	22.519	10.979	17.312	1.058377	0.247103	0.120474	0.189966
3	84.258	87.182	21.629	13.887	13.002	1.034703	0.2567	0.164815	0.154312
4	93.947	96.07	24.791	11.101	18.159	1.022598	0.263883	0.118162	0.19329
5	78.929	89.286	30.254	8.51	12.647	1.131219	0.383307	0.107818	0.160233
6	91.253	89.383	25.136	17.715	10.108	0.979508	0.275454	0.194131	0.110769
7	88.214	90.171	19.455	14.913	10.861	1.022185	0.220543	0.169055	0.123121
8	87.751	100.577	23.301	8.989	9.318	1.146164	0.265535	0.102438	0.106187
9	87.906	99.144	23.071	6.276	10.468	1.127841	0.262451	0.071394	0.119082
10	86.018	88.765	18.215	6.997	11.494	1.031935	0.211758	0.081343	0.133623
11	78.715	91.085	28.335	19.21	17.404	1.157149	0.35997	0.244045	0.221101
12	77.849	96.173	23.443	7.556	13.824	1.235379	0.301134	0.09706	0.177575
13	86.285	90.664	23.051	6.881	12.892	1.05075	0.26715	0.079747	0.149412
14	87.593	87.805	21.897	10.533	12.24	1.00242	0.249986	0.120249	0.139737
15	85.634	86.237	16.22	5.501	11.891	1.007042	0.189411	0.064239	0.138858
16	88.459	89.855	21.572	12.119	20.446	1.015781	0.243864	0.137001	0.231135
17	75.609	82.716	21.668	8.584	16.347	1.093997	0.28658	0.113531	0.216204
18	88.273	89.476	20.047	9.294	12.12	1.013628	0.227102	0.105287	0.137301
19	92.436	88.057	24	7.556	10.481	0.952627	0.259639	0.081743	0.113387
20	78.807	95.2	20.729	8.332	11.214	1.208015	0.263035	0.105727	0.142297
Mean						**1.063648**	**0.264353**	**0.12075**	**0.155076**
Standard Deviation						**0.077075**	**0.043654**	**0.043217**	**0.036806**

Table A.38: Middle Finger features of subject 4 for Right hand before lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	40.062	39.098	11.805	10.441	14.949	0.975937	0.294668	0.260621	0.373147
2	45.35	44.182	12.929	9.96	13.503	0.974245	0.285094	0.219625	0.297751
3	41.042	45.265	17.336	10.998	10.268	1.102895	0.422397	0.267969	0.250183
4	43.64	41.946	14.5	8.161	9.249	0.961182	0.332264	0.187007	0.211939
5	37.707	45.358	18.59	10.697	10.444	1.202907	0.493012	0.283687	0.276978
6	42.478	45.115	14.823	10.826	11.788	1.062079	0.348957	0.254861	0.277508
7	44.747	42.53	18.299	8.837	7.881	0.950455	0.408944	0.197488	0.176124
8	40.429	42.93	15.804	11.16	12.505	1.061862	0.390908	0.276039	0.309308
9	46.371	47.087	19.29	10.309	11.055	1.015441	0.415993	0.222316	0.238403

10	45.431	42.404	16.018	9.138	9.519	0.933371	0.352579	0.20114	0.209527
11	42.119	42.563	13.341	10.482	8.418	1.010542	0.316745	0.248866	0.199862
12	42.036	45.045	13.414	8.148	9.375	1.071582	0.319107	0.193834	0.223023
13	45.762	41.589	14.353	13.405	12.172	0.908811	0.313645	0.292929	0.265985
14	43.076	47.763	17.824	9.944	10.861	1.108808	0.41378	0.230848	0.252136
15	46.151	42.561	14.026	12.119	10.994	0.922212	0.303915	0.262595	0.238218
16	33.374	36.243	12.653	11.076	8.425	1.085965	0.379127	0.331875	0.252442
17	38.517	36.282	13.15	13.433	12.048	0.941974	0.341408	0.348755	0.312797
18	30.843	37.033	13.629	13.174	9.306	1.200694	0.441883	0.427131	0.301722
19	28.198	36.215	11.72	9.24	8.36	1.284311	0.415632	0.327683	0.296475
20	28.883	27.779	10.798	5.206	9.945	0.961777	0.373853	0.180244	0.34432
Mean						**1.036852**	**0.368196**	**0.260776**	**0.265392**
Standard Deviation						**0.101717**	**0.054766**	**0.06124**	**0.048841**

Table A.39: Ring Finger features of subject 4 for Right hand before lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	26.254	18.731	10.668	3.385	6.55	0.713453	0.406338	0.128933	0.249486
2	23.972	19.14	8.317	7.683	8.814	0.798432	0.346946	0.320499	0.367679
3	26.431	20.484	9.188	5.059	7.063	0.774999	0.347622	0.191404	0.267224
4	36.186	20.733	11.849	5.091	5.406	0.572956	0.327447	0.14069	0.149395
5	25.719	17.853	8.783	5.71	6.14	0.694156	0.341499	0.222015	0.238734
6	26.539	18.418	8.71	7.002	6.589	0.693998	0.328196	0.263838	0.248276
7	30.413	20.027	10.673	4.187	5.194	0.658501	0.350935	0.137671	0.170782
8	24.446	22.172	10.709	3.657	7.903	0.906979	0.438068	0.149595	0.323284
9	26.764	19.456	8.14	7.672	7.33	0.726947	0.30414	0.286654	0.273875
10	22.537	19.424	9.64	6.067	7.026	0.861872	0.427741	0.269202	0.311754
11	27.563	22.499	8.05	5.335	5.375	0.816275	0.292058	0.193557	0.195008
12	33.274	20.419	11.044	6.314	8.094	0.613662	0.331911	0.189758	0.243253
13	27.777	20.824	6.654	8.892	8.82	0.749685	0.239551	0.320121	0.317529
14	27.81	24.14	10.403	11.078	8.224	0.868033	0.374074	0.398346	0.295721
15	24.322	20.574	10.434	7.716	5.445	0.845901	0.428994	0.317244	0.223871
16	29.03	21.855	8.118	7.128	7.011	0.752842	0.279642	0.245539	0.241509
17	32.52	20.934	9.655	7.589	7.163	0.643727	0.296894	0.233364	0.220264
18	30.567	22.534	10.447	5.648	5.625	0.7372	0.341774	0.184774	0.184022
19	30.795	20.461	10.892	5.205	6.613	0.664426	0.353694	0.169021	0.214743
20	31.592	22.284	10.927	4.337	6.009	0.705368	0.345879	0.137282	0.190206
Mean						**0.739971**	**0.34517**	**0.224975**	**0.246331**
Standard Deviation						**0.08742**	**0.050127**	**0.074143**	**0.055085**

Table A.40: Index Finger features of subject 4 for Left hand before lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	85.209	79.654	18.602	11.017	19.394	0.934807	0.21831	0.129294	0.227605
2	100.619	89.882	22.105	16.629	19.268	0.893291	0.21969	0.165267	0.191495
3	94.323	83.952	19.657	10.284	20.874	0.890048	0.208401	0.10903	0.221303
4	76.583	76.175	15.257	10.957	15.854	0.994672	0.199222	0.143074	0.207017
5	83.108	77.333	14.009	9.976	17.571	0.930512	0.168564	0.120037	0.211424
6	72.069	68.591	15.709	7.756	17.443	0.951741	0.217972	0.107619	0.242032
7	82.033	71.243	9.624	12.991	20.405	0.868468	0.117319	0.158363	0.248741
8	70.357	70.715	10.71	10.248	18.985	1.005088	0.152224	0.145657	0.269838
9	80.362	71.671	16.341	15.993	14.324	0.891852	0.203342	0.199012	0.178243
10	84.408	73.277	17.037	12.227	16.874	0.868129	0.201841	0.144856	0.19991
11	71.438	72.259	14.924	13.697	17.61	1.011492	0.208908	0.191733	0.246507
12	78.12	60.733	11.422	13.397	14.777	0.777432	0.146211	0.171493	0.189158
13	74.784	64.654	14.579	13.153	21.093	0.864543	0.194948	0.17588	0.282052
14	70.675	62.074	14.907	12.643	14.679	0.878302	0.210923	0.178889	0.207697
15	67.689	65.666	13.496	11.377	19.951	0.970113	0.199382	0.168078	0.294745
16	80.971	73.851	20.468	12.54	20.677	0.912067	0.252782	0.15487	0.255363
17	69.973	65.434	16.486	12.581	16.553	0.935132	0.235605	0.179798	0.236563
18	86.662	77.986	16.033	10.426	16.923	0.899887	0.185006	0.120306	0.195276
19	76.652	73.787	15.39	18.819	19.892	0.962623	0.200778	0.245512	0.259511
20	74.704	63.112	13.849	11.609	17.017	0.844828	0.185385	0.1554	0.227792
Mean						**0.914251**	**0.196341**	**0.158208**	**0.229614**
Standard Deviation						**0.057196**	**0.030481**	**0.032582**	**0.031787**

Table A.41: Middle Finger features of subject 4 for Left hand before lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	209.173	210.421	57.894	31.195	48.347	1.005966	0.276776	0.149135	0.231134
2	200.972	214.273	55.787	33.264	42.409	1.066183	0.277586	0.165516	0.211019
3	200.764	197.437	59.301	44.689	42.074	0.983428	0.295377	0.222595	0.209569
4	186.315	193.049	50.904	24.993	31.319	1.036143	0.273215	0.134144	0.168097
5	202.223	202.218	52.242	33.962	39.75	0.999975	0.258339	0.167943	0.196565
6	191.829	198.745	50.908	33.507	44.099	1.036053	0.265382	0.174671	0.229887
7	184.19	191.208	46.727	31.297	47.851	1.038102	0.253689	0.169917	0.259792
8	194.678	195.002	45.108	35.049	43.149	1.001664	0.231706	0.180036	0.221643
9	201.509	187.098	49.216	36.846	38.336	0.928485	0.244237	0.18285	0.190245
10	188.576	183.647	46.465	31.88	47.189	0.973862	0.246399	0.169057	0.250239
11	178.63	186.253	45.006	32.203	37.528	1.042675	0.251951	0.180278	0.210088

