Design and Develop Autonomous UAV to Identify the Target with Precision

Thesis submitted in partial fulfilment of the requirements for the award of degree of

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in

Computer Applications

Submitted By

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CERTIFICATE

I hereby certify that the work which is being presented in the thesis entitled, *"Design and Develop Autonomous UAV to Identify the Target with Precision* ", in partial fulfilment of the requirements for the award of degree of Master of Technology in *Computer Applications* submitted in Computer Science and Engineering Department of Thapar Institute of Engineering and Technology, Patiala, is an authentic record of my own work carried out under the supervision of *Dr. Maninder Singh* and refers other researcher's work which are duly listed in the reference section.

The matter presented in the thesis has not been submitted for award of any other degree of this or any other University.

Signature:

(**Salil Sharma**)

This is to certify that the above statement made by the candidate is correct and true to the best of my knowledge.

(**Dr. Maninder Singh**)
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Computer Science and Engineering Department

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ABSTRACT

Taking facial images and comparing it with target's face, results in Integration of drones with facial recognition. Targets can be Identified by certain set of raw images which will be matching at a certain heights of drones. The drone which is having a decision making ability results the landing of drone near to target. Thinking about the different mission prerequisites, the multi-UAV framework is fit for changing the network architecture or adding more UAV hubs to accomplish the required framework limit.

The UAV system is improved with attainable haul and cruising capability and distinct data delivery results in value of production and distribution. Working face recognition on drones, keeping in mind the end goal is to develop the drones for a military warfare, Drone to take out of facial pictures taken from different altitudes with different angles for assessing how a face recognition system functions in perceiving assigned faces from the air to identify the target with precision.

The Drones is semi-autonomous with Pixhawk and having capability of making its own decisions. The mission we would like to design and develop UAV system which will identify target even if environment may have walls or trees so drones. UAV will constitutes obstacle avoidance as the drone propeller might hit them. Initially the drone lands near to targets. When target is Identified not mere landing but we can hit, follow, shoot the target. The major contribution of this thesis is a Python and open CV based *https://github.com/salil0001/ drone-vision/* .

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CHAPTER 1

INTRODUCTION

This chapter introduces the work done in this thesis. Beside stating the definitions, it underlines the objectives to carry out this work, motivation and literature reviewed. The chapter provides the a brief summary of the work presented in this thesis.

Autonomous robots are currently in demand and its trend is increasing day by day. Increase in performance of microcontroller it is possible to create optimal solutions. The work presented in this thesis mainly focuses on the Artificial intelligence of drones which is having its own decision making capability to avoid obstacles avoidance. The primary objective is to Indentify the targets from certain heights. The performance of drones is being tested with different angles and altitudes. UAV drones then will have own decision making capability to traverse the path autonomously and identify the targets. The Deep Learning approach will help in identifying of faces and will give proper classification result.

Figure 1.1: The Drone with Raspberry Pi 3

Deep learning algorithm and neural network algorithm are used to determine the feature of the faces as face which helps in revealing the identity the facial features of a person. System

then design and developed will give semi autonomous Height, Camera angles then a drone can be sent to mission.

Developed countries have been using UAVs to catch and offer a few ventures like reconnaissance in agribusiness. In the meantime, media researchers have stressed the need to better comprehend the protection and moral concerns encompassing UAVs. Legitimate limitations to and ramifications of their utilization have been generally unexplored. Drones should fly at a certain height as it can be dangerous especially in surveillance in military area. The drone is now the most advanced topic for research. Having its own decision making ability making it fully autonomous, it is important to know what those barriers. what are the research required for UAVs as tools for the military.

This research advances the benefits of UAVs by offering the image processing capability with precision to drone. The motive of shaping the use of UAVs for targeting the object and extract special features in it.

The work is being uploaded as public repository at ***https://github.com/salil0001/drone-vision/tree/master/salil*** which contributes to thesis where the code is present in open source framework and which is presented in python. Raspberry pi is capable for handling Deep Learning library's hence it is having decision making ability. This post on a public platform will help how deep learning libraries are helpful in handling independent approach Making all inclusive framework fit for performing great in both of those errands would be extremely troublesome as they are exceptionally not at all like each other and require distinctive methodologies.

Additionally, each request handles diverse qualities of machine Learning i.e. high nimbleness for landing on a floor or an object and capacity to fly with a capability for gathering faces, so utilizing distinctive machine Learning in each phases was conceivable choice. Be that as it may, a few parts i.e PX4 flight controller can be utilized at its best. The introduced system work has verified utilization on different hardware stages and it is equipped for acknowledging diverse missions with negligible changes.

1.1 Research motivation

The research idea begins with real problem in a military warfare i.e. what are the modern day problems that are being faced by military because as the weapons are getting advanced and

smart. During the world war II several new nuclear weapons were introduced. But now the modern demand has been shifted the military's attention towards the smart and lethal weapons. The smart weapons having a capability to make their own decision. The requirement of precision is important in modern days of warfare hence the UAV(Unmanned Aerial Vehicle) will help in attaining the precision. The drones are smart enough to recognise the targets precisely. Earlier the Unmanned controlled vehicle were controlled manually via Remote Controls but now as the technology advances our Geo Positioning system helps to find the apt position of a drone.

The drone can autonomously can be sent to mission once it is configured properly without the intervention of other person. The modern UAV is capable of performing all the actions successfully. Modern UAV are capable for attacking the targets. The modern topics like machine learning will help the drones for precision in attacking the targets. The drones are the modern soldiers that will helps us in defence and as well as attack e.g. Modern UAV's are helps the soldiers to find the anti-tank mines. The sensor having capability to find the metal detectors hence integration of drones with the metal detectors results into a warfare application in a military. The nano-drones are capable for spying the target hence it is not important to send the humans on the mission rather than we can have drones.

Target identifications comprises of several major challenges :

- Image capture from certain heights leads to several handling exceptions face captured leads to several computing failure hence these exceptions must be handled properly image recognition algorithm with not work in that case.
- Any face provide large amount of pixel array structure which is to be placed in neural networks with deep learning to arrive at the final result.

1.2 Key Research area

The key research area focuses on the applying the Adam Geitgey algorithm, Deep learning methods , automation of drones.

1. This research is focusing on Adam Geitgey algorithm to implement on drones as the leading technology focuses on automation. The autonomous will attain certain height and distinctive move of drone results different actions on targets.

2. The Drone is intelligent and capable enough of taking dynamic decisions with help of image results that will help the military to increase the security of the field.

3. Semi-autonomous drone is emerging the miltary market. The switch of mode is of both the autonomous and remotely-operated drones. The tendency to provide control to the flight and decrease in the human intervention is estimated to be one important factor is emerging in industry.

4. The distance native to a drone camera is calculative Adam Gietgey algorithm utilizing sonar, lidar or any other sensor. The codes has been made and placed in Github with proper demonstration and written in high level languages.

5. The Machine Learning's usage has also made an interest to understand the extent in which Deep Learning algorithms and effects are vulnerable to attacks. These attacks are increasing due to facial algorithm.

6. This research is totally done onboard and the result is stored in local storage

The rotation of drone is done by slowing the speed of that propeller which is in that direction as the motor is 3 phase. The whole rotation is being programmed using a MAVLINK commands.

CHAPTER 2

LITRATURE SURVEY

This section briefly reviewed the Adam Geitgey and its advance variants, Deep learning approaches on an semi automated drone Making a facial recognition system using machine learning and deep learning approaches . To accomplish our goals the most important step is face recognition which is provided Adam Geitgey. The Adam Geitgey algorithm is preferred and highly desirable due to its high detection and quick processing time. Once the face is detected, the facials points are extracted and Deep learning helps in better in feature extraction[1]. Hidden layers of neural networks which leads to better accuracy of a data of classificstion.

Deep learning is a sub-field of a more extensive group of machine learning which used to extricate abnormal state reflections or portrayals of information along multiple processing layers. The larger amount highlights are sketched out from the lower-level ideas.(Binyam Tesfahun Liyew, 2017)[30] . Deep learning is connected in various kinds of research zones, for example, neural system, artificial intelligence, graphical demonstrating, pattern recognition, flag processing, and natural language processing (NLP). There are three essential purposes behind fame of deep learning: the first is the expanded chip processing limits i.e, GPGPUs, Second is huge measure of information that utilized for preparing, and the third one is the improvement of cutting edge late innovations in machine learning.

Distinguishing people by utilizing their facial component is one of a biometrics approach that has picked up ubiquity in the course of recent years and it is for the most part utilized as a part of different segments, for example, get to controls, reconnaissance frameworks, and other security applications.[5](Mark O. Milhouse, 2015) The facial highlights of every single individuals are one of a kind, which provides this uniqueness to the subject matter. Keeping in mind the end goal to achieve confront acknowledgment the principal assignment to be performed is confront identification. There are challenges amid the face discovery stage for instance, off-edge faces, impediments, low-determination, and enlightenments are the most critical difficulties in confront identification that need to consider.

