VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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INTERNSHIP REPORT ON

"LABVIEW AND DESIGN OF AN AUTONOMOUS QUAD COPTER TO SERVE NATURAL COMMODITY USING ARM 32"

Submitted in partial fulfillment of the requirements for the award of degree

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Submittedby

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CERTIFICATE

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BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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ABSTRACT

An internship is a period of work experience offered by an organization for a limited period of time. They are typically undertaken by students and graduates looking to gain relevant skills and experience in a particular field. Employers benefit from these placements because they often recruit employees from their best interns, who have known capabilities, thus saving time and money in the long run. Internships are usually arranged by third-party organizations which recruit interns on behalf of industry groups. Rules vary from country to country about when interns should be regarded as employees. Internships for professional careers are similar in some ways, but not as rigorous as apprenticeships for professions, trade and vocational jobs. These positions may be paid or unpaid and aretemporary.

Typically, an internship consists of an exchange of services for experience between the intern and the organization. Internships are used to determine if the intern still has an interest in that field after the real life after the real life experience. In addition, an internship can be used to create a professional network that can assist with letters of recommendation or lead to future employment opportunities. The benefit of bringing an intern into full time employment is that they are already familiar with the company, their position and they typically need little to no training. Internships provide current college students the ability to participate in a field of their choice to receive hands on learning about a particular future career, preparing them for full timework following graduation.

ACKNOWLEDGENT

Fisrt I would like to thank **Dr. K V SC Sastry, Scientist ‘ F’, DRDO (DARE),** for giving me the opportunity to do aninternship within the organization.

I would also like to thank **Mr. Sathya,DRDO (DARE),** for giving me the opportunity to do aninternship within the organization.

I also would like all the people that worked along with me in **DRDO (DARE),** with their patience and openness for creating anenjoyable working environment. It is indeed with a great sense of pleasure and immense sense of gratitude that I acknowledge the help of these individuals.

I am highly indebted to Managing Trustee **Mr. Vivek Alva** and Principal **Dr.Peter Fernandes,Alva’Institute of Engineering andTechnology, Mijar**f or the facilities provided to accomplish this internship.

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I would like to thank **Mr. Deepak Raj, Assistant Professor, Department of Electronics and Communication Engineering** for his support and advices tocomplete internship in above said organization.

I am extremely great full to my department staff members and friends who helped me in successful completion of this internship.

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Date: 15th Feb 2019

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This is to certify that **Ms Kavyashree M (Univ Reg No. 4AL15EC036)** and **Ms Gaganashree P (Univ Reg No. 4AL15EC024)** student of B.E (Electronics and communication Engineering) from ALVA's Institute of Engineering and Technology, Mangalore have successfully completed their Internship from 21st Jan to 15th Feb 2019 under my supervision at Defence Avionics Research Establishment, DRDO, Bangalore.

They have fulfilled the tenure successfully with enthusiasm, sincerity and regularity and was good at understanding the concepts.

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DRDO

21/01/19-15/02/19

CHAPTER 1

INTRODUCTION

1.1 PRELUDE

It was a great opportunity for me to do 45 days of internship inDRDO (DARE)., under the guidance of Dr. K V S C Sastry, Scientist ‘F’. The objective of this internship is to study the design and working principle of Drone technology and its applications. A drone, in technological terms, is an unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). Essentially, a drone is a flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded systems, working in conjunction with onboard sensors and GPS. In the recent past, UAVs were most often associated with the military, where they were used initially for anti-aircraft target practice, intelligence gathering and then, more controversially, as weapons platforms. Drones are now also used in a wide range of civilian roles ranging from search and rescue, surveillance, traffic monitoring and firefighting, to personal drones and business drones-based photography, as well as videography, agriculture and even delivery services.

The first generally used drone appeared in 1935 as a full-size retooling of the De Havilland DH82B “Queen Bee” biplane, which was fitted with a radio and servo-operated controls in the back seat. The plane could be conventionally piloted from the front seat, but generally it flew unmanned and was shot at by artillery gunners in training. The term drone dates to this initial use, a play on the “Queen Bee” nomenclature.

UAV technology continued to be of interest to military, but it was often too unreliable and costly to put into use. After concerns about the shooting down of spy planes arose, the military revisited the topic of unmanned aerial vehicles. Military use of drones soon expanded to play roles in dropping leaflets and acting as spying decoys.

Fig 1.1 Infrastructure of DRDO

CHAPTER 2

OBJECTIVES

Learning objectives provide the foundation and framework for learning during an internship experience. From the student perspective, an internship assists with career development by providing real work experiences that provide students with opportunities to explore their interests and develop professional skills and competencies. During internships, students are provided with opportunities to apply what they learned in classes to actual practice. It is expected that students will also be challenged to examine how their attitudes, beliefs, and values influence the helping process. From the facility perspective, an internship provides a unique training experience designed to enhance the professional development and functioning of the student. In accepting students as interns, the facility representative recognizes that the internship is a learning process designed to promote professional growth of the student. The main internship learning objectives are:

- To learn the emerging technology like Arduino Mega 2560 and Arduino IDE programming language, to develop new prototypes.
- To develop communication, interpersonal and other critical skills.
- To develop work habits and attitudes necessary for the job success.
- Learn to appreciate work and its function in the economy.

CHAPTER 3
INTERNSHIP DISCUSSION

3.1 Introduction

Instrumentation is a collective term of measuring instruments that are used for indicating, measuring and recording physical quantities.