12	174.191	171.616	47.243	32.92	43.931	0.985217	0.271214	0.188988	0.2522
13	184.467	181.35	41.17	36.391	41.835	0.983103	0.223184	0.197276	0.226789
14	175.057	177.976	39.653	30.112	41.975	1.016675	0.226515	0.172013	0.239779
15	164.796	161.334	38.844	33.332	42.671	0.978992	0.23571	0.202262	0.258932
16	173.482	165.986	31.525	25.676	39.508	0.956791	0.181719	0.148004	0.227735
17	177.141	171.004	39.061	26.73	41.016	0.965355	0.220508	0.150897	0.231544
18	173.668	164.891	39.898	24.291	40.462	0.949461	0.229737	0.13987	0.232985
19	172.366	164.378	38.26	33.275	37.467	0.953657	0.22197	0.193049	0.217369
20	182.691	170.968	41.767	25.711	34.439	0.935832	0.228621	0.140735	0.18851
Mean						**0.991881**	**0.245692**	**0.171462**	**0.222706**
Standard Deviation						**0.037524**	**0.025999**	**0.022535**	**0.023814**

Table A.42: Ring Finger features of subject 4 for Left hand before lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	18.407	18.585	5.807	5.276	6.33	1.00967	0.315478	0.28663	0.343891
2	16.917	13.502	4.983	4.079	5.344	0.798132	0.294556	0.241118	0.315895
3	15.36	12.815	5.022	5.587	5.288	0.83431	0.326953	0.363737	0.344271
4	15.25	15.368	4.708	6.252	5.941	1.007738	0.308721	0.409967	0.389574
5	18.87	13.121	4.371	5.785	7.961	0.695337	0.231638	0.306571	0.421887
6	19.391	16.113	6.804	4.427	6.734	0.830953	0.350884	0.228302	0.347275
7	19.893	14.475	6.585	6.006	5.159	0.727643	0.331021	0.301915	0.259337
8	17.275	15.768	5.973	6.11	4.13	0.912764	0.34576	0.35369	0.239074
9	17.691	14.438	4.688	4.48	4.264	0.816121	0.264993	0.253236	0.241027
10	18.575	17.787	5.296	5.707	5.975	0.957577	0.285114	0.307241	0.321669
11	18.808	14.035	6.814	1.802	4.949	0.746225	0.362293	0.09581	0.263133
12	22.577	14.288	5.237	3.827	4.82	0.632856	0.231962	0.169509	0.213492
13	16.589	13.426	5.845	4.823	4.247	0.809331	0.352342	0.290735	0.256013
14	13.513	12.652	7.242	3.969	4.553	0.936284	0.535928	0.293717	0.336935
15	15.277	11.188	3.38	4.44	4.574	0.732343	0.221248	0.290633	0.299404
16	15.258	13.214	3.693	4.55	6.598	0.866037	0.242037	0.298204	0.432429
17	15.327	12.657	5.061	3.433	6.964	0.825798	0.330202	0.223984	0.454362
18	18.193	13.007	4.279	4.441	7.857	0.714945	0.2352	0.244105	0.431869
19	15.039	10.781	7.111	4.424	5.363	0.716869	0.472837	0.294168	0.356606
20	12.752	9.948	3.219	4.757	4.255	0.780113	0.252431	0.37304	0.333673
Mean						**0.817552**	**0.31458**	**0.281316**	**0.330091**
Standard Deviation						**0.102646**	**0.0782**	**0.069404**	**0.069171**

A.8 Subject 4 After Lunch

Table A.43: Index Finger features of subject 4 for Right hand after lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	24.265	40.996	11.248	4.678	9.87	1.689512	0.463548	0.192788	0.406759
2	31.69	37.954	11.261	5.984	7.835	1.197665	0.355349	0.188829	0.247239
3	25.686	40.112	9.63	1.8	7.561	1.561629	0.374912	0.070077	0.294363
4	32.584	40.894	9.261	4.942	8.861	1.255033	0.284219	0.15167	0.271943
5	33.464	41.919	11.874	6.66	7.645	1.25266	0.354829	0.19902	0.228454
6	27.396	35.983	13.494	1.55	6.83	1.31344	0.492554	0.056578	0.249306
7	21.739	37.478	12.562	2.198	8.757	1.723998	0.577855	0.101109	0.402824
8	35.899	35.032	10.997	3.953	9.13	0.975849	0.306332	0.110114	0.254325
9	25.07	42.038	8.584	2.016	8.12	1.676825	0.342401	0.080415	0.323893
10	21.759	33.931	7.301	3.437	6.382	1.559401	0.335539	0.157958	0.293304
11	25.988	39.198	9.496	6.893	7.572	1.508312	0.365399	0.265238	0.291365
12	22.312	33.718	12.761	8.419	10.254	1.511205	0.571934	0.377331	0.459573
13	21.81	40.086	8.639	5.437	9.825	1.837964	0.396103	0.249289	0.450481
14	30.399	41.355	9.535	6.128	6.682	1.360407	0.313662	0.201586	0.21981
15	25.487	36.026	11.198	4.997	8.314	1.413505	0.439361	0.196061	0.326206
16	30.014	34.238	14.573	5.863	11.153	1.140734	0.48554	0.195342	0.371593
17	39.052	45.089	10.813	10.539	17.965	1.154589	0.276887	0.269871	0.460028
18	36.63	41.845	10.711	2.374	5.65	1.14237	0.292411	0.06481	0.154245
19	33.257	42.832	12.225	7.185	6.179	1.287909	0.367592	0.216045	0.185795
20	34.325	37.384	11.352	10.74	8.721	1.089119	0.330721	0.312891	0.254071
Mean						**1.382606**	**0.386357**	**0.182851**	**0.307279**
Standard Deviation						**0.234804**	**0.087894**	**0.084362**	**0.088695**

Table A.44: Middle Finger features of subject 4 for Right hand after lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	30.679	28.424	11.58	7.523	9.952	0.926497	0.377457	0.245217	0.324391
2	29.178	26.338	12.864	6.288	9.084	0.902666	0.44088	0.215505	0.31133
3	26.77	28.253	12.177	6.099	12.082	1.055398	0.454875	0.22783	0.451326
4	29.431	28.751	12.529	6.712	8.053	0.976895	0.425708	0.228059	0.273623
5	28.419	24.506	8.486	7.331	5.046	0.86231	0.298603	0.257961	0.177557
6	28.458	24.982	13.893	6.466	5.411	0.877855	0.488193	0.227212	0.19014
7	29.424	27.61	10.983	6.177	5.627	0.93835	0.373267	0.209931	0.191238
8	29.585	21.897	9.379	7.304	5.472	0.740139	0.317019	0.246882	0.184959
9	27.19	20.309	10.619	5.557	7.247	0.746929	0.390548	0.204377	0.266532
10	25.42	18.535	7.549	4.694	4.006	0.72915	0.296971	0.184658	0.157592

11	27.028	21.473	7.054	5.897	6.238	0.794472	0.260989	0.218181	0.230798
12	21.402	21.733	7.451	5.684	4.139	1.015466	0.348145	0.265583	0.193393
13	21.235	16.756	7.704	4.446	6.004	0.789075	0.362797	0.209371	0.282741
14	23.943	21.267	8.547	3.916	4.508	0.888235	0.356973	0.163555	0.18828
15	20.83	16.748	9.989	3.541	5.401	0.804033	0.479549	0.169995	0.259289
16	16.982	18.731	5.286	3.622	4.453	1.102991	0.311271	0.213285	0.262219
17	19.997	17.43	6.972	6.799	5.323	0.871631	0.348652	0.340001	0.26619
18	22.415	15.151	4.864	6.571	6.635	0.675931	0.216998	0.293152	0.296007
19	14.317	11.507	5.769	4.899	4.807	0.80373	0.402948	0.342181	0.335755
20	13.783	12.963	6.425	7.184	4.32	0.940506	0.466154	0.521222	0.31343
Mean						**0.872113**	**0.3709**	**0.249208**	**0.25784**
Standard Deviation						**0.11091**	**0.07254**	**0.07774**	**0.069617**

Table A.45: Ring Finger features of subject 4 for Right hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	98.632	80.292	24.854	22.638	25.273	0.814056	0.251987	0.22952	0.256235
2	105.527	66.89	24.295	22.182	28.159	0.633866	0.230225	0.210202	0.266842
3	100.352	76.945	25.79	26.292	24.2	0.766751	0.256995	0.261998	0.241151
4	92.389	69.516	29.659	17.354	20.624	0.752427	0.321023	0.187836	0.22323
5	77.418	64.321	25.044	16.188	19.996	0.830827	0.323491	0.209099	0.258286
6	92.34	72.786	24.587	22.249	25.076	0.788239	0.266266	0.240947	0.271562
7	90.885	72.178	27.398	23.424	23.526	0.794168	0.301458	0.257732	0.258855
8	87.466	70.477	21.799	21.505	19.216	0.805765	0.249228	0.245867	0.219697
9	82.972	68.81	21.363	24.423	22.538	0.829316	0.257472	0.294352	0.271634
10	93.827	81.486	25.636	19.261	24.714	0.868471	0.273226	0.205282	0.2634
11	91.713	74.657	25.788	18.04	15.223	0.814029	0.281182	0.196701	0.165985
12	85.639	73.215	27.663	24.138	20.643	0.854926	0.323019	0.281858	0.241047
13	88.688	67.288	24.499	23.558	24.354	0.758705	0.276238	0.265628	0.274603
14	89.341	68.814	29.557	26.153	27.413	0.77024	0.330834	0.292732	0.306836
15	79.142	65.246	19.467	23.9	24.456	0.824417	0.245976	0.301989	0.309014
16	86.55	75.882	21.182	27.275	29.625	0.876742	0.244737	0.315136	0.342288
17	89.496	73.276	23.286	29.212	24.862	0.818763	0.26019	0.326406	0.2778
18	81.796	70.85	23.517	26.316	25.452	0.866179	0.287508	0.321727	0.311164
19	88.671	73.124	23.738	26.409	22.111	0.824666	0.267709	0.297831	0.24936
20	96.261	75.292	27.232	23.179	26.069	0.782165	0.282898	0.240793	0.270816
Mean						**0.803736**	**0.276583**	**0.259182**	**0.26399**
Standard Deviation						**0.052697**	**0.028932**	**0.042633**	**0.036947**