As talked about in the above area the conventional hand-created neighbourhood non-straight highlights, for example, Local Binary Patterns, Local Phase Quantisation, and Fisher vectors give a decent execution in compelled conditions. Sadly, such highlights had additionally challenges in uncontrolled situations, i.e, in the LFW standard. Metric learning can be utilized to enhance the face acknowledgment execution in such difficult circumstance. The learning instrument of metric learning is by taking in the change of highlights that pulls the articles which have a similar mark appearance while pushing the items which have diverse name appearance . One of the real advantages of utilizing CNN is that every last handling layer, starting from the crude pixel-level information, have a configurable parameter which can be gained from information. For CNN model that take in a substantial number of parameter (may be in millions), it requires a huge preparing datasets. For instance, in LFW standard the CNN model is prepared utilizing a dataset with a great many marked appearances. Furthermore, luckily it achieved best in class execution, i.e., Facebook utilizes 4 million preparing tests to prepare the DeepFace model and Google utilize 200 million preparing tests to prepare the FaceNet model.

Unmanned Aerial Vehicles (UAVs) have altered open air aerial errands from photography to war-battling.(Jae-Neung Lee, 2014)[11] New improvements in UAV innovation have stretched out their utilization to indoor undertakings. UAVs can work in jumbled indoor situations and can arrange impediments, for example, stairways, which confuse the activity of haggled robots. This mobility makes them valuable for some indoor mechanical applications. Particularly, in light of its great mobility, the unmanned aerial vehicle (UAV) is broadly connected to the private division, for example, investigation, aerial photography, and farming and debacle perception and in addition to the military area, for example, military observation, urban battle condition. In the zone to which it is troublesome for individuals to access, for example, hazardous situations or much crowed downtowns, the UAV picture handling can appropriately help individuals to play out their errands without really getting to the zones. Unmanned aerial vehicle (UAV) for the most part alludes to any flying vehicle that self-governing fly in light of the pre-entered program or all alone acknowledgment of the environment, without a pilot. The historical backdrop of the UAV began with the examination led by the United States after the World War I as they perceived the requirement for unmanned air ships for surveillance. Quadcopter implies a flying article that controls the parts of Roll, Pitch and Yaw, keeps up the adjust, and flies forward and backward and from side to side, with four props.

2.1 Autonomous decision making system

An efficient audit is given on artificial operator strategies appropriate to control designing of autonomous vehicles and robots. The paper centre around a few basics that make a machine autonomous: decision making that includes demonstrating the earth and shaping information deliberations for emblematic handling and rationale based thinking. Most pertinent capacities, for example, route, autonomous way arranging, way following control, and correspondences, that straightforwardly influence decision making, are dealt with as essential aptitudes of specialists. Albeit numerous autonomous vehicles have been designed in the past without utilizing the operator arranged approach, most decision making locally available of vehicles is like or can be named some sort of specialist engineering, regardless of whether in an innocent frame. To begin with the ANSI standard of canny frameworks is reviewed then a rundown of the principal sorts of conceivable specialist structures for autonomous vehicles are displayed, beginning from receptive, through layered, to cutting edge models as far as convictions, objectives, and goals.[22](S M Veres, 2011) The audit recognizes some missing connections between software engineering comes about on discrete specialists and building after effects of consistent world detecting, activation, and way arranging.

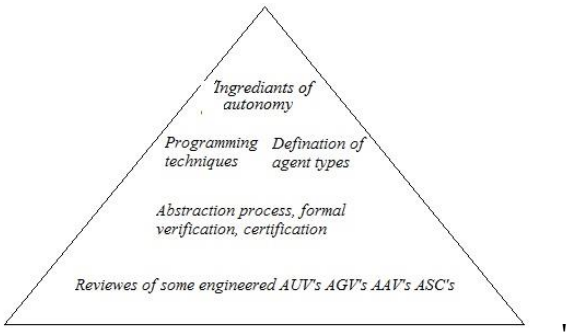

Fig 2.1[22] Autonomous approach without agents

In this setting configuration instruments for 'deliberations writing computer programs' are distinguished as expected to fill in the hole between rationale based thinking and detecting

Efforts of developing autonomous vehicles such as autonomous underwater vehicles (AUVs), For ground vehicles autonomous ground vehicles (AGVs), autonomous aerial vehicles (AAVs) with aerial surveillance, and autonomous spacecraft (ASC) for space craft.

One of the fundamental finishes of this survey is that institutionalization of decision making through operator designs is alluring for the eventual fate of keen vehicle improvements and their lawful affirmation. As humans are as a rule dynamically pushed advance downstream in the basic leadership procedure of self-ruling frameworks, the need emerges to guarantee that ethical norms, anyway characterized, are clung to by these robotic ancient rarities. While significant advances have been made around there with respect to the utilization of moral deadly military robots, including work by our research facility, these necessities rise above the war-fighting space and are inescapable, reaching out to eldercare, robot caretakers, and different types of administration and excitement robotic stages. This paper displays a diagram of the range and phantom of moral issues raised by the appearance of these frameworks, and different specialized outcomes got to date by our examination gathering, adapted towards overseeing moral conduct in self-sufficient robots in connection to humanity. This incorporates: 1) the utilization of a moral senator equipped for confining robotic conduct to predefined social standards; 2) a moral connector which draws upon the ethical feelings to enable a framework to helpfully and proactively change its conduct in view of the results of its activities; 3) the improvement of models of robotic trust in humans and its double, misdirection, drawing on psychological models of reliance hypothesis; and 4) finishing up with an approach towards the support of respect in human-robot connections. At last, inquire about is explored on autonomous vehicles in water, on the ground, noticeable all around, and in space with remarks on their strategies for decision making.

2.2 Adaptive collective decision-making in limited robot swarms without communication

Examining spatial collective decision-production in a swarm of micro robots, enlivened by the thermo-tactic conglomeration conduct of bumble bees.(Serge Kernbach, 2013) [14] The detecting and route abilities of these robots are purposefully constrained; no computerized sensor information preparing and no immediate correspondence are permitted. Along these lines, we can rough the highlights of littler frameworks and show that even such a constrained swarm is in any case ready to display straightforward types of insightful and versatile collective conduct. In this work we contend that a basic type of collective intelligence can be accomplished when all components can take a typical decision. There is frequently a criticism circle amongst environmental and collective flow and a dynamical procedure that progressions the condition of a whole swarm might be begun by one or a couple of people controlling the environment on a negligible scale. To investigate straightforward types of

collective intelligence in constrained mesoscopic frameworks, we utilized a swarm of micro-robots. Distinctive physical laws acting at the micro and meso-levels don't permit the formation of a generous similarity between practices on these levels. In any case, the re-programmability of micro-robots speaks to favourable position for understanding the standards of utilizing physical requirements in the outline of cooperation's. Collective intelligence is frequently connected with the naturally visible abilities of coordination among robots, collective decision making, division of work, and assignment designation inside gatherings and is fundamentally characterized by communications among swarm operators. There are two distinct instances of such connections. In the primary, the specialists impart through a correspondence channel fit for trading semantic messages. From the data trade, the operators construct diverse kinds of normal information, which underlie the collective intelligence. In the second case, the naturally visible capacities are characterized by spatial or dynamical conditions in the environment. The framework and environment fabricate a shut naturally visible criticism circle, which works all things considered as a disseminated control instrument. For this situation, there is no requirement for coordinate correspondence; the operators collaborate actively or through that impacts.

2.3 Face Recognition using Deep Learning

The Convolution Neural Networks leads to new innovation . This CNN model is trained with public datasets and the new datasets are made and are being tested on a real time environment and to utilize maximum amount of deep learning concept. The drones are contributing to optimize the concept of deep learning. CNN method is an efficient method to solve the concept to improve the concept of face recognition. In this research the combination of multiple CNNs and deep leaning.[1](Hwai-Jung Hsu, 2017) The numerous CNN is utilized to make the distinctive systems catch the data from different area and plate to make a hearty face portrayal. The separations amongst drones and targets bring the principal challenge. Drones may not be ready to perceive the objectives accurately in long separations, and can be undermined on the off chance that they approaches a pernicious target excessively close. On the other hand, the elevations of drones influence the pitch angle of the faces caught. Vast discouragement angle came about because of high elevation decreases the exactness of face recognition. Testing the fitting extent in separations and elevations for drones on following targets is subsequently basic for the practicality to apply drones in reconnaissance missions in the city.