3.2 Network Analysis

Network analysis (NA) is a set of integrated techniques to depict relations among actors and to analyze the social structures that emerge from the recurrence of these relations. The basic assumption is that better explanations of social phenomena are yielded by **analysis** of the relations among entities

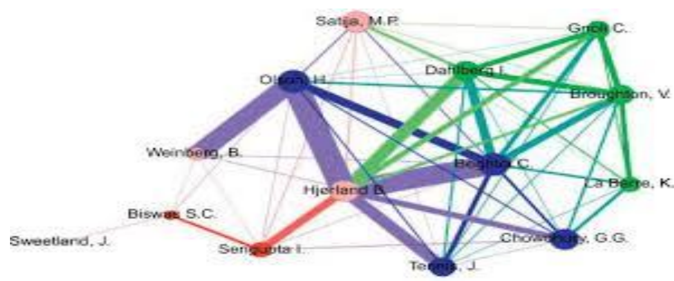

Fig 3.2 Network Analysis

3.3 Antenna Parameter

Typical **parameters** of **antennas** are gain, bandwidth, radiation pattern, beamwidth, polarization, and impedance. The **antenna** pattern is the response of the **antenna** to a plane wave incident from a given direction or the relative power density of the wave transmitted by the **antenna** in a given direction.

3.4 ElectricalConnectors

An **electrical connector** is an electromechanical device used to join electrical conductors and create an electrical circuit. Most electrical connectors have a gender – i.e. the male component, called a *plug*, connects to the female component, or *socket*. The connection may be removable (as for portable equipment), require a tool for assembly and removal, or serve as a permanent electrical joint between two points. An adapter can be used to join dissimilar connectors.

Fig. 3.4 Eletrical connectors

3.5 LABVIEW(Laboratory Virtual Instrument Engineering Workbench)

LabVIEW (**Lab**oratory **V**irtual **I**nstrument **E**ngineering **W**orkbench) is a graphical programming environment which has become prevalent throughout research labs, academia and industry. It is a powerful and versatile analysis and instrumentation software system for measurement and automation. Its graphical programming language called G programming is performed using a graphical block diagram that compiles into machine code and eliminates a lot of the syntactical details. LabVIEW offers more flexibility than standard laboratory instruments because it is software based. Using LabVIEW, the user can originate exactly the type of virtual instrument needed and programmers can easily view and modify data or control inputs. The popularity of the National Instruments LabVIEW graphical dataflow software for beginners and experienced programmers in so many different engineering applications and industries can be attributed to the software's intuitive graphical programming language used for automating measurement and control systems.

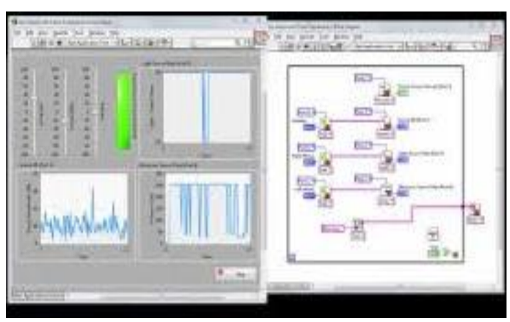

Fig. 3.5 Programming of LABVIEW

3.6 Spectrum Analysis

Spectrum analysis is **analysis** in terms of a **spectrum** of frequencies or related quantities such as energies, eigenvalues, etc. In specific areas it may refer to: Spectroscopy in chemistry and physics, a method of analyzing the properties of matter from their electromagnetic interactions.

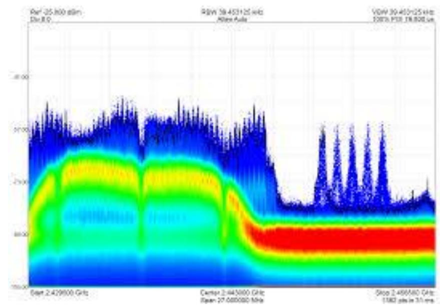

Fig. 3.6 Practical of Spectrum Analysis

3.7Function Generator

A function generator is usually a piece of electronic test equipment or software used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most common waveforms produced by the function generator are the sine wave , square wave, triangular wave and sawtooth shapes.

Fig. 3.7 Function Generator

CHAPTER 4

CONCLUSION

On the whole, this internship was useful experience was a useful experience. I have gained new knowledge, skills and met many new people. I achieved several of our learning goals. I got insight into professional practices that are currently advocated in the industry. Related to our study I learnt about many electronic devices and their testing, working, functions and the applications, which will be helpful for me in my future.

This internship programmed was not one sided, but it was a way of sharping knowledge, ideas and opinions. As well internship indirectly helps to improve my communication skills and strengthen when communicating with others. During my internship period, I have received a great advice from senior executive’s engineers and technician when mistakes were made, I took their advices in positive way to improve my career.

INTERNSHIP 2

DRDO(Project Intership)

15/07/19-06/09/19

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CERTIFICATE

This is to certify that the following students of VII Semester B.E (Electronics and Communication) from **ALVAS INSTITUTE OF ENGINEERING AND TECHNOLOGY**, Mangalore have been working on their project internship from 15th July to 6th September 2019, under my supervision at **Defence Avionics Research Establishment, DRDO**, Bangalore.

They have been working on "Design of an Autonomous Quad-Copter to serve for the need of an emergency commodity using ARM 32 Bit Controller".

Ms KAVYASHREE M	4AL15EC036
Ms DEEKSHA U SHETTIGAR	4AL16EC019
Ms GAGANASHREE P	4AL15EC024
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They have fulfilled