Table A.46: Index Finger features of subject 4 for Left hand after lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	80.891	82.306	23.035	11.028	16.791	1.017493	0.284766	0.136332	0.207576
2	79.631	82.345	22.379	14.743	17.226	1.034082	0.281034	0.185141	0.216323
3	70.63	70.058	23.582	15.047	14.364	0.991901	0.333881	0.21304	0.20337
4	65.092	68.891	19.348	16.506	13.827	1.058364	0.297241	0.25358	0.212422
5	61.769	63.881	21.857	15.364	22.503	1.034192	0.353851	0.248733	0.364309
6	64.567	62.869	23.098	14.554	19.891	0.973702	0.357737	0.225409	0.308068
7	67.8	66.837	19.373	14.887	15.407	0.985796	0.285737	0.219572	0.227242
8	71.205	65.118	21.681	11.632	16.26	0.914514	0.304487	0.163359	0.228355
9	79.098	65.77	17.466	12.361	15.51	0.8315	0.220815	0.156274	0.196086
10	75.384	68.925	19.531	10.786	13.184	0.914319	0.259087	0.143081	0.174891
11	69.646	66.483	16.477	11.03	13.84	0.954585	0.236582	0.158372	0.198719
12	76.907	64.995	21.76	9.114	10.694	0.845112	0.282939	0.118507	0.139051
13	69.501	60.119	18.769	9.39	13.329	0.865009	0.270054	0.135106	0.191781
14	57.994	56.889	15.74	10.261	8.936	0.980946	0.271407	0.176932	0.154085
15	56.953	54.481	13.616	7.673	11.87	0.956596	0.239074	0.134725	0.208417
16	49.595	51.99	10.605	11.701	10.114	1.048291	0.213832	0.235931	0.203932
17	47.51	47.856	19.674	10.888	12.173	1.007283	0.414102	0.229173	0.25622
18	40.871	46.898	16.547	12.873	9.461	1.147464	0.404859	0.314967	0.231484
19	43.797	44.064	13.104	10.349	13.985	1.006096	0.299199	0.236295	0.319314
20	46.419	46.317	13.974	8.48	15.428	0.997803	0.301041	0.182684	0.332364
Mean						**0.978252**	**0.295586**	**0.193361**	**0.2287**
Standard Deviation						**0.074592**	**0.053357**	**0.050342**	**0.05778**

Table A.47: Middle Finger features of subject 4 for Left hand after lunch

Middle Finger									
Sr. no.	**a**	**B**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	202.374	152.153	40.98	31.628	45.717	0.751841	0.202496	0.156285	0.225904
2	250.439	197.204	37.431	22.399	36.236	0.787433	0.149462	0.089439	0.14469
3	278.162	220.602	47.304	23.463	36.933	0.79307	0.170059	0.08435	0.132775
4	263.34	217.753	45.646	21.766	37.093	0.826889	0.173335	0.082654	0.140856
5	276.354	225.199	41.666	31.803	38.215	0.814893	0.15077	0.115081	0.138283
6	302.08	243.326	42.598	25.331	35.761	0.805502	0.141016	0.083855	0.118383
7	311.117	240.141	46.113	28.261	38.968	0.771867	0.148218	0.090837	0.125252
8	266.592	202.08	46.767	31.891	37.445	0.758012	0.175425	0.119625	0.140458
9	285.402	222.553	35.02	24.492	35.136	0.779788	0.122704	0.085816	0.123111
10	238.908	191.465	39.865	28.217	32.672	0.801417	0.166863	0.118108	0.136756
11	204.472	163.968	33.895	26.533	37.086	0.801909	0.165768	0.129763	0.181374

12	215.397	164.674	34.969	27.91	31.803	0.764514	0.162347	0.129575	0.147648
13	192.666	140.783	27.141	28.519	37.016	0.73071	0.140871	0.148023	0.192125
14	169.616	122.696	29.607	31.702	30.826	0.723375	0.174553	0.186905	0.18174
15	243.912	190.593	40.823	26.382	37.007	0.781401	0.167368	0.108162	0.151723
16	252.542	198.333	39.029	25.496	38.078	0.785347	0.154545	0.100957	0.150779
17	252.506	196.115	40.42	27.549	36.661	0.776675	0.160075	0.109102	0.145189
18	250.801	206.582	37.878	26.107	34.364	0.823689	0.151028	0.104094	0.137017
19	279.71	217.241	42.628	22.519	43.688	0.776665	0.152401	0.080508	0.15619
20	262.325	199.662	41.599	25.855	37.765	0.761125	0.158578	0.098561	0.143963
Mean						**0.780806**	**0.159394**	**0.111085**	**0.150711**
Standard Deviation						**0.027161**	**0.016263**	**0.027407**	**0.025437**

Table A.48: Ring Finger features of subject 4 for Left hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	190.938	165.058	40.99	35.447	36.714	0.864459	0.214677	0.185647	0.192282
2	196.278	161.74	42.209	34.08	30.795	0.824035	0.215047	0.173631	0.156895
3	176.982	158.41	41.866	32.568	32.072	0.895063	0.236555	0.184019	0.181216
4	218.604	170.311	41.664	39.01	30.832	0.779085	0.190591	0.178451	0.14104
5	182.827	163.84	42	34.187	34.998	0.896148	0.229725	0.186991	0.191427
6	190.586	169.635	41.319	31.513	32.372	0.890071	0.2168	0.165348	0.169855
7	195.597	162.86	41.897	33.065	34.076	0.83263	0.214201	0.169047	0.174215
8	184.848	160.077	44.985	29.424	37.538	0.865993	0.243362	0.159179	0.203075
9	196.716	158.97	43.918	34.082	25.494	0.808119	0.223256	0.173255	0.129598
10	168.417	139.071	38.824	34.245	36.29	0.825754	0.230523	0.203335	0.215477
11	181.087	142.712	32.603	31.447	33.124	0.788085	0.180041	0.173657	0.182918
12	141.671	130.54	35.076	30.335	31.682	0.921431	0.247588	0.214123	0.223631
13	147.981	123.922	30.242	30.669	29.244	0.837418	0.204364	0.20725	0.19762
14	132.056	116.435	28.437	35.325	34.613	0.881709	0.21534	0.2675	0.262108
15	125.737	112.451	35.736	32.441	32.226	0.894335	0.284212	0.258007	0.256297
16	117.484	116.737	27.794	36.22	39.552	0.993642	0.236577	0.308297	0.336659
17	119.525	128.802	27.888	39.782	40.437	1.077616	0.233324	0.332834	0.338314
18	118.323	122.941	31.323	29.653	36.491	1.039029	0.264725	0.250611	0.308402
19	118.036	108.067	27.338	28.241	35.15	0.915543	0.231607	0.239258	0.297791
20	109.274	112.947	32.415	29.314	26.761	1.033613	0.29664	0.268261	0.244898
Mean						**0.893189**	**0.230458**	**0.214935**	**0.220186**
Standard Deviation						**0.082317**	**0.027403**	**0.049439**	**0.060609**

A.9 Subject 5 Before Lunch

Table A.49: Index Finger features of subject 4 for Right hand before lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	26.039	25.934	11.977	9.868	9.95	0.995968	0.459964	0.37897	0.382119
2	20.55	30.257	12.411	10.335	10.435	1.47236	0.603942	0.50292	0.507786
3	24.757	25.983	11.545	10.166	10.155	1.049521	0.466333	0.410631	0.410187
4	25.248	28.965	20.455	11.599	10.84	1.14722	0.810163	0.459403	0.429341
5	24.306	26.021	18.579	8.479	9.011	1.070559	0.764379	0.348844	0.370732
6	26.296	23.702	16.471	11.103	9.928	0.901354	0.626369	0.422232	0.377548
7	23.322	24.365	18.152	9.169	10.627	1.044722	0.778321	0.393148	0.455664
8	23.081	22.806	14.554	13.116	6.747	0.988085	0.630562	0.56826	0.292318
9	18.255	27.274	16.019	13.041	7.786	1.494056	0.877513	0.71438	0.426513
10	25.282	25.806	11.887	9.025	8.936	1.020726	0.470176	0.356973	0.353453
11	28.839	30.017	13.616	11.715	10.288	1.040847	0.472138	0.406221	0.356739
12	25.385	33.677	10.774	9.802	10.689	1.32665	0.424424	0.386134	0.421075
13	21.71	29.287	12.086	11.675	9.967	1.34901	0.556702	0.537771	0.459097
14	22.565	30.564	9.626	15.842	5.68	1.354487	0.42659	0.702061	0.251717
15	18.223	24.04	9.763	11.229	7.862	1.319212	0.535752	0.616199	0.431433
16	16.818	24.514	13.98	11.452	6.522	1.457605	0.831252	0.680937	0.387799
17	28.933	24.272	13.131	12.162	6.18	0.838904	0.453842	0.42035	0.213597
18	24.482	23.469	14.697	9.749	10.863	0.958623	0.600319	0.398211	0.443714
19	29.959	28.147	15.561	12.215	10.36	0.939517	0.51941	0.407724	0.345806
20	24.343	28.268	16.253	12.924	5.142	1.161237	0.667666	0.530912	0.211231
Mean						**1.146533**	**0.598791**	**0.482114**	**0.376393**
Standard Deviation						**0.200456**	**0.142322**	**0.115263**	**0.079007**

Table A.50: Middle Finger features of subject 4 for Right hand before lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	57.684	56.347	16.263	17.692	10.087	0.976822	0.281933	0.306705	0.174867
2	46.011	53.537	18.727	14.575	13.618	1.16357	0.407011	0.316772	0.295973
3	51.969	46.395	19.978	14.241	11.318	0.892744	0.384421	0.274029	0.217784
4	41.761	57.496	23.67	13.267	9.388	1.376787	0.566797	0.317689	0.224803
5	52.81	52.95	21.589	16.801	9.088	1.002651	0.408805	0.318141	0.172089
6	59.998	56.534	20.711	14.51	10.245	0.942265	0.345195	0.241841	0.170756
7	56.22	60.83	24.378	21.641	11.273	1.081999	0.433618	0.384934	0.200516
8	62.593	59.221	22.233	20.371	15.052	0.946128	0.355199	0.325452	0.240474
9	58.84	62.751	23.172	19.386	11.192	1.066468	0.393814	0.32947	0.190211