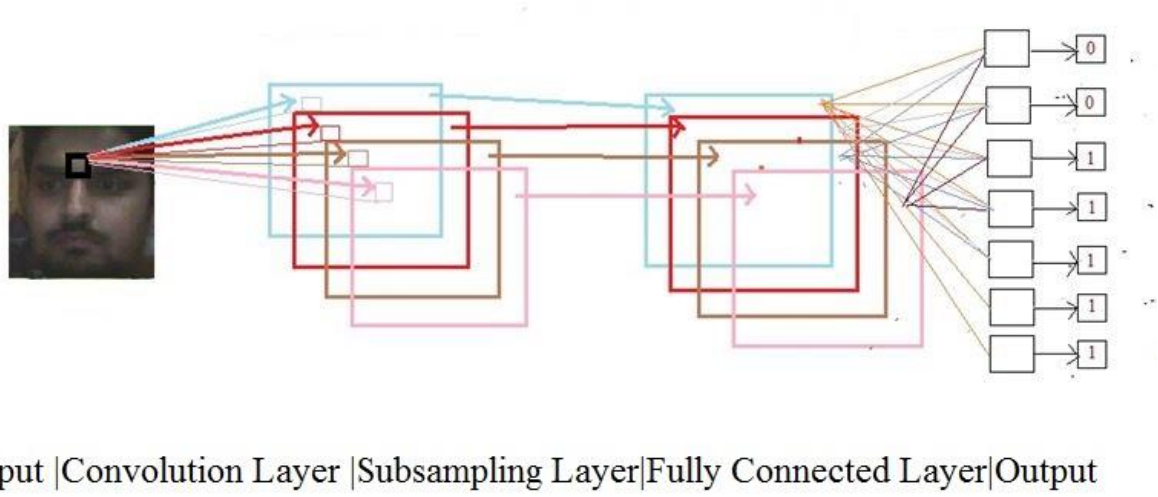

Figure 2.2. Deep learning approach on faces[1]

Face recognition has turned into a mainstream theme of research as of late because of increments popular for security and additionally the quick advancement of cell phones. There are numerous applications which face recognition can be connected to such as access control, personality confirmation, security frameworks, observation frameworks, and online networking systems. Access control incorporates workplaces, PCs, telephones, ATMs, and so on. The greater part of these structures as of now don't utilize face recognition as the standard type of allowing passage, however with propelling advances in PCs alongside more refined algorithms, facial recognition is gaining some footing in supplanting passwords and unique mark scanners. As far back as the occasions of 9/11, there has been a more concerned accentuation on creating security frameworks to guarantee the wellbeing of pure natives. To be specific, in spots, for example, air terminals and outskirt intersections where recognizable proof check is important, face recognition frameworks possibly can the hazard and at last keep future assaults from happening[1](Kuan-Ta Chen,2017). With respect to reconnaissance frameworks, a similar point can be made if there are lawbreakers free to move around at will. Reconnaissance cameras with face recognition capacities would aide be able to in endeavours of finding these people. On the other hand, these same observation frameworks can likewise help distinguish the whereabouts of missing people, despite the fact that this is subject to powerful facial recognition algorithms and also a completely created database of faces. What's more, in conclusion, facial recognition has surfaced in social media applications on stages, for example, Facebook which propose clients label companions who have been recognized in pictures. Plainly there are numerous applications the utilizations for

facial recognition frameworks. All in all, the means to accomplish this is the accompanying: face identification, highlight extraction, and in conclusion, preparing a model. Facial identification by means of the GA algorithm is a remarkable strategy utilized because of its high recognition rate and quick preparing speed. Straightforward highlights are utilized, propelled by Haar premise capacities, which are basically rectangular highlights in different designs. A two-rectangle include speaks to the contrast between the whole of the pixels in two neighbouring locales of indistinguishable shape and size. This thought can be stretched out to the three-rectangle and four-rectangle highlights. Keeping in mind the end goal to rapidly register these rectangle includes, a substitute portrayal of the info picture is required, called a integral picture.

The deep learning concept have tendency to make the drone semi autonomous. Semi Autonomous because we have set some credentials say Height, Camera Angle etc. then drone can be send to mission. The cutting edge of face recognition has been fundamentally cutting-edge by the rise of deep learning. Deep neural systems as of late made awesome progress on general protest recognition as a result of their brilliant learning limit. This inspires us to research their adequacy face recognition.[34](GA, 2018) This paper proposes two deep neural system designs, alluded to as Deep for face recognition. These two models are revamped from stacked convolution and commencement layer. Joint face recognizable proof confirmation supervisory signs are added to both moderate and last component extraction layers amid preparing. A gathering of the proposed two models accomplishes 99.53% face confirmation exactness and 96.0% face distinguishing proof precision, individually. A further exchange of face check result is given at last.

Convolutional neural networks i.e (CNNs) have been generally utilized as a part of PC vision group, altogether enhancing the state-of-the-art. In a large portion of the accessible CNNs[33](Yongdon Wen, 2016), the softmax misfortune function is utilized as the supervision flag to prepare the deep model. So as to improve the discriminative energy of the deeply learned highlights, this paper proposes another supervision flag, called focus misfortune, for confront acknowledgment assignment. In particular, the inside misfortune at the same time takes in a middle for deep highlights of each class and punishes the separations between the deep highlights and their comparing class focuses. All the more critically, we demonstrate that the proposed focus misfortune function is trainable and simple to upgrade in the CNNs. With the joint supervision of softmax misfortune and focus misfortune, we can prepare a powerful CNNs to get the deep highlights with the two key learning goals, between

class dispension and intra-class minimization however much as could be expected, which are extremely fundamental to confront acknowledgment. It is urging to see that our CNNs (with such joint supervision) accomplish the state-of-the-art precision on a few essential face acknowledgment benchmarks, Labelled Faces in the Wild (LFW), YouTube Faces (YTF), and MegaFace Challenge. Particularly, our new approach accomplishes the best outcomes on MegaFace (the biggest open space confront benchmark) under the convention of little preparing set altogether enhancing the past outcomes and setting new state-of-the-art for both face acknowledgment and face check assignments.

For large datasets data is being exchanged by third party processor. Detecting and recognizing faces appearing in real time camera are essential tasks of many video indexing and retrieval applications. Human face is most important object in terms of uniqueness. The process of converting the physical scene into a digital input is not under the control, and is additionally affected by factors such as lighting variations as camera focus on high intensity light with other factors like pose and distance. As a result, it is more difficult for attackers to manipulate or craft inputs that would cause misclassification than it would be.

(Mahmood Sharif, 2016) [19] The broad use of machine learning has also caused a rising interest to understand the extent to which ML algorithms and applications are useful to target the victim. The autonomous flight with complete decision ability results with the complete reliability on drones. Face Recognition library embedded with deep learning library which comprises of input layer, computational layer and loss layer and produces the result. Defining and study a new class of targets that are practically attainable and at the same time are unspectacular

The target which are identified are unostentatious the target is unaware what is happening to him and how the target is getting recognized by the face. this recognition is adverse because if the target got identified any action could be taken. the target get prone to attack. any special action like landing near to target or follow him could be other applications if target gets identified from altitude and distance. The targets identification seeks several exceptions like unfocused image. The smudge image cannot be converted into facial algorithm hence the exception will continuously generated until the facial angle and the drone camera angle is apt.

Testing the photos consecutively results will increase the efficiency of algorithm hence will get better output results. Targets that represent a reasonable and commonsense risk to frameworks that as of now are or can undoubtedly be sent.

Assaults that can be physically executed with the end goal of facial biometric systems. Also, we center around assaults on best in class calculations. Past work on deluding ML calculations regularly targets calculations that are not as refined or also prepared as the ones utilized as a part of work on leaving the real-world ramifications of conceivable assaults misty. Conversely, we center around those assaults that represent a realistic and functional risk to systems that as of now are or can undoubtedly be conveyed. We isolate the assaults we think about into two classifications, which contrast both in the particular inspirations of potential aggressors and in the specialized methodologies for actualizing the assaults. The two classifications of assaults we are occupied with are avoiding and pantomime. Both avoiding and pantomime target face recognition systems (FRSs) that perform multi-class grouping specifically, they endeavour to discover the individual to whom a given face picture has a place.

2.4 Autonomous Landing

This article depicts an idea of an autonomous landing arrangement of UAV (Unmanned Aerial Vehicle).[13] (Marcin Skoczylas, 2014) This kind of gadget is furnished with the usefulness of FPV perception (First Person View) and radio telecom of video or image information.

The issue is the execution of an arrangement of autonomous automaton arriving in a territory with measurements of 1m × 1m, in light of camera combined with an image transmission framework associated with a base station. Caught images are examined and landing marker is identified. For this reason, image highlights locators, are used to make a database of keypoints of the arrival marker and in another image keypoints are discovered utilizing a similar component finder. In this paper after effects of a structure that permits discovery of a characterized marker with the end goal of automaton landing field situating will be introduced. The model is trained and then made the landing possible.

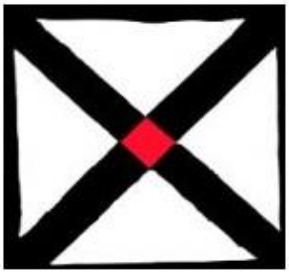

Figure 2.3: Trained feature for landing[13]

It is essential to choose legitimate keypoint finder algorithm relying upon runtime and image conditions. Considering, that the entire technique will be kept running in a situation with restricted assets, the algorithm must be robust. Along these lines, the speed and runtime of the algorithm is supported over the accuracy, yet from the other hand high accuracy additionally should be accomplished. The key point identifier is most critical part for the entire methodology, as it's the most computationally thorough part. This segment primary motivations behind the introduced approach, and additionally contrasts in existing applications will be outlined. The principle reason for the arrangement is a probability of legitimate location of landing markers by flying the automaton progressively. Markers, speaking to landing positions, are characterized before catching images nearby and are reused in following keeps running of the algorithm. [25] (Marcin Skoczylas, 2014) The automaton catches surroundings utilizing its versatile camera and because of the system, the algorithm should provide for the automaton gadgets data about places of identified landing markers. In by and large, the algorithm must be robust with low computational many-sided quality, yet additionally with high accuracy. It's essential to take note of, that the arrival markers will be unmistakable in automaton's surroundings in various scales and pivots. The arrangement should deal with this circumstance nimbly, providing for the automaton probability of various catch edges and light forces, conceivably without confounded calibration. Additionally, the caught image can be confused by radio clamor and frequently that commotion covers the arrival marker, in this way deceiving the location.

To tackle the issue above, with the end goal of appropriate discovery of the arrival marker even in low-quality images, image highlights identifiers are used to make a database of key purposes of the arrival marker. Micro-drone shot that marker amid the trip over the ground. Videos, all things considered, situations from miniaturized scale ramble camera were caught and a few video frames were removed for additionally handling.

2.5 Hindering Face Detection

As a huge measure of visual media is day by day shared, saw and put away on the web, genuine threats to the depicted people's security might be posted. For instance, World Wide Web checking frameworks that utilization confront detection, following and acknowledgment in shared videos or images could likewise be utilized to disregard protection.[12](Panteleimon Chriskos, 2017) Another significant threat to security is because of the wide utilization of video reconnaissance out in the open places by observation/activity cameras or

automatons, since, any individual can possibly be identified on such videos and images. In this unique situation, let us assume that a vindictive client endeavours to perceive and track a particular individual in visual media consequently. The initial step is to detect all countenances in an image or video outline at that point perceive these facial districts of intrigue and hold just the ones that depict the focused on person. In order to secure the focused on singular protection, dedicated to hinder confront acknowledgment, otherwise called confront de-identification techniques have been proposed.

In the first place, impromptu face de-identification techniques apply veils on face, e.g. by utilizing dark bars to cover the eyes or T-formed covers that cover both the eyes and nose as well as mouth. Other veil shapes can be utilized, e.g. rectangular ones that uncover just the mouth and curved or roundabout ones that over the whole facial image ROI. Other specially appointed strategies low-pass channel the facial image ROI, apply irregular clamor, utilize the negative of the facial image, or swap confront sub locales, for example, eyes, nose or mouth, having a place with various people. Other de-identification techniques spatially subsample a facial image, bringing about pixelation, or apply a limit to the facial image pixels. Variational versatile sifting in conjunction with confront key point detection has likewise been proposed to accomplish confront de-identification, while holding the facial appearance of the depicted person. In Active Appearance Models and the k-Same-uttermost model are utilized to hold facial articulations on de-identified images. An expansive group of face de-identification strategies actualize the k-secrecy model, with the goal that any of the de-identified images can be misclassified as having a place with at any rate to k unique people. The de-identified image is computed by averaging the k facial images that are most like the information image. Moreover, a target function can be planned and the ideal weights for averaging the k most comparable images are found out by means of inclination descent. In, the slightest comparative k images known as k-Same-farthest, are utilized. Expanding upon past work, aside from utilizing the slightest comparable k images, special de-identified countenances are created a for every one of the k unique appearances.

In the underlying face is supplanted with a face from someone else. Another face de-identification technique diminishes the quantity of eigenfaces utilized as a part of reproducing the facial images.

2.6 Cores required for Image Processing

The more the complex algorithm the more energy is required with more cores. UAVs (Unmanned Aerial Vehicles) are utilized as a part of an assortment of undertakings, for example, observation, review, arrive looking over. [10](Dries Hulens, 2016)They are generally physically controlled remotely or take after a predefined flight way, while gathering intriguing pictures of nature. These pictures are regularly broke down disconnected since the preparing energy of these UAVs is restricted. Generally a remote connection is given to do the handling of the pictures on a ground station giving the guidelines to the UAV. To be more self-ruling and work all the more heartily

UAVs ought to be furnished with handling power so pictures can be prepared locally available. This will guarantee that UAVs can break down and respond progressively on the pictures and that they can fly considerably facilitate since a remote connection isn't essential.

Late advances concerning inserted stages demonstrate a continuous increment in preparing power at sensible power utilization and weight. As of now, it even ends up conceivable to utilize these mind boggling equipment stages under UAVs.

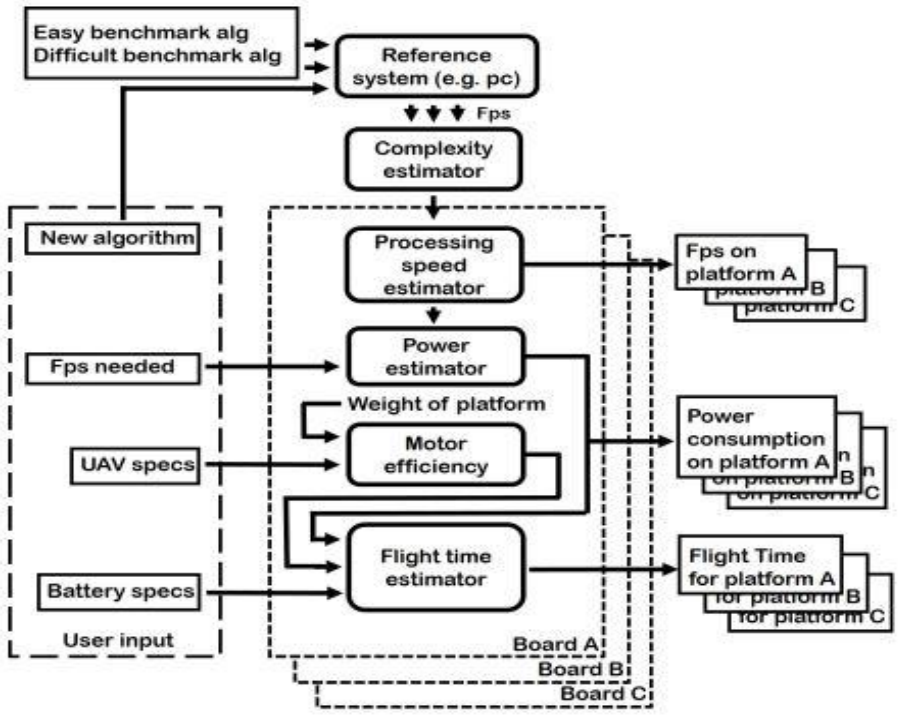

Figure 2.4: To determine the requirement of processor for quadcopter[10]

For an assortment of errands, complex picture preparing algorithms are a need to make UAVs more independent. Regularly, the handling of pictures of the on-board camera is performed on a ground station, which extremely restrains the working scope of the UAV. Frequently, disconnected handling is utilized since it is hard to locate an appropriate equipment stage to run a particular vision algorithm on-board the UAV. As a matter of first importance, it is elusive a decent exchange off between speed, control utilization and weight of a particular equipment stage and furthermore, because of the assortment of equipment stages, [10](Toon Goedeme, 2016) it is hard to locate a reasonable equipment stage and to assess the speed the client's algorithm will keep running on that equipment stage. In this paper we handle those issues by exhibiting a framework that consequently decides the most-suited equipment stage for each self-assertive complex vision algorithm. Moreover, our framework evaluates the speed, control utilization and flight time of this algorithm for an assortment of equipment stages on a particular UAV. We show this system on two genuine cases and give a diagram of the present best handling CPU-based stages for locally available UAV picture preparing.

An outstanding lightweight preparing stage is the Raspberry PI. The PI is a little, minimal effort 1GHz based equipment stage created for instructive purposes. The fundamental favourable position of this little stage is that it runs a linux-based circulation, which permits the compilation and utilization of well-known vision libraries e.g. OpenCV. Obviously, the preparing speed is restricted, however straightforward vision algorithms, as e.g. confront discovery based on skin shading division, keep running at ongoing execution. The PI with lighweight core and small size with a GPU which as of late ended up open-source

2.6 UAV for 3-D mapping

Drone is deployed in a building and getting rough sketch of the building. Rough sketches like where are the walls where is the kitchen. The drone is totally autonomous which will send its signal to ground station. the map is made up of GUI framework for he ease of user. [7](Avery E. Holton, 2016)UAV stages are these days a profitable wellspring of information for examination, surveillance, mapping and 3D displaying issues. New applications in the short- and short proximity space are presented, being the UAVs ease contrasting options to the established kept an eye on aerial photogrammetric. Revolving or settled wing UAVs, fit for playing out the photogrammetric information securing with novice or SLR advanced cameras, can fly in manual, semi-mechanized and self-ruling modes.