10	59.485	66.253	20.719	15.237	20.954	1.113777	0.348306	0.256149	0.352257
11	66.537	63.813	29.378	23.251	14.8	0.95906	0.441529	0.349445	0.222433
12	56.951	72.631	32.089	21.648	12.281	1.275324	0.563449	0.380116	0.215642
13	63.893	63.976	27.112	22.368	12.845	1.001299	0.424334	0.350085	0.201039
14	71.173	73.627	27.166	19.977	21.779	1.034479	0.38169	0.280682	0.306001
15	70.909	71.473	27.851	15.441	12.232	1.007954	0.392771	0.217758	0.172503
16	74.66	78.643	34.737	21.971	16.862	1.053349	0.465269	0.294281	0.225851
17	83.396	88.63	40.336	22.809	14.152	1.062761	0.483668	0.273502	0.169696
18	80.171	84.986	29.706	20.643	14.748	1.060059	0.370533	0.257487	0.183957
19	71.289	82.289	32.478	21.361	13.441	1.154302	0.455582	0.299639	0.188542
20	80.089	81.71	36.444	23.122	16.675	1.02024	0.455044	0.288704	0.208206
Mean						**1.059602**	**0.417948**	**0.303144**	**0.21668**
Standard Deviation						**0.112559**	**0.067899**	**0.042813**	**0.048241**

Table A.51: Ring Finger features of subject 4 for Right hand before lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	87.351	91.09	39.968	27.98	13.158	1.042804	0.457556	0.320317	0.150634
2	84.38	88.407	33.288	27.021	14.764	1.047725	0.394501	0.32023	0.17497
3	89.9	97.521	32.354	24.123	17.837	1.084772	0.359889	0.268331	0.198409
4	83.24	96.646	31.589	23.773	17.72	1.161052	0.379493	0.285596	0.212878
5	77.646	95.629	35.735	23.751	18.508	1.231602	0.46023	0.305888	0.238364
6	77.06	90.877	39.689	28.446	24.272	1.179302	0.51504	0.369141	0.314975
7	78.725	93.594	31.523	22.951	13.013	1.188873	0.400419	0.291534	0.165297
8	77.536	88.687	29.834	19.459	17.395	1.143817	0.384776	0.250967	0.224347
9	74.883	83.072	27.839	25.113	15.542	1.109357	0.371767	0.335363	0.20755
10	71.605	81.651	25.212	20.227	13.769	1.140297	0.352098	0.28248	0.192291
11	62.652	69.28	27.54	19.158	13.411	1.105791	0.439571	0.305784	0.214055
12	67.563	72.143	27.76	22.571	14.193	1.067789	0.410876	0.334073	0.210071
13	52.819	63.434	20.878	15.596	10.062	1.200969	0.395274	0.295273	0.1905
14	59.706	66.449	29.916	22.561	11.81	1.112937	0.501055	0.377868	0.197803
15	59.877	69.199	18.629	19.113	15.69	1.155686	0.311121	0.319204	0.262037
16	68.005	72.273	23.043	18.104	13.038	1.06276	0.338843	0.266216	0.191721
17	59.795	66.265	19.475	20.053	13.665	1.108203	0.325696	0.335362	0.228531
18	59.514	56.91	18.766	12.845	10.841	0.956246	0.315321	0.215832	0.182159
19	58.087	62.29	22.84	15.22	11.657	1.072357	0.393203	0.262021	0.200682
20	50.602	53.711	29.604	14.694	12.104	1.06144	0.585036	0.290384	0.2392
Mean						**1.111689**	**0.404588**	**0.301593**	**0.209824**
Standard Deviation						**0.063747**	**0.069163**	**0.038399**	**0.035275**

Table A.52: Index Finger features of subject 4 for Left hand before lunch

Index Finger									
Sr. no.	**A**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	48.56	55.238	21.555	12.925	14.068	1.137521	0.443884	0.266166	0.289703
2	53.293	56.362	22.179	17.453	11.886	1.057587	0.416171	0.327491	0.223031
3	52.568	59.606	23.828	18.74	14.123	1.133884	0.45328	0.356491	0.268662
4	58.955	59.312	23.512	14.988	15.011	1.006055	0.398813	0.254228	0.254618
5	58.397	58.498	20.762	15.082	18.185	1.00173	0.355532	0.258267	0.311403
6	48.215	60.94	30.453	15.766	13.817	1.263922	0.631608	0.326994	0.286571
7	56.927	56.7	29.13	16.521	8.76	0.996012	0.511708	0.290214	0.153881
8	65.989	60.997	30.314	16.659	14.667	0.924351	0.45938	0.252451	0.222264
9	66.427	60.08	27.226	12.464	12.682	0.904452	0.409863	0.187635	0.190916
10	55.64	60.967	33.351	11.956	10.002	1.09574	0.599407	0.214881	0.179763
11	78.041	69.512	30.18	14.197	15.278	0.890711	0.38672	0.181917	0.195769
12	68.149	70.073	23.884	14.119	11.56	1.028232	0.350467	0.207178	0.169628
13	67.948	66.216	26.781	15.658	12.562	0.97451	0.39414	0.230441	0.184877
14	66.726	68.016	30.17	22.665	15.558	1.019333	0.452148	0.339673	0.233162
15	64.627	62.525	37.229	18.611	15.951	0.967475	0.57606	0.287976	0.246816
16	62.237	65.993	29.758	17.349	15.113	1.06035	0.47814	0.278757	0.24283
17	60.266	66.41	29.889	17.914	15.879	1.101948	0.495951	0.297249	0.263482
18	63.83	66.249	36.909	13.101	15.596	1.037898	0.578239	0.205248	0.244337
19	53.129	63.174	37.722	15.736	16.41	1.189068	0.710008	0.296185	0.308871
20	62.095	71.403	30.955	16.781	11.277	1.149899	0.49851	0.270247	0.181609
Mean						**1.047034**	**0.480001**	**0.266484**	**0.23261**
Standard Deviation						**0.094379**	**0.094281**	**0.049433**	**0.046102**

Table A.53: Middle Finger features of subject 4 for Left hand before lunch

Middle Finger									
Sr. no.	**a**	**B**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	44.455	53.376	22.686	13.121	15.293	1.200675	0.510314	0.295152	0.344011
2	43.079	45.492	15.539	18.463	12.022	1.056013	0.360709	0.428585	0.279069
3	47.335	60.117	24.302	15.183	10.889	1.270033	0.513404	0.320756	0.230041
4	55.998	67.742	22.525	12.191	12.266	1.209722	0.402247	0.217704	0.219044
5	52.83	63.901	22.611	22.719	12.975	1.209559	0.427995	0.43004	0.245599
6	59.9	64.441	25.423	17.84	12.421	1.07581	0.424424	0.29783	0.207362
7	67.387	69.497	22.915	16.03	12.95	1.031312	0.340051	0.23788	0.192174
8	65.216	80.204	24.501	19.535	15.132	1.229821	0.37569	0.299543	0.232029
9	73.741	79.377	32.549	20.862	12.177	1.07643	0.441396	0.282909	0.165132
10	68.091	81.409	27.291	21.228	11.685	1.195591	0.400802	0.311759	0.171609
11	84.417	93.11	29.531	25.543	14.587	1.102977	0.349823	0.302581	0.172797

12	76.793	89.399	31.186	19.077	11.438	1.164156	0.406105	0.248421	0.148946
13	72.553	82.451	35.542	28.869	13.945	1.136424	0.489876	0.397902	0.192204
14	76.014	92.917	38.6	24.536	13.19	1.222367	0.507801	0.322783	0.173521
15	84.846	98.862	26.114	15.161	17.235	1.165193	0.307781	0.178688	0.203133
16	67.629	84.936	27.291	19.794	14.041	1.255911	0.40354	0.292685	0.207618
17	62.61	69.553	26.921	19.063	13.725	1.110893	0.429979	0.304472	0.219214
18	67.845	64.883	25.1	20.366	11.759	0.956342	0.369961	0.300184	0.173322
19	61.851	77.356	31.785	16.675	8.147	1.250683	0.513896	0.2696	0.13172
20	72.592	79.286	33.043	18.264	14.552	1.092214	0.455188	0.251598	0.200463
Mean						**1.150606**	**0.421549**	**0.299554**	**0.20545**
Standard Deviation						**0.083114**	**0.060482**	**0.061559**	**0.046273**

Table A.54: Ring Finger features of subject 4 for Left hand before lunch

Ring Finger									
Sr. no.	**A**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	123.155	168.72	55.036	34.426	23.107	1.369981	0.446884	0.279534	0.187625
2	118.391	161.503	53.09	31.918	22.618	1.364149	0.448429	0.269598	0.191045
3	109.743	149.022	63.269	35.421	22.703	1.357918	0.57652	0.322763	0.206874
4	116.849	158.503	53.634	32.272	24.611	1.356477	0.459003	0.276186	0.210622
5	127.223	165.072	53.427	38.922	24.01	1.297501	0.419948	0.305935	0.188724
6	113.091	155.611	56.665	38.1	19.979	1.37598	0.501057	0.336897	0.176663
7	115.249	152.735	63.747	43.599	26.152	1.325261	0.553124	0.378303	0.226917
8	123.923	173.007	54.679	41.793	26.791	1.396085	0.441234	0.33725	0.216191
9	126.321	176.794	53.938	36.874	20.685	1.399561	0.426992	0.291907	0.163749
10	115.159	173.212	68.954	41.005	23.873	1.504112	0.598772	0.356073	0.207305
11	126.85	177.106	65.608	38.265	21.921	1.396184	0.517209	0.301655	0.17281
12	131.717	179.418	55.077	33.668	20.55	1.362148	0.418146	0.255609	0.156016
13	131.26	181.222	57.383	36.825	25.371	1.380634	0.437171	0.28055	0.193288
14	135.478	178.959	63.073	39.395	23.064	1.320945	0.465559	0.290785	0.170242
15	124.442	179.163	68.401	40.515	20.974	1.439731	0.549662	0.325573	0.168544
16	147.143	188.065	57.716	39.124	23.996	1.27811	0.392244	0.265891	0.163079
17	136.288	185.179	63.378	43.545	21.886	1.358733	0.46503	0.319507	0.160586
18	123.247	174.589	63.302	45.428	23.314	1.416578	0.513619	0.368593	0.189165
19	128.648	182.897	68.292	40.587	19.792	1.421686	0.530844	0.315489	0.153846
20	139.379	192.721	54.823	44.498	20.626	1.382712	0.393338	0.319259	0.147985
Mean						**1.375224**	**0.477739**	**0.309868**	**0.182564**
Standard Deviation						**0.04917**	**0.059507**	**0.033583**	**0.022139**