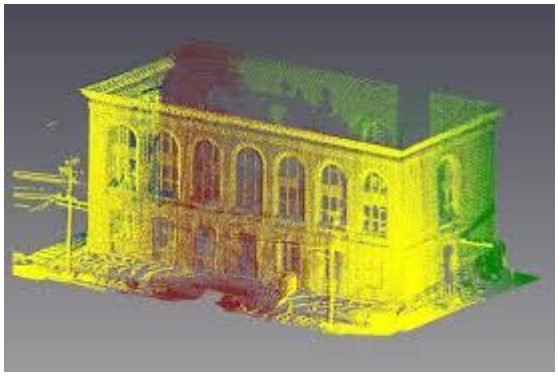

Figure 2.5: 3-D mapping using lidar[7]

UAVs which incorporate small scale, smaller than usual, close-, short-medium-extend, medium-go continuance, low height profound entrance, low elevation long perseverance, medium height long continuance frameworks. UAVs like unmanned battle self-ruling vehicles, deadly and imitations frameworks. In the past the improvement of UAV frameworks and stages was fundamentally inspired by military objectives and applications. Unmanned assessment, surveillance, observation and mapping of unfriendly zones were the essential military points. GNSS is for the most part utilized as a part of code-based situating mode and in this manner it isn't adequate for exact direct sensor introduction. The utilization of RTK(Real Time Kinmetic) procedures would enhance the nature of situating to a decimetre level, however the framework would turn out to be excessively mind boggling, costly and heavy. GNSS is mostly utilized as a part of code-based situating mode and along these lines it isn't adequate for precise direct sensor introduction. The utilization of Real-time kinematic methods would enhance the nature of situating to a decimetre level, yet the framework would turn out to be excessively intricate, costly and overwhelming. Camera alignment and picture introduction undertakings require the extraction of regular highlights unmistakable in whatever number pictures as could reasonably be expected. In aerial photogrammetric this undertaking is refined today by misusing automatic aerial triangulation procedures. In short proximity photogrammetric, the mechanization of this assignment is a more unpredictable issue because of expansive (and regularly fluctuating) picture scale, united picture geometry, sporadic cover, solid geometric and radiometric changes. As a rule, picture pieces procured by utilizing UAV frameworks are more like short proximity than aerial squares. Therefore, standard AAT methodology don't work out legitimately. Strategy in light of the manual ID of tie focuses by a specialist administrator or in view of signalized coded markers are very much surveyed and utilized today in short proximity applications. As of late a few methodology for the computerized extraction of a reliable and repetitive

arrangements of tie focuses from marker less short proximity (or UAV) pictures have been created for photogrammetric applications.

2.7 Drone automatic surveillance challenges

Protected and dependable outside route of self-sufficient frameworks, e.g. unmanned aerial vehicles (UAVs), is a testing open issue in apply autonomy. Having the capacity to effectively explore while dodging snags is for sure pivotal to open numerous apply autonomy applications, e.g. reconnaissance, development checking, conveyance, and crisis reaction . An automated framework confronting the above undertakings ought to at the same time comprehend numerous difficulties in recognition, control, and limitation.

These turn out to be particularly troublesome when working in urban zones, as the one delineated. In those cases, the independent operator isn't just anticipated that would explore while maintaining a strategic distance from crashes, yet in addition to securely associate with different specialists introduce in the earth, for example, people on foot or autos. [25](Antonio Loquercio, 2018) The conventional way to deal with handle this issue is a two stage interleaved process comprising of

(i) programmed limitation in a given guide (utilizing GPS, visual as well as range sensors), and

(ii) calculation of control charges to enable the operator to maintain a strategic distance from deterrents while accomplishing its objective new methodologies in light of profound learning have offered an approach to firmly couple recognition and control, accomplishing amazing outcomes in a substantial arrangement of undertakings .

Among them, strategies in light of reinforcement learning (RL) experience the ill effects of fundamentally high example unpredictability, preventing their application to UAVs working in wellbeing basic situations. Interestingly, directed learning strategies offer a more feasible approach to learn. viable flying strategies, yet despite everything they leave the issue of gathering enough master directions to impersonate. Moreover, as pointed out by, impact directions maintained a strategic distance from by master human pilots are really important to give the automated stage a chance to figure out how to act in hazardous circumstances.

UAV effectively exploring through the avenues ought to have the capacity to take after the roadway and additionally immediately respond to hazardous circumstances precisely as some

other ground vehicle would do. Along these lines, we thus propose to utilize information gathered from ground vehicles which are as of now incorporated in conditions as previously mentioned.

While Reinforced Learning based calculations have been fruitful in learning summing up arrangements, they as a rule require a lot of robot encounter which is expensive and perilous to secure in genuine wellbeing basic frameworks. Conversely, supervised learning offers a more reasonable approach to prepare control strategies, yet clearly relies on the gave master flag to mirror. This supervision may originate from a human master, hard-coded directions, or model prescient control. Be that as it may, when working in the boulevards of a city, it can be both repetitive and perilous to gather an extensive arrangement of master directions or assess somewhat prepared strategies. Also, the area move amongst master and specialist may impede speculation capacities of supervised learning strategies. To be sure, past work in prepared a UAV from video gathered by a mountain climber yet did not demonstrate the scholarly arrangement to sum up to situations inconspicuous at preparing time. Another promising methodology has been utilize re-enactments to get preparing information for reinforcement or impersonation learning undertakings, while testing the educated strategy in reality. Clearly, this approach experiences the space move amongst recreation and reality and might require some certifiable information to have the capacity to sum up. As far as anyone is concerned, current test systems still neglect to show the substantial measure of fluctuation introduce in a urban situation and are along these lines not completely satisfactory for our errand. Also, despite the fact that some spearheading work has been done in, it is as yet not by any means clear how to make approaches learned in re-enactment sum up into this present reality. [25](Ana I. Maqueda, 2018) To conquer the previously mentioned confinements, we propose to prepare a neural system strategy by impersonating master conduct which is produced from wheeled kept an eye on vehicles as it were. Despite the fact that there is a collection of writing on the assignment of controlling point forecast for ground vehicles, our objective isn't to propose yet another technique for guiding edge expectation, but instead to demonstrate that we can send this skill likewise on flying stages. The outcome is a solitary shallow system that procedures all visual data simultaneously, and straightforwardly creates control summons for a flying automaton.

In our moral, field of legitimate, explore, and there social issues viewpoints that more incorporate than others. The point we propose to center around in this article is unmistakably one of them. Give us a chance to think about a case to show this reality. Utilizing automatons

to help casualties in a territory where a war happens can prompt sudden practices from regular citizens (dread, freeze, or even forcefulness), in light of the fact that the regular people can consider the UAV (unmanned aerial vehicle) a risk. They may have seen or been recounted military automatons, for example, the Predator, which are weapons: subsequently, the "Predator Disorder." For a few non-specialized reasons, for example, this, look into endeavours toward a helpful automaton can't be made without considering the moral, legitimate, also, social angles from the origination stage to the landscape tests. Sociologies along these lines permit bringing up issues and giving pieces of information about the best answers for address the issue internationally that is to state, in fact and non-technically.

Technique for ongoing understanding of natural highlights having visual route arrangement i.e Unmanned Aerial Vehicle (UAV) is introduced. [38](Davide Scaramuzza, 2018)Having Proposed approach utilizes physically inspected shading esteems to characterize diverse land covers. Shading data of an arrangement of physically chose windows is contrasted with selecting the best characteristics required for separation various landing covers in different (common) lighting intensity conditions. Each edge is then mostly checked and wanted ecological highlights are separated and characterized. The outcomes improves the earlier stage of speed and efficiency and exactness from the previous outcomes.

CHAPTER 3

PROBLEM STATEMENT

3.1 Gaps in Study

In the above literature survey. There are several gaps which are being found. The drone with on-board decision making ability is not there. Either they do off-board by matching the datasets on ground or they save data on local storage and calculate the results later. Furthermore, The landing of drone is done based on the landing sign in which the openCV model is trained. The drone is being landed on the landing sign. Whether it is supervised learning or unsupervised learning there are several weaknesses while implementing it on drones. The research haven't gone for matching the face onboard with different angles and altitudes. Our approach is to identifying the distance of target from the drone. The target is created when the face is matched and to know the apt distance from the drone. In the litrature knowledge there no such dataset in which face is being captured from certain heights and certain angles. Though the prototype is build we are making the drones into the next level by adding the searching for the faces comparing it with local images and producing the classification results.

There are several research papers which tells us about the boards which are suitable for image processing using drones. The Drones however is either connected through telemetry or Wifi or Bluetooth but is directly or indirectly connected with the remote server i.e the ground station. The drone somehow depends upon third party processor. The researchers are made on specific frameworks like AR parrot drones. Researchers are dependent upon framework like flyOS to compute the results accordingly. The result is being calculated without IR or sonar sensors. The modern research will be done integrating all the modules so that we can build a better prototype.

3.2 Problem Definition

As per gaps found after the extensive literature survey, This research will be carried out on an onboard platform. The results which are required will be fetched without the involvement of third party processor. The drone will integrate with image processing platform from the

certain height and altitudes. The image processing is done with the Convolution Neural Network (CNN).To enhance the image processing platform we can use parallel processes the recognize multiple face on one frame in a single time. Integrating it with the obstacle avoidance is leads to more involvement of energy.

3.3 Objectives

- To design working prototype of UAV using Raspberry pi 3.
- To implement face recognition algorithm and detect target algorithm.
- To compare results produced by Amazon ReKognition, Deep learning algorithm with the propel algorithm by using MAVLINK commands.

CHAPTER 4

DESIGN AND DEVOPLMENT OF SEMI-AUTOMATED UAV

The Design and Development of semi-automated UAV is subdivided into Technical Overview and Research Orientation.

4.1 Technical Overview

To implement research methodology, Firstly we need is how to optimize our results with minimum amount of resources. Assembling the drone is another challenge, Soldering all the ESC to the circuit and connecting it with a PIXHAWK and PIXHAWK further with Raspberry pi 3.

Here are the parts used for testing purposes

Table 4.1: Parts Description of quadcopter

Sr no.	Part Name	Description
1	Pixhawk 2.4.6 Flight Controller	Balances the frames equipped with commands
2	Raspberry Pi 3	On board Processor, Decision making ability
3	Electronic Speed Control *4	Controls the speed of the motors
4	Sonar Sensors*5	Obstacle avoidance
5	RPI Camera	Image processing and Recognition
6	Battery 5200Mah	More battery more life
7	Remote control. Transmitter and Receivers	AUTO and GUIDED Mode
8	PX4 Flow Sensor	For Safe Landing

The drone built should be neat and tidy and one must be aware of Pins and slots. Once the wires are being properly placed. It is important to calibrate the Pixhawk with Remote control as Firstly we have to drive it manual and then we can make in autonomous state.

If we calibrate all four motors first we will be at a safe side because the propellers might get broken and it is important to test on ground. We don't know how the drone is collaborated initially. Configure the Quad copter with mission planner. The mission planner installs all the necessary packages in the Pixhawk. The Pixhawk stores all the essential details in the local storage of itself and picks up all the files when loaded. The battery of a drone covers hardly about 12mins. As the weight of drone increases the motors required with higher amps and the battery will discharge at quicker rate. We won't go into that deeper. The pins connections are available on http://ardupilot.org.

4.2 Research Orientation

The research is implemented in several phases. The drown flying at a certain height The first method is Traversing, Face Recognition, Face Identification, Classification, Landing.

4.2.1 Traversing

The Traversing algorithm is dynamic algorithm. It depends upon the size of the ground. At what Yaw axis it should rotate to traverse the whole ground. Larger the ground larger the traversing larger the power required by the drone to implement. Traversing algorithm

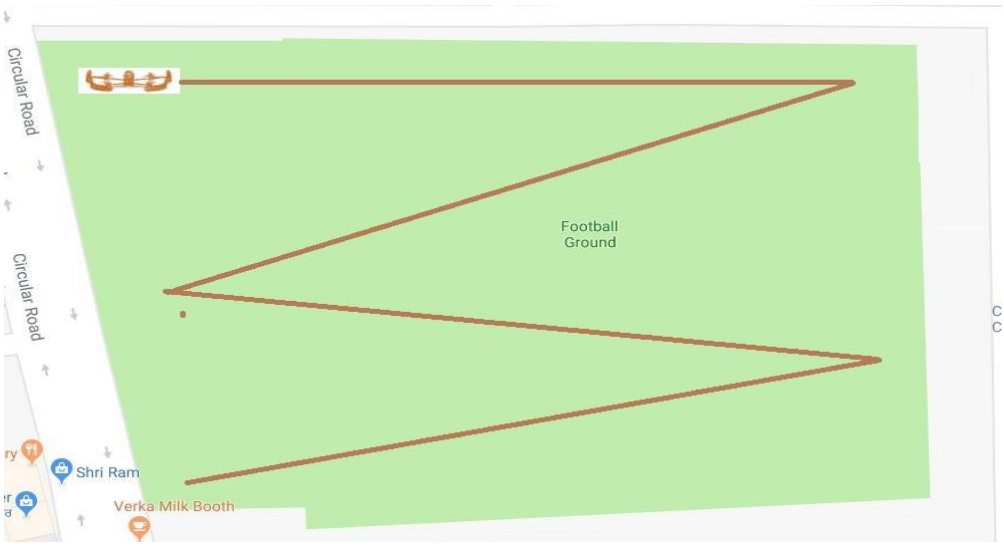

Figure 4.1: Traversing of drone

The traversing algorithm also depends upon the Altitude of the drone. The drone covering the frame size. As we move to higher altitude the frame size get increase but the face array will get blurr and face recognition algorithm may vary. Scanning the whole ground is difficult to implement and scanning the people might create several exceptions. These exceptions had been discussed in challenges chapter 3. The traversing will proceed in normal manner but when the face is being found in the frame it will switch to land mode.

4.2.2 Face Identification

Face Identification is done with OpenCV. While searching in the frame if the face is found in the frame the face would be extracted from the camera. The face is trained with Harcascade_front_face.xml file. This Xml file is combination of positive and negative images which trains the model but in this OpenCV. Our focus was on various facial algorithm so we used pre tested algorithms of OpenCV. The Image is fetched and recorded in local storage. The images which are stored are recorded for tested purposes.

The image which is being stored in rectangle format of a only face. which helps us to take only facial features hence the algorithm works fine. Sometimes the algorithm may put an exception due to the movement of a drone. The camera might take a blur rectangular face. More the camera will be fine, there will less probability the image that is fetched will be blur. If the blur image is taken the algorithm is being put in exception. It will put into exception because the algorithm will fail to fetch the facial features. It will be fetching continuously until able to fetch correct image of a face.

4.2.3 Face Recognition

The face recognition library having an accuracy of 99.38% in the nearest approach made Dlib library by Davis King for providing with trained facial feature extraction and face encoding models used in this docs. Method overview constitutes of high cores which are helpful in fast processing leads to immediate results. Our propose is to approach the detecting facial features such as Unmanned Aerial Vehicles (UAVs) drones when they conquer a small area of the field. Our approach of learning is to extract features with different sides and different angles and evaluate testing results and avoiding obstacles . When the image is extracted. The deep learning algorithm works on Convolution Neural Network (CNN) . CNN network algorithms will help to match the face features and it designed and recognise the pattern of lips, ear, nose, eyes.

CNN network clusters and classify the data. They help to aggregate unlabeled data as indicated by similarities among the example inputs, and they classify data when they have a labelled dataset to prepare on. Neural Networks can likewise extract features that are encouraged to different algorithms for clustering and classification. A supervised learning is imposed where classification work depends upon detailed datasets. The co-relation between data and labels are found in supervised learning. Detection of similar ties is done via clustering.

4.2.4 Landing

Perusing from face recognition the code. The code switches to MAVLINK commands. The MAVLINK is new in technology for automation. The MAVLINK platform is continuously developing for drone automation platform. MAVLINK may have several vulnerabilities as it is new platform. These are later get converted into MAVLINK which takes control over flying commands which enable a UAV to safely navigate while avoiding obstacles. The landing of a drone will confirm that the drone lands to the right owner. The interesting thing about the drone or research is that the drone land autonomously without making the plus sign on ground. Mostly the research paper based upon the landing based upon the landing mark on ground. Without approaching the mission planner. The landing command will help us to know at what distance the target is. When the landing command is performed. Drone will judge the distance of the person and land accordingly.

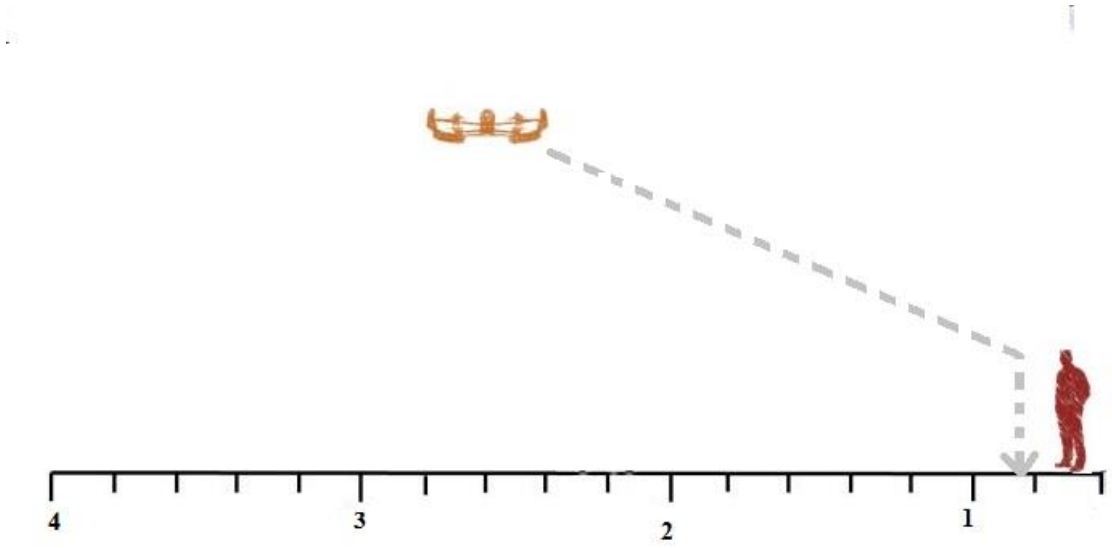

Figure 4.2: Landing method overview

Note: Multiple targets**:** Having multiple targets within a single frame the maximum the height is the maximum the angle results maximum face in a frame and maximum chances of disarray image. Target victim will not get aware that the facial array is being taken and testing is done on the bases of that.