A.10 Subject 5 After Lunch

Table A.55: Index Finger features of subject 5 for Right hand after lunch

Index Finger									
Sr. no.		**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	88.295	102.764	36.093	23.309	14.709	1.163871	0.408777	0.26399	0.166589
2	81.607	99.836	40.701	21.75	18.643	1.223375	0.498744	0.266521	0.228449
3	88.882	89.248	29.565	24.709	16.922	1.004118	0.332632	0.277998	0.190387
4	79.524	92.057	41.347	23.752	16.963	1.1576	0.519931	0.298677	0.213307
5	81.292	98.18	38.793	23.694	12.038	1.207745	0.477206	0.291468	0.148083
6	85.524	105.087	40.056	21.676	9.743	1.228743	0.46836	0.253449	0.113921
7	93.63	104.439	35.246	19.021	10.409	1.115444	0.376439	0.203151	0.111172
8	82.592	103.226	40.171	23.678	11.594	1.24983	0.486379	0.286686	0.140377
9	96.515	113.287	52.834	24.101	11.122	1.173776	0.547417	0.249712	0.115236
10	94.558	118.032	40.162	24.569	9.174	1.24825	0.424734	0.25983	0.09702
11	94.074	113.731	40.541	22.281	15.876	1.208953	0.430948	0.236845	0.168761
12	97.215	119.85	44.874	26.463	15.242	1.232834	0.461595	0.272211	0.156787
13	105.188	117.227	42.501	28.54	16.564	1.114452	0.404048	0.271324	0.15747
14	97.64	125.051	39.135	25.205	18.853	1.280735	0.400809	0.258142	0.193087
15	90.154	121.827	38.938	28.045	15.327	1.351321	0.431905	0.311079	0.170009
16	101.277	114.635	49.994	27.711	16.282	1.131896	0.493636	0.273616	0.160767
17	100.753	124.816	45.767	26.612	15.442	1.238832	0.45425	0.264131	0.153266
18	100.325	119.315	42.303	20.592	13.736	1.189285	0.42166	0.205253	0.136915
19	98.498	123.038	50.527	27.07	13.381	1.249142	0.512975	0.274828	0.13585
20	103.182	121.304	48.478	25.513	8.616	1.175631	0.46983	0.247262	0.083503
Mean						**1.197292**	**0.451114**	**0.263309**	**0.152048**
Standard Deviation						**0.071614**	**0.051525**	**0.02622**	**0.036425**

Table A.56: Middle Finger features of subject 5 for Right hand after lunch

Middle Finger									
Sr. no.	**a**	**B**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	93.301	122.291	41.068	19.476	10.085	1.310715	0.440167	0.208744	0.108091
2	90.878	118.906	39.183	25.025	11.395	1.308413	0.43116	0.275369	0.125388
3	93.387	119.904	47.509	25.279	11.619	1.283947	0.508732	0.270691	0.124418
4	95.469	121.294	41.085	27.707	11.457	1.270507	0.430349	0.29022	0.120008
5	91.366	128.876	52.181	25.713	16.548	1.410547	0.571121	0.281429	0.181118
6	101.135	120.771	37.747	25.791	12.371	1.194156	0.373234	0.255016	0.122322
7	96.984	116.546	46.443	21.26	12.141	1.201703	0.478873	0.219211	0.125186
8	96.048	118.036	54.099	21.008	12.082	1.228927	0.56325	0.218724	0.125791
9	99.769	132.052	39.261	21.031	10.83	1.323577	0.393519	0.210797	0.108551
10	103.901	136.736	41.409	25.868	18.226	1.316022	0.398543	0.248968	0.175417

11	95.184	132.005	43.173	24.835	14.909	1.38684	0.453574	0.260916	0.156633
12	106.337	131.536	47.022	30.806	11.988	1.236973	0.442198	0.289702	0.112736
13	110.453	135.052	46.153	21.836	13.535	1.22271	0.417852	0.197695	0.122541
14	109.142	130.938	47.771	28.845	15.506	1.199703	0.437696	0.264289	0.142072
15	104.13	118.664	52.087	23.52	14.664	1.139576	0.500211	0.225872	0.140824
16	95.682	126.876	50.759	20.545	14.889	1.326017	0.530497	0.214722	0.155609
17	103.599	133.126	52.651	24.005	15.348	1.285012	0.508219	0.231711	0.148148
18	99.734	117.909	51.755	25.687	16.148	1.182235	0.51893	0.257555	0.161911
19	101.136	126.126	45.064	21.916	11.203	1.247093	0.445578	0.216698	0.110772
20	103.962	124.649	55.025	22.737	12.796	1.198986	0.52928	0.218705	0.123083
Mean						**1.263683**	**0.468649**	**0.242852**	**0.134531**
Standard Deviation						**0.068899**	**0.055721**	**0.028973**	**0.021453**

Table A.57: Ring Finger features of subject 5 for Right hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	74.705	59.082	27.87	11.353	13.588	0.790871	0.373067	0.151971	0.181889
2	78.451	69.844	27.719	19.369	19.907	0.890288	0.353329	0.246893	0.253751
3	79.926	70.295	36.708	15.022	15.567	0.879501	0.459275	0.187949	0.194768
4	67.046	71.723	32.21	17.228	10.044	1.069758	0.480416	0.256958	0.149808
5	72.49	75.758	30.948	13.1	8.681	1.045082	0.426928	0.180715	0.119754
6	75.247	82.514	34.152	15.908	13.47	1.096575	0.453865	0.21141	0.17901
7	79.001	73.594	36.842	17.898	18.159	0.931558	0.466349	0.226554	0.229858
8	79.25	78.092	34.234	13.722	8.178	0.985388	0.431975	0.173148	0.103192
9	83.26	82.046	40.021	18.354	15.473	0.985419	0.480675	0.220442	0.18584
10	82.757	83.583	38.873	15.109	9.253	1.009981	0.469725	0.182571	0.111809
11	88.444	87.898	38.366	18.306	10.721	0.993827	0.433789	0.206978	0.121218
12	87.467	85.699	40.904	12.206	6.944	0.979787	0.467651	0.13955	0.07939
13	82.642	88.151	45.962	14.608	10.487	1.066661	0.556158	0.176762	0.126897
14	71.395	84.347	45.862	21.084	7.528	1.181413	0.64237	0.295315	0.105442
15	73.717	77.575	38.288	16.422	8.33	1.052335	0.519392	0.222771	0.113
16	78.159	76.341	34.501	19.143	13.724	0.97674	0.441421	0.244924	0.175591
17	81.986	75.266	33.594	11.097	12.818	0.918035	0.409753	0.135352	0.156344
18	86.12	81.816	34.278	12.406	7.834	0.950023	0.398026	0.144055	0.090966
19	78.305	75.906	41.335	13.777	9.982	0.969363	0.527872	0.17594	0.127476
20	77.834	70.174	39.409	12.867	14.47	0.901585	0.506321	0.165313	0.185908
Mean						**0.98371**	**0.464918**	**0.197279**	**0.149595**
Standard Deviation						**0.085831**	**0.063871**	**0.042043**	**0.046113**

Table A.58: Index Finger features of subject 5 for Left hand after lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	94.012	107.663	57.095	25.217	9.803	1.145205	0.607316	0.268232	0.104274
2	108.641	124.843	58.494	16.316	14.57	1.149133	0.538416	0.150183	0.134111
3	106.305	119.259	49.045	21.791	6.159	1.121857	0.461361	0.204986	0.057937
4	101.732	128.535	51.314	18.58	8.889	1.263467	0.504404	0.182637	0.087377
5	97.662	124.278	57.697	14.823	6.425	1.272532	0.590782	0.151779	0.065788
6	93.741	132.067	49.917	21.372	15.489	1.40885	0.532499	0.22799	0.165232
7	96.987	107.607	46.832	22.417	14.453	1.109499	0.482869	0.231134	0.14902
8	97.621	113.009	49.034	17.548	13.977	1.15763	0.502289	0.179756	0.143176
9	87.134	114.811	46.036	19.901	9.087	1.317637	0.528336	0.228395	0.104288
10	99.486	136.188	50.816	19.02	8.718	1.368916	0.510785	0.191183	0.08763
11	101.402	136.023	51.352	18.266	16.844	1.341423	0.50642	0.180135	0.166111
12	93.205	132.122	48.777	24.063	14.337	1.417542	0.52333	0.258173	0.153822
13	86.096	121.897	51.227	22.872	15.113	1.415827	0.594999	0.265657	0.175537
14	97.451	127.854	45.645	22.872	11.672	1.311982	0.468389	0.234703	0.119773
15	95.39	132.537	45.431	21.752	9.339	1.389422	0.476266	0.228032	0.097903
16	97.458	130.524	57.14	16.08	12.715	1.339285	0.586304	0.164994	0.130466
17	96.041	108.8	48.38	16.983	11.754	1.13285	0.503743	0.176831	0.122385
18	98.262	117.835	55.905	24.343	10.971	1.199192	0.568938	0.247736	0.11165
19	100.336	113.645	44.6	22.01	15.728	1.132644	0.444506	0.219363	0.156753
20	92.698	124.156	52.804	22.718	10.356	1.33936	0.569635	0.245075	0.111718
Mean						**1.266713**	**0.525079**	**0.211849**	**0.122248**
Standard Deviation						**0.10912**	**0.046775**	**0.036438**	**0.032686**

Table A.59: Middle Finger features of subject 5 for Left hand after lunch

Middle Finger									
Sr. no.	**a**	**B**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	129.812	143.99	63.597	26.47	19.108	1.109219	0.489916	0.20391	0.147197
2	139.166	140.859	63.471	32.145	23.747	1.012165	0.456081	0.230983	0.170638
3	133.144	143.581	77.679	30.887	16.516	1.078389	0.583421	0.231982	0.124046
4	128.203	140.118	71.065	25.74	9.632	1.092939	0.554316	0.200775	0.075131
5	145.446	150.928	60.852	30.509	8.832	1.037691	0.418382	0.209762	0.060724
6	132.924	150.298	65.854	27.188	15.797	1.130706	0.495426	0.204538	0.118842
7	130.803	158.519	62.915	31.587	17.848	1.211891	0.48099	0.241485	0.136449
8	124.478	149.906	66.504	38.353	22.035	1.204277	0.534263	0.308111	0.177019
9	133.99	154.919	58.032	30.009	23.214	1.156198	0.433107	0.223964	0.173252
10	129.072	162.168	63.491	33.703	25.705	1.256415	0.491904	0.261118	0.199152
11	120.061	151.455	72.535	28.825	18.374	1.261484	0.604151	0.240086	0.153039
12	134.149	152.833	65.291	31.285	18.582	1.139278	0.486705	0.233211	0.138518

13	145.187	152.498	60.466	26.322	16.374	1.050356	0.41647	0.181297	0.112779
14	137.706	147.058	70.12	35.03	18.838	1.067913	0.509201	0.254383	0.136799
15	142.715	144.412	74.455	34.602	19.428	1.011891	0.521704	0.242455	0.136131
16	154.658	152.241	71.566	34.808	15.471	0.984372	0.462737	0.225064	0.100034
17	152.031	158.524	74.857	32.958	13.666	1.042708	0.49238	0.216785	0.08989
18	145.643	161.479	74.808	36.989	10.282	1.108732	0.51364	0.25397	0.070597
19	136.263	170.764	64.137	31.6	22.682	1.253194	0.470685	0.231904	0.166458
20	137.34	156.72	67.984	42.313	17.946	1.14111	0.495005	0.308089	0.130668
Mean						**1.117546**	**0.495524**	**0.235194**	**0.130868**
Standard Deviation						**0.083296**	**0.047629**	**0.031149**	**0.036848**

Table A.60: Ring Finger features of subject 5 for Left hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	91.773	112.749	49.303	22.973	10.377	1.228564	0.537228	0.250324	0.113072
2	95.232	116.188	48.071	23.005	10.377	1.220052	0.504778	0.241568	0.108965
3	95.232	116.188	48.071	23.005	10.267	1.220052	0.504778	0.241568	0.10781
4	98.771	120.307	44.883	26.128	4.361	1.21804	0.454415	0.264531	0.044153
5	98.976	120.125	44.294	28.626	8.396	1.213678	0.447523	0.289222	0.084829
6	100.719	125.899	44.507	26.809	14.419	1.250002	0.441893	0.266176	0.143161
7	100.143	126.456	50.44	28.516	14.496	1.262754	0.50368	0.284753	0.144753
8	96.953	128.642	49.964	26.256	17.461	1.326849	0.515342	0.270812	0.180098
9	96.824	127.051	46.458	24.785	17.755	1.312185	0.479819	0.25598	0.183374
10	109.688	137.709	48.365	25	19.044	1.255461	0.440932	0.227919	0.17362
11	99.87	127.223	53.07	28.424	20.444	1.273886	0.531391	0.28461	0.204706
12	104.316	129.158	55.567	25.714	20.378	1.238142	0.53268	0.246501	0.195349
13	98.756	134.589	52.628	37.471	14.892	1.362844	0.532909	0.37943	0.150796
14	109.113	140.587	60.939	25.364	15.883	1.288453	0.558494	0.232456	0.145565
15	101.117	136.48	59.145	29.921	12.189	1.349724	0.584916	0.295905	0.120544
16	113.814	136.699	48.775	25.019	17.521	1.201074	0.42855	0.219824	0.153944
17	98.334	135.876	63.902	29.668	13.063	1.38178	0.649846	0.301706	0.132843
18	112.924	120.138	53.862	29.596	12.519	1.063884	0.476976	0.262088	0.110862
19	106.044	141.154	45.498	30.575	17.059	1.331089	0.429048	0.288324	0.160867
20	108.749	131.98	54.4	24.792	17.162	1.21362	0.500234	0.227975	0.157813
Mean						**1.260607**	**0.502772**	**0.266584**	**0.140856**
Standard Deviation						**0.070525**	**0.055011**	**0.03527**	**0.038221**

A.11 Subject 6 Before Lunch

Table A.61: Index Finger features of subject 6for Right hand before lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	19.611	22.15	13.507	5.819	6.51	1.129468	0.688746	0.296721	0.331957
2	20.925	19.386	8.214	7.174	7.308	0.926452	0.392545	0.342843	0.349247
3	19.315	24.689	8.348	6.927	6.16	1.278229	0.432203	0.358633	0.318923
4	23.204	23.54	10.826	12.186	6.755	1.01448	0.466557	0.525168	0.291114
5	19.29	16.445	9.019	5.71	7.009	0.852514	0.467548	0.296008	0.363349
6	17.342	18.852	9.579	6.204	5.374	1.087072	0.552358	0.357744	0.309884
7	23.492	22.049	8.829	6.245	6.139	0.938575	0.37583	0.265835	0.261323
8	27.964	19.43	10.746	7.823	7.524	0.694822	0.38428	0.279753	0.26906
9	23.371	19.59	8.851	5.87	9.939	0.838218	0.378717	0.251166	0.425271
10	21.067	19.925	9.171	7.786	6.113	0.945792	0.435325	0.369583	0.290169
11	18.783	18.885	6.154	3.54	5.542	1.00543	0.327637	0.188468	0.295054
12	27.431	15.642	8.304	8.676	9.007	0.570231	0.302723	0.316284	0.328351
13	23.606	18.188	10.693	8.813	8.993	0.770482	0.452978	0.373337	0.380962
14	24.382	19.13	5.723	4.697	6.33	0.784595	0.234722	0.192642	0.259618
15	27.674	18.421	6.955	11.552	5.529	0.665643	0.251319	0.417432	0.19979
16	27.791	20.926	8.353	4.69	9.059	0.752978	0.300565	0.16876	0.325969
17	23.799	19.43	9.876	11.123	9.717	0.816421	0.414975	0.467373	0.408294
18	18.525	14.958	9.986	6.106	6.779	0.807449	0.539055	0.329609	0.365938
19	15.289	16.219	8.692	5.155	10.154	1.060828	0.568513	0.337171	0.664138
20	17.354	16.37	9.629	7.792	5.701	0.943298	0.554858	0.449003	0.328512
Mean						**0.894149**	**0.426073**	**0.329177**	**0.338346**
Standard Deviation						**0.168133**	**0.112775**	**0.090612**	**0.091116**

Table A.62: Middle Finger features of subject 6 for Right hand before lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	26.263	29.012	13.904	7.304	9.121	1.104672	0.529414	0.27811	0.347295
2	21.062	26.889	10.161	7.167	4.843	1.276659	0.482433	0.340281	0.22994
3	29.307	22.1	9.122	7.128	7.866	0.754086	0.311257	0.243218	0.2684
4	25.642	21.019	10.402	7.758	5.749	0.81971	0.405663	0.302551	0.224202
5	22.767	20.454	12.289	7.892	9.352	0.898406	0.539772	0.346642	0.41077
6	22.748	25.068	8.821	5.599	6.593	1.101987	0.38777	0.246132	0.289828
7	28.494	23.862	11.392	7.774	5.968	0.837439	0.399803	0.272829	0.209448
8	21.245	26.071	9.169	6.177	11.475	1.227159	0.431584	0.290751	0.540127
9	28.028	28.476	8.304	6.193	5.907	1.015984	0.296275	0.220958	0.210754
10	24.474	19.567	11.64	6.571	5.045	0.799502	0.475607	0.268489	0.206137

11	28.972	24.144	12.956	8.574	13.29	0.833356	0.44719	0.295941	0.458719
12	21.649	24.043	11.208	8.419	5.379	1.110582	0.517714	0.388886	0.248464
13	23.874	25.019	9.933	12.066	5.615	1.04796	0.416059	0.505403	0.235193
14	23.46	20.937	10.022	8.529	13.908	0.892455	0.427195	0.363555	0.592839
15	24.818	24.707	8.332	7.556	10.47	0.995527	0.335724	0.304456	0.421871
16	29.602	25.398	9.978	10.228	10.811	0.857983	0.337072	0.345517	0.365212
17	33.683	29.187	12.422	8.981	11.757	0.86652	0.368791	0.266633	0.349048
18	26.295	24.944	17.412	8.864	7.506	0.948621	0.662179	0.337098	0.285454
19	27.659	27.345	11.163	9.292	5.88	0.988647	0.403594	0.335949	0.212589
20	29.553	29.838	11.764	6.678	7.928	1.009644	0.398064	0.225967	0.268264
Mean						**0.969345**	**0.428658**	**0.308968**	**0.318728**
Standard Deviation						**0.140645**	**0.085757**	**0.064174**	**0.111816**

Table A.63: Ring Finger features of subject 6 for Right hand before lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	150.883	125.411	36.697	27.948	9.928	0.83118	0.243215	0.18523	0.065799
2	133.783	117.238	37.107	27.272	15.272	0.87633	0.277367	0.203853	0.114155
3	145.973	113.995	29.189	24.13	13.359	0.780932	0.199962	0.165305	0.091517
4	149.328	107.388	27.91	24.402	12.695	0.719142	0.186904	0.163412	0.085014
5	139.287	112.697	32.66	24.604	9.918	0.809099	0.23448	0.176642	0.071205
6	127.958	106.986	29.077	29.692	11.608	0.836102	0.227239	0.232045	0.090717
7	120.879	90.688	31.238	25.254	10.411	0.750238	0.258424	0.20892	0.086127
8	117.929	92.747	27.223	19.223	12.836	0.786465	0.230842	0.163005	0.108845
9	118.043	95.345	24.557	16.112	12.347	0.807714	0.208034	0.136493	0.104597
10	112.699	101.018	29.534	17.78	13.544	0.896352	0.262061	0.157765	0.120179
11	98.362	96.261	27.42	19.681	13.088	0.97864	0.278766	0.200087	0.13306
12	106.768	92.013	23.916	18.252	9.433	0.861803	0.224	0.17095	0.08835
13	102.105	95.071	21.852	10.371	10.57	0.93111	0.214015	0.101572	0.103521
14	97.961	96.677	22.232	14.869	10.418	0.986893	0.226947	0.151785	0.106348
15	85.197	88.843	25.547	16.277	10.077	1.042795	0.299858	0.191051	0.118279
16	85.877	85.822	18.88	17.295	12.093	0.99936	0.219849	0.201393	0.140818
17	84.79	79.708	23.737	17.928	11.395	0.940064	0.27995	0.21144	0.134391
18	77.157	70.975	23.507	18.577	8.731	0.919878	0.304665	0.240769	0.113159
19	73.488	66.849	23.627	15.537	10.326	0.909659	0.321508	0.211422	0.140513
20	68.04	61.853	19.237	15.646	7.144	0.909068	0.282731	0.229953	0.104997
Mean						**0.878641**	**0.249041**	**0.185155**	**0.10608**
Standard Deviation						**0.085981**	**0.036851**	**0.033886**	**0.02103**