4.3 Process Overflow

This figure depicts the automation process. The drone process will take more than one independent processes and the landing command will work accordingly.

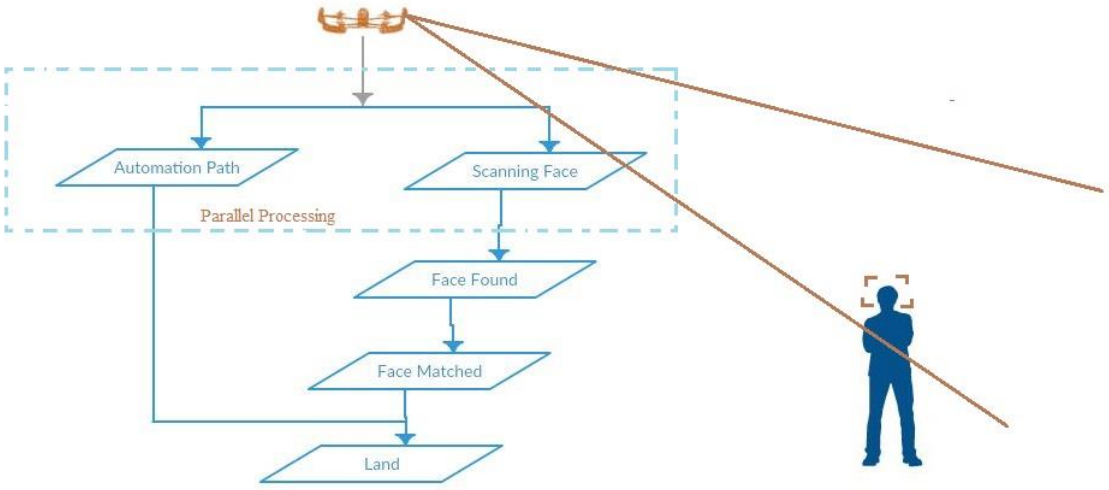

Figure 4.3: Process Flow of research

4.4 Algorithm Study

This section comprises of Algorithm study. Here it follows

4.4.1 Algorithm Definition

The practical implementation is done using MAVLINK which is embedded in python. Python 3 doesn't work well with MAVLINK commands. It's better to implement python 2.7. Here the Raspberry Pi 3 problem arise. The face recognition library works well in Python 3 in Raspbian OS but MAVLINK performs better in Python 2.7.

Note: The algorithm is not performed together on raspberry pi 3. The algorithm is subdivided into sub modules i.e

- Deep Recognition: Using the concept of deep learning.
- Landing: Only face is detected and land with respect to the face.
- Face Tracking : Following the face.

The reason for dividing the algorithm into modules because of less cores of raspberry. This test might perform better results NVIDIA TX1 model.

Traversing the path

Let the target image be the $I_{ij}(G)$ and $T_{ij}(G)$ to be the traverse path.

$$T_{ij}(G) = \begin{cases} U_{ij}(G) i \in L,\ j \in L \\ I_{ij}(G).Otherwise \end{cases}$$

where L belongs to Longitude and Latitude of a function and it follow a distinct path after the set of intervals. The target image is further deviated into $I_{ij}(G)$ with the description as given below.

$T_{ij}(G)$ refers to the deep learning pattern of face recognition pattern. $K(G)$ belongs to the ignoring state where face doesn't match.

$$I_{ij}(G) = \begin{cases} T_{ij}(G) i \in M \\ K(G).Otherwise \end{cases}$$

where M belongs to face recognition points embedded with deep learning.

4.4.2 Algorithm

Initialize the parameters of the drone

Initialize the images

Initialize the modes

Parallel Process1: Guided

Drone automation is following the path

Parallel Process 2: Loiter

while stopping conditions doesn't match **do**

Searching for a face with the trained model

if $I_{ij}(G)$ is found **do**

if $T_{ij}(G)$ is found **do**

Stop Parallel Process 1: Guided

LAND command thorough loiter or guided

end if

end if

end while

Return the drone to initial stage.

4.4.3 Algorithm Details

Initialize the parameter means drone has to been connected to GPS first. To get accurate results we first fetch the true GPS location. The Neo GPS Location is having a very good accuracy as compared to the APM2 . It even tells different the precision in 2 cms. To test inside environment we have to use other modules because GPS doesn't give better results.

The path can be set through tower application which is being developed by DroidPlanner Labs. The commands will be given through telemetry. On the parallel side the raspberry pi will on the openCV and search for the face. If any command is generated through the Raspberry pi 3, The Pixhawk 1 is having the capability to receive the dual commands. On the other side we can have one more raspberry pi3 to have more integrated processing. When the facial features are being fetched. The drone will automatically land. This command is being set on raspberry pi 3. This algorithm cannot be performed in a single module hence more than one raspberry pi 3 module. The better alternative can be NVIDIA TX1 an integrate all the modules in one logic.

CHAPTER 5

RESULTS & DISCUSSIONS

5.1 Testing Description

The drone testing has resulted discontinuity. To know that face is detected we need to connect the board of Raspberry Pi 3. With raspberry Pi 3 onboard the pins are connected with Tx Rx on-board with the Pixhawk 1. While implementing the testing results the drone is not able to detect faces due to light hence the experiment that has been performed mostly on the evening. We need a good ground clearance to perform the testing. The speed of the wind changes the PID value.

The Testing is being performed in loiter mode and the transmitter which comprises of 9 channels which each button having different ability. The landing command which is being given to Pixhawk when face is detected is through channel 7.

The testing is being performed the help of GPS only. The PX4 sensor created lot of problems due to the uneven of the grass. Hence the autonomous state is achieved with the GPS only. When the drone is armed we plotted the points carefully and with the last point we performed return to local(RTL). The RTL stands for return to local.

The testing comprises of 3 results

- Face Detection
- Landing near to the target
- Drone following the face

The code is embedded in Python and performed using SITL. The follow me feature which is developed using python which is tested in SITL to check the performance of drones. This test is performed without the help of sonar or lidars.

5.2 Deep Learning v/s ReKognition

Here are the testing results of various algorithms results which the pictures are taken on-board and result are being calculated to the local computer. The RE-algorithm is performed in evening where the light intensity is high. The lens will focus to its best side hence the result is calculated on the bases of that.

Here x means the width distance and y means the altitude of the drone.

Table 5.1: The RE-Kognition accuracy results

4	0%	0%	0%	35%	95%	5%	0%	0%	0%
3.5	12%	0%	25%	75%	100%	45%	35%	24%	0%
3	25%	25%	65%	100%	75%	65%	50%	30%	5%
2.5	92%	50%	100%	100%	100%	79%	60%	40%	7%
2	95%	100%	100%	100%	100%	100%	75%	24%	3%
1.5	100%	100%	100%	100%	100%	91%	65%	23%	5%
x/y	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**	**4.5**	**5**

The test is done on raspberry pi 3. Though camera specifications were less but the result is calculated on board. The result which is being produced is classification result.

Table 5.2: Classification result with approach of deep learning

4	0	0	0	1	1	0	0	0	0
3.5	0	0	0	1	1	1	0	0	0
3	0	0	1	1	1	1	1	1	0
2.5	1	1	1	1	1	1	1	0	0
2	1	1	1	1	1	1	1	1	0
1.5	1	1	1	1	1	1	1	0	0
x/y	**1**	**1.5**	**2**	**2.5**	**3**	**3.5**	**4**	**4.5**	**5**

The testing results comprises of face recognition library which is embedded with deep learning and you can see the we can receive better results using deep learning library.

5.3 Autonomous Flight Results

The testing is of automation path is done with the help of tower application. The path is initialized. On the other hand the Loiter and stable command is given by RC only. The commands on the other side is also given by raspberry pi 3 whether to continue the autonomous path or land.

Figure 5.1: Traversing & testing automation path

The next table depicts the testing of the autonomous path whereas RTL stand for return to local which mean when drone is not able to perform its autonomous path we can change the mode to RTL. This drone works on GPS path. This autonomous path is having the limitations. It cannot be perform inside the room.

Table 5.3: Testing of autonomous path

Sr.no	Altitude	Delay	Followed	RTL
1	2	1s	yes	no
2	3	2s	yes	no
3	2	2s	yes	no
4	5	3s	yes	no
5	1	5s	yes	yes

The tower application provides the rough graphical view of the data which is being traversed in which waypoints are being classified. After being armed the drone is set for the mission. All the parameters are deployed and all the waypoints perform a specific function.

The tower application is in all versions of android and apple, rather carrying heavy laptops with us. These are the screen shots of the testing results. The drone followed the path successfully. Marking the points on trough the GPS is an challenging task watching the ground points. This should empower additionally work on development of the more effective control law.