Table A.64: Index Finger features of subject 6 for Left hand before lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	86.637	89.574	33.966	12.18	18.641	1.0339	0.39205	0.140587	0.215162
2	83.128	94.663	38.171	17.698	21.16	1.138762	0.459183	0.212901	0.254547
3	78.444	90.929	38.281	16.16	20.794	1.159158	0.488004	0.206007	0.265081
4	89.198	96.436	31.01	12.979	16.968	1.081145	0.347654	0.145508	0.190228
5	91.022	111.775	32.006	9.123	15.252	1.228	0.351629	0.100229	0.167564
6	85.238	102.569	39.339	16.484	18.75	1.203325	0.46152	0.193388	0.219972
7	86.822	100.455	40.211	18.102	14.471	1.157022	0.463143	0.208496	0.166674
8	90.291	100.94	32.832	14.028	17.14	1.117941	0.363624	0.155364	0.189831
9	94.052	101.136	33.805	33.509	16.876	1.07532	0.359429	0.356282	0.179433
10	98.476	104.625	41.02	11.461	16.45	1.062442	0.416548	0.116384	0.167046
11	82.713	94.216	42.206	12.266	18.385	1.139071	0.51027	0.148296	0.222275
12	80.847	89.155	37.79	17.633	15.219	1.102762	0.467426	0.218103	0.188244
13	75.987	91.993	27.541	15.594	18.611	1.210641	0.362444	0.205219	0.244923
14	83.49	96.643	34.549	12.965	16.565	1.15754	0.41381	0.155288	0.198407
15	90.316	93.991	32.122	10.883	15.652	1.04069	0.355662	0.120499	0.173303
16	85.594	100.738	34.483	15.396	17.224	1.176928	0.402867	0.179872	0.201229
17	97.13	109.073	36.748	12.159	20.043	1.122959	0.378338	0.125183	0.206352
18	86.543	97.257	41.37	18.585	21.819	1.1238	0.478028	0.214749	0.252117
19	93.785	108.575	40.388	12.749	17.169	1.157701	0.430645	0.135939	0.183068
20	96.062	109.156	36.718	18.056	16.488	1.136308	0.382232	0.187962	0.171639
Mean						**1.131271**	**0.414225**	**0.176313**	**0.202855**
Standard Deviation						**0.052481**	**0.050721**	**0.055125**	**0.03063**

Table A.65: Middle Finger features of subject 6 for Left hand before lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	60.63	65.656	14.955	10.995	11.07	1.082896	0.24666	0.181346	0.182583
2	52.815	65.25	28.686	9.972	13.617	1.235444	0.543141	0.18881	0.257824
3	62.086	64.068	27.973	8.991	13.09	1.031923	0.450552	0.144815	0.210837
4	59.201	63.412	18.945	10.148	16.868	1.071131	0.320011	0.171416	0.284928
5	54.241	66.292	19.453	10.012	12.124	1.222175	0.35864	0.184584	0.223521
6	58.487	80.326	17.53	7.08	7.524	1.373399	0.299725	0.121053	0.128644
7	61.118	71.4	15.832	6.725	15.004	1.168232	0.25904	0.110033	0.245492
8	54.794	58.212	15.128	4.951	11.527	1.062379	0.276089	0.090357	0.21037
9	50.435	60.955	22.295	11.535	12.6	1.208585	0.442054	0.22871	0.249827
10	58.646	72.698	25.501	15.636	12.331	1.239607	0.434829	0.266617	0.210262
11	51.373	74.774	24.206	7.593	15.605	1.455512	0.471181	0.147801	0.303759
12	49.312	61.389	13.585	5.83	14.375	1.24491	0.275491	0.118227	0.291511

13	35.707	65.354	12.691	10.507	10.176	1.830285	0.355421	0.294256	0.284986
14	60.093	67.476	18.301	10.886	17.121	1.12286	0.304545	0.181153	0.284908
15	56.923	75.873	15.347	7.611	13.635	1.332906	0.26961	0.133707	0.239534
16	69.267	68.816	26.16	8.592	13.442	0.993489	0.377669	0.124042	0.194061
17	57.987	69.478	29.425	16.774	15.67	1.198165	0.507441	0.289272	0.270233
18	52.058	82.634	22.944	14.318	11.034	1.587345	0.440739	0.275039	0.211956
19	57.424	79.064	23.927	13.055	11.695	1.376846	0.416672	0.227344	0.20366
20	58.256	87.886	19.755	9.517	12.068	1.508617	0.339107	0.163365	0.207155
Mean						**1.267335**	**0.369431**	**0.182097**	**0.234802**
Standard Deviation						**0.203553**	**0.086774**	**0.060942**	**0.043286**

Table A.66: Ring Finger features of subject 6 for Left hand before lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	55.296	65.199	32.476	10.733	10.809	1.179091	0.587312	0.194101	0.195475
2	47.139	57.14	22.886	11.116	9.401	1.21216	0.4855	0.235813	0.199431
3	47.75	56.76	15.621	12.014	19.557	1.188691	0.327141	0.251602	0.409571
4	46.892	54.318	17.081	7.217	10.44	1.158364	0.364263	0.153907	0.222639
5	44.175	53.686	22.445	13.821	16.344	1.215303	0.508093	0.312869	0.369983
6	39.043	43.067	15.526	10.411	10.166	1.103066	0.397664	0.266655	0.26038
7	39.599	38.378	11.853	13.961	11.512	0.969166	0.299326	0.352559	0.290714
8	45.445	34.698	12.079	16.918	9.935	0.763516	0.265794	0.372274	0.218616
9	32.443	32.773	15.352	9.349	9.383	1.010172	0.473199	0.288167	0.289215
10	33.265	37.102	14.125	7.08	18.274	1.115346	0.42462	0.212836	0.549346
11	44.946	43.799	21.038	11.996	10.963	0.97448	0.468073	0.266898	0.243915
12	40.688	45.52	20.04	10.724	10.491	1.118757	0.492529	0.263567	0.25784
13	45.251	48.464	31.902	20.264	13.461	1.071004	0.705001	0.447813	0.297474
14	56.198	70.279	18.911	11.379	9.226	1.250561	0.336507	0.202481	0.16417
15	61.812	66.878	20.885	17.998	10.752	1.081958	0.337879	0.291173	0.173947
16	61.087	69.29	23.728	13.345	17.178	1.134284	0.38843	0.218459	0.281205
17	53.372	64.474	22.501	8.771	21.213	1.208012	0.421588	0.164337	0.397456
18	55.649	62.214	25.429	11.428	10.499	1.117972	0.456953	0.205359	0.188665
19	58.671	68.367	25.014	13.144	14.966	1.165261	0.426344	0.224029	0.255083
20	60.564	65.997	23.539	15.959	11.117	1.089707	0.388663	0.263506	0.183558
Mean						**1.106343**	**0.427744**	**0.25942**	**0.272434**
Standard Deviation						**0.109252**	**0.09954**	**0.070022**	**0.093912**

A.12 Subject 6 After Lunch

Table A.67: Index Finger features of subject 6 for Right hand after lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	80.596	82.984	21.217	9.815	9.743	1.029629	0.263251	0.12178	0.120887
2	82.229	79.299	21.571	9.552	12.622	0.964368	0.262328	0.116163	0.153498
3	100.072	86.677	20.723	13.161	12.39	0.866146	0.207081	0.131515	0.123811
4	85.784	79.676	17.086	8.206	6.645	0.928798	0.199175	0.095659	0.077462
5	78.407	74.346	13.435	12.141	12.105	0.948206	0.171349	0.154846	0.154387
6	78.544	69.272	15.182	7.7	8.799	0.881952	0.193293	0.098034	0.112026
7	74.738	72.484	17.027	8.855	10.857	0.969841	0.227823	0.118481	0.145267
8	82.754	68.793	15.415	11.723	7.125	0.831295	0.186275	0.141661	0.086099
9	83.238	74.063	17.277	10.652	9.408	0.889774	0.207561	0.12797	0.113025
10	80.366	65.681	12.498	10.344	13.008	0.817273	0.155514	0.128711	0.161859
11	82.489	72.525	15.311	5.91	6.457	0.879208	0.185613	0.071646	0.078277
12	70.139	65.277	14.83	8.935	12.591	0.930681	0.211437	0.12739	0.179515
13	74.902	69.165	14.515	12.326	10.976	0.923407	0.193787	0.164562	0.146538
14	72.86	63.817	14.358	11.689	9.895	0.875885	0.197063	0.160431	0.135808
15	75.67	64.242	13.403	6.878	10.112	0.848976	0.177124	0.090895	0.133633
16	82.181	68.78	17.817	8.715	8.322	0.836933	0.216802	0.106046	0.101264
17	78.354	66.914	11.859	11.152	10.157	0.853996	0.151352	0.142328	0.12963
18	63.516	59.032	13.84	9.282	8.152	0.929404	0.217898	0.146136	0.128346
19	71.02	67.534	16.497	10.83	7.765	0.950915	0.232287	0.152492	0.109335
20	65.945	64.165	15.928	13.755	12.389	0.973008	0.241535	0.208583	0.187869
Mean						**0.906485**	**0.204927**	**0.130267**	**0.128927**
Standard Deviation						**0.055346**	**0.029967**	**0.030068**	**0.02987**

Table A.68: Middle Finger features of subject 6 for Right hand after lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	51.601	64.952	24.398	11.021	12.869	1.258735	0.47282	0.213581	0.249394
2	46.627	61.858	18.338	8.72	9.516	1.326656	0.393291	0.187016	0.204088
3	46.287	61.193	22.811	8.294	7.92	1.322034	0.492817	0.179186	0.171106
4	41.18	54.007	20.479	11.183	9.557	1.311486	0.497305	0.271564	0.232079
5	39.383	54.358	19.099	10.308	9.506	1.38024	0.484955	0.261737	0.241373
6	42.332	53.501	19.796	11.981	8.863	1.263843	0.467637	0.283025	0.209369
7	51.737	55.471	15.941	14.128	9.109	1.072173	0.308116	0.273073	0.176064
8	51.151	60.584	17.265	12.061	7.936	1.184415	0.33753	0.235792	0.155148
9	48.312	61.481	20.365	11.89	10.062	1.272582	0.421531	0.246109	0.208271
10	44.776	56.413	22.061	13.045	10.83	1.259894	0.492697	0.291339	0.241871