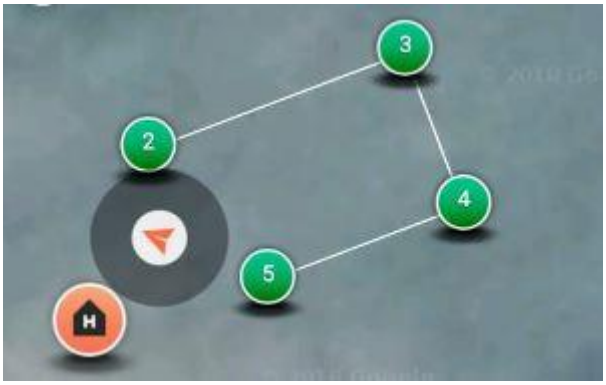

Figure 5.2: Traversing graph of the drone

5.4 Testing the python code

The MAV code is embedded in python it takes about a days while installing the components. The stable mode is communicated through the GPS.

Image Processing result are as follows:

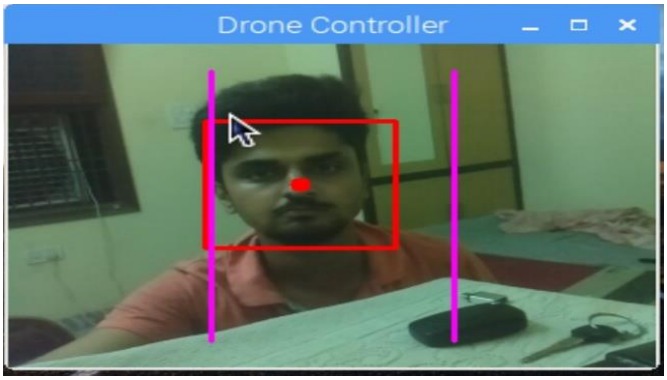

Figure 5.3: The reference lines for follow me

The reference lines depicts when t he face will go out of frame, Let's say when the face will be right the loiter command will rotate towards right and vice versa i.e when the face will rotate left the drone automatically rotate left hence the automation will proceed successfully. This automation is done through SITL.

5.4.1 Pitch Results

Here are the pitch results

```
vehicle.channels.overrides[2] = 1500

vehicle.channels.overrides[2] = 1300
```

```
vehicle.channels.overrides[2] = 1700
```

Figure 5.4: The testing results in python

The values like 1500, 1300, 1700 depicts that these all the radio values which are being through RC but here the drone is autonomous so we are giving MAV commands through raspberry pi 3 and [2] depicts that it the pitch.

5.4.2 Yaw axis results

Yaw results

```
vehicle.channels.overrides[4] = 1400
vehicle.channels.overrides[4] = 1600
```

Figure 5.5: Channel 4 yaw results through MAV link

The channel depicts the Yaw results. The instruction is given by python commands the python integrated feature helps in integrating the sensors also. The Rpi library is helpful in that case.

5.5 Pi Heating Results

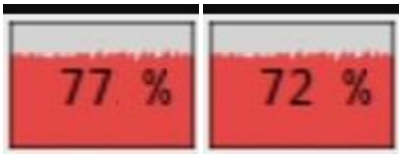

Figure 5.6: Processor heating results on ongoing process

The above figure tells about the processor results of the openCV with drone kit and with MAV. All modules consume some memory e.g openCV consumes about 30-35% and the remaining like core has been taken by MAV link and drone kit which is all being. Raspberry PI's processor more than 85 % results break the remote dekstop connection. and the raspberry pi heats at the extreme level. Hence this shows that we need other higher board.

CHAPTER 6

CONCLUSIONS & FUTURE WORK

This chapter 6 is having a conclusions regarding drones based on testing results which is being implemented above and further it tells about the future work could be done for further research.

6.1 Conclusions

In this research we strived ourselves to implement face recognition using Adam Geitgey algorithm with the concept of Deep Learning. The main work of thesis is done into sub segments which are as follows:

- We can apply Deep Leaning while implementing it on drones on-boards. Rather than making our drone slave.
- Face Recognition is possible with implementation of deep learning. To achieve better results.
- The Raspberry pi 3 is not that much efficient board. Switching to Odroid and Nvidia tx4 is better alternative to implement collision avoidance also.
- The 5 MP camera fails after a distance of 4 mts. Its fails to fetch the facial array data while flying.
- The sonar sensor fails while flying a drone. The propellers create a massive thrust which fails the sonar due to wind.
- The drone can be converted to nano-drone. Which will minimizes all our drone modules and integrate into single module.
- The MAVLINK is helpful is creating the framework for the drones which will ease implementation.
- The python code has been made and uploaded. The reference has been given in the introduction part above in chapter 1.

There are all conclusion which has been made by our research.

6.2 Future Work

The conclusions we have made by aiming our research resulted several future works which we will implement later.

- The research can be further extendable using odroid, Nvidia tx4 to integrate both lidar for collision avoidance and face recognation by the deep learning.
- Camera with higher mega pixels can be used which can demonstrate greater distance on which it is able to detect the faces.
- Semi-autonomous to fully autonomous vehicle (without RC).
- Convert the drone to nano-drone.

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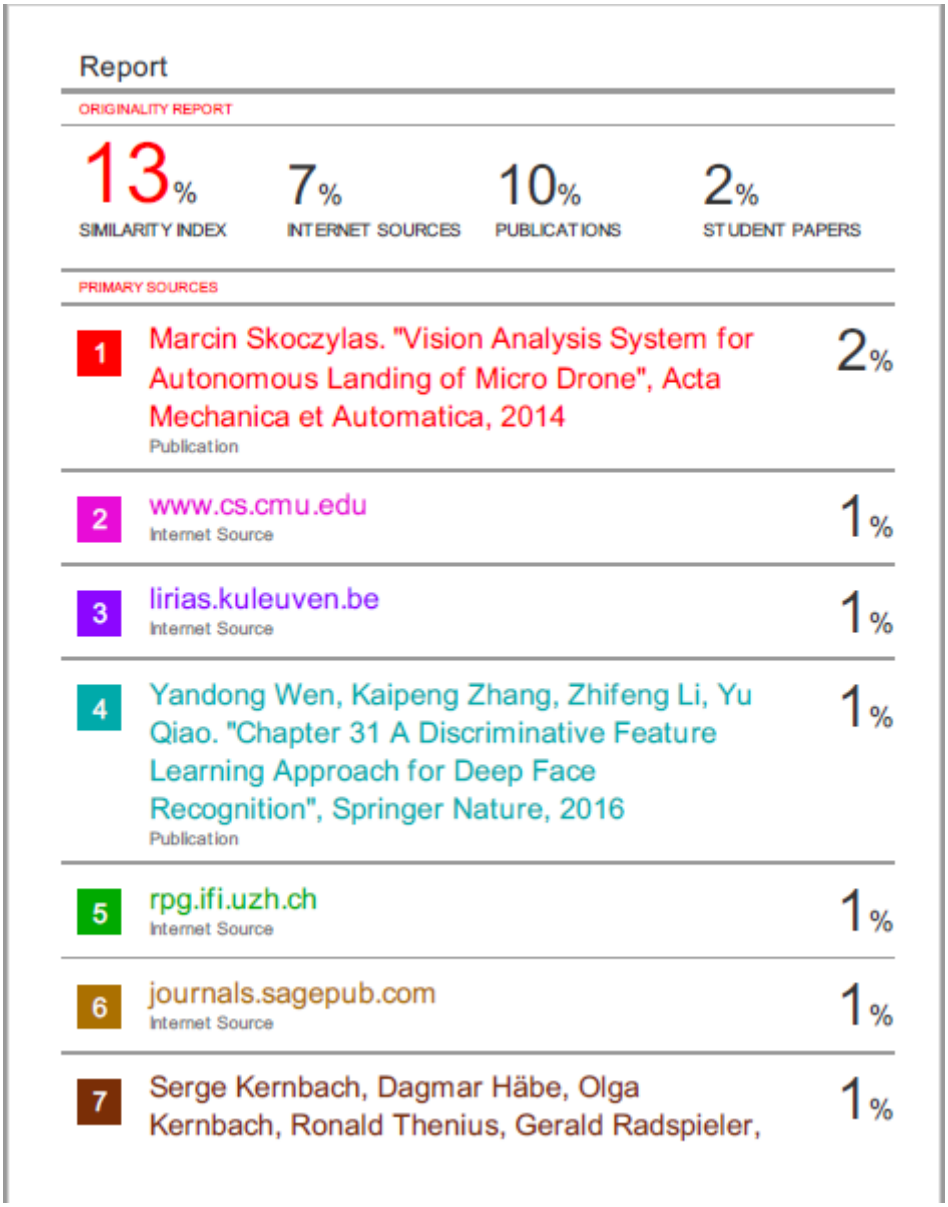
VIDEO LINKS & REFERENCE LINKS

- Drone following the face with repect to camera link: https://www.youtube.com/watch?v=j1E-O_9cOT0
- Landing of a drone with respect to drone link: https://www.youtube.com/watch?v=PyqBv0nyvNs
- Visual of Python camera link: https://www.youtube.com/watch?v=PAeLegcHZQo

APPENDIX

Plagiarism Report



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