11	42.82	59.409	20.011	9.594	8.049	1.387412	0.467328	0.224054	0.187973
12	45.611	63.708	17.999	8.143	12.701	1.396768	0.39462	0.178531	0.278464
13	54.265	63.82	22.406	9.92	12.164	1.17608	0.4129	0.182807	0.224159
14	51.432	62.518	21.897	9.15	9.171	1.215547	0.425747	0.177905	0.178313
15	46.697	59.392	24.081	10.963	11.083	1.271859	0.515686	0.234769	0.237339
16	47.1	60.689	17.083	11.483	9.692	1.288514	0.362696	0.2438	0.205775
17	45.248	66.642	19.622	10.534	14.247	1.472816	0.433655	0.232806	0.314865
18	54.062	61.915	19.99	6.492	7.686	1.145259	0.369761	0.120084	0.14217
19	48.453	58.567	24.571	12.167	9.129	1.208738	0.50711	0.251109	0.188409
20	48.632	60.28	23.458	9.976	11.202	1.239513	0.482357	0.205132	0.230342
Mean						**1.272728**	**0.437028**	**0.224671**	**0.213829**
Standard Deviation						**0.092125**	**0.059022**	**0.042767**	**0.040668**

Table A.69: Ring Finger features of subject 6 for Right hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	95.688	109.466	36.62	18.071	18.022	1.143989	0.382702	0.188853	0.188341
2	95.836	112.844	35.06	15.166	11.733	1.17747	0.365833	0.15825	0.122428
3	104.077	116.608	39.757	15.917	23.205	1.120401	0.381996	0.152935	0.22296
4	90.701	119.62	43.206	24.341	12.567	1.318839	0.476356	0.268365	0.138554
5	101.822	120.15	42.448	23.994	17.106	1.18	0.416884	0.235647	0.167999
6	102.567	120.686	44.252	24.349	14.771	1.176655	0.431445	0.237396	0.144013
7	100.277	124.132	47.351	17.606	13.576	1.237891	0.472202	0.175574	0.135385
8	111.669	133.724	39.248	20.835	20.241	1.197503	0.351467	0.186578	0.181259
9	121.427	133.456	34.804	13.951	22.75	1.099064	0.286625	0.114892	0.187355
10	114.791	140.054	35.102	18.528	16.102	1.220078	0.305791	0.161406	0.140272
11	121.758	138.29	46.88	26.922	17.106	1.135778	0.385026	0.221111	0.140492
12	108.532	122.751	46.897	20.956	17.042	1.131012	0.432103	0.193086	0.157023
13	111.31	123.322	38.159	14.834	16.525	1.107915	0.342817	0.133267	0.148459
14	109.346	115.126	33.092	18.797	14.599	1.05286	0.302636	0.171904	0.133512
15	106.663	115.162	40.902	22.473	16.43	1.079681	0.383469	0.210692	0.154037
16	100.256	110.549	44.242	18.889	16.576	1.102667	0.44129	0.188408	0.165337
17	100.062	118.924	38.216	23.387	19.358	1.188503	0.381923	0.233725	0.19346
18	111.279	126.462	31.307	13.342	19.376	1.136441	0.281338	0.119897	0.174121
19	113.991	130.855	35.056	20.903	20.169	1.147942	0.307533	0.183374	0.176935
20	118.979	127.091	38.207	17.528	18.231	1.06818	0.321124	0.14732	0.153229
Mean						**1.151143**	**0.372528**	**0.184134**	**0.161259**
Standard Deviation						**0.061873**	**0.058421**	**0.040306**	**0.024558**

Table A.70: Index Finger features of subject 6 for Left hand after lunch

Index Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	126.545	163.423	58.844	24.832	25.059	1.291422	0.465005	0.196231	0.198024
2	133.19	170.335	56.679	19.445	18.642	1.278887	0.42555	0.145994	0.139965
3	135.752	171.346	48.534	17.433	20.518	1.262199	0.35752	0.128418	0.151143
4	135.023	169.512	53.528	19.278	20.123	1.255431	0.396436	0.142776	0.149034
5	128.75	160.242	55.11	15.748	19.189	1.244598	0.428039	0.122315	0.149041
6	131.681	163.127	49.609	20.885	20.514	1.238804	0.376736	0.158603	0.155786
7	134.698	170.835	43.187	13.451	23.163	1.268282	0.320621	0.09986	0.171962
8	140.073	166.374	45.512	20.951	20.416	1.187766	0.324916	0.149572	0.145753
9	128.778	169.568	52.318	17.087	16.344	1.316747	0.406265	0.132686	0.126916
10	124.212	156.88	53.575	19.514	13.391	1.263002	0.431319	0.157102	0.107808
11	143.386	170.492	59.51	21.754	20.601	1.189042	0.415034	0.151716	0.143675
12	144.636	176.437	43.151	20.407	16.522	1.219869	0.298342	0.141092	0.114232
13	136.547	171.834	48.797	16.45	16.513	1.258424	0.357364	0.120471	0.120933
14	135.935	168.407	60.252	15.484	18.968	1.238879	0.443241	0.113907	0.139537
15	137.301	179.272	52.73	25.139	22.321	1.305686	0.384047	0.183094	0.16257
16	141.128	172.485	42.906	14.89	21.098	1.222188	0.304022	0.105507	0.149495
17	134.354	176.927	54.6	22.632	18.084	1.316872	0.406389	0.168451	0.1346
18	130.491	164.357	66.721	21.05	21.105	1.259527	0.511307	0.161314	0.161735
19	143.459	176.906	67.101	21.468	15.167	1.233147	0.467736	0.149646	0.105724
20	139.606	187.301	59.222	20.962	13.756	1.34164	0.424208	0.150151	0.098534
Mean						**1.259621**	**0.397205**	**0.143945**	**0.141323**
Standard Deviation						**0.039875**	**0.055742**	**0.02392**	**0.02363**

Table A.71: Middle Finger features of subject 6 for Left hand after lunch

Middle Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	69.214	83.451	26.279	11.804	8.929	1.205695	0.379678	0.170544	0.129006
2	73.55	80.265	27.227	10.508	14.289	1.091298	0.370184	0.142869	0.194276
3	79.809	83.667	31.483	7.483	15.731	1.04834	0.394479	0.093761	0.197108
4	76.867	73.751	28.189	17.816	13.856	0.959462	0.366724	0.231777	0.180259
5	76.361	70.266	26.118	11.158	17.358	0.920182	0.342033	0.146122	0.227315
6	81.662	77.197	25.058	13.433	17.472	0.945323	0.30685	0.164495	0.213955
7	79.111	74.872	26.584	11.562	12.023	0.946417	0.336034	0.146149	0.151976
8	76.844	75.412	24.598	6.373	6.761	0.981365	0.320103	0.082934	0.087983
9	80.565	67.268	29.893	17.128	11.642	0.834953	0.371042	0.212599	0.144504
10	59.908	76.164	26.95	12.213	16.859	1.271349	0.449856	0.203863	0.281415
11	80.544	73.553	19.636	10.498	18.177	0.913203	0.243792	0.130339	0.225678
12	68.993	72.439	20.609	10.19	16.747	1.049947	0.298711	0.147696	0.242735

13	78.121	68.129	28.185	9.371	11.593	0.872096	0.360786	0.119955	0.148398
14	57.152	64.964	27.524	11.514	11.523	1.136688	0.481593	0.201463	0.20162
15	64.086	61.623	20.271	10.246	11.408	0.961567	0.316309	0.159879	0.178011
16	68.682	77.722	20.307	10.078	8.902	1.131621	0.295667	0.146734	0.129612
17	69.873	75.482	19.84	11.032	11.186	1.080274	0.283944	0.157886	0.16009
18	67.314	65.948	22.737	16.958	11.834	0.979707	0.337775	0.251924	0.175803
19	71.557	73.762	20.196	7.203	12.322	1.030815	0.282237	0.100661	0.172198
20	66.694	73.212	21.237	10.078	8.548	1.09773	0.318424	0.151108	0.128167
Mean						**1.022902**	**0.342811**	**0.158138**	**0.178506**
Standard Deviation						**0.109274**	**0.055441**	**0.043298**	**0.044963**

Table A.72: Ring Finger features of subject 6 for Left hand after lunch

Ring Finger									
Sr. no.	**a**	**b**	**c**	**d**	**e**	**b/a**	**c/a**	**d/a**	**e/a**
1	113.859	93.764	40.514	17.747	16.147	0.82351	0.355826	0.155868	0.141816
2	117.177	99.16	32.608	15.376	11.52	0.846241	0.27828	0.13122	0.098313
3	118.415	97.957	39.718	11.455	16.603	0.827235	0.335414	0.096736	0.14021
4	123.495	96.213	34.399	10.815	17.294	0.779084	0.278546	0.087574	0.140038
5	122.928	90.286	43.423	14.153	12.272	0.734462	0.353239	0.115132	0.099831
6	104.903	84.611	33.729	16.614	15.642	0.806564	0.321526	0.158375	0.149109
7	113.815	99.156	43.229	14.666	20.746	0.871203	0.379818	0.128858	0.182278
8	113.186	90.804	32.154	9.051	16.619	0.802255	0.284081	0.079966	0.146829
9	118.838	91.203	32.588	16.57	12.716	0.767457	0.274222	0.139434	0.107003
10	109.503	88.39	34.795	13.535	19.881	0.807192	0.317754	0.123604	0.181557
11	117.001	98.052	35.78	11.959	19.387	0.838044	0.305809	0.102213	0.165699
12	133.073	89.315	46.086	17.054	13.612	0.671173	0.346321	0.128155	0.10229
13	113.411	83.267	44.135	14.745	18.452	0.734206	0.38916	0.130014	0.1627
14	129.452	94.401	33.999	14.306	13.166	0.729236	0.262638	0.110512	0.101706
15	126.813	106.845	34.843	16.336	11.062	0.84254	0.274759	0.12882	0.087231
16	120.009	96.083	41.278	16.077	21.466	0.800632	0.343958	0.133965	0.17887
17	121.838	101.143	31.298	12.461	12.461	0.830143	0.256882	0.102275	0.102275
18	111.858	88.634	26.88	11.643	20.388	0.79238	0.240305	0.104087	0.182267
19	119.328	103.193	36.464	15.05	18.636	0.864784	0.305578	0.126123	0.156175
20	128.712	98.574	50.411	22.717	15.009	0.765849	0.391657	0.176495	0.116609
Mean						**0.796709**	**0.314789**	**0.122971**	**0.13714**
Standard Deviation						**0.049849**	**0.044598**	**0.023494**	**0.031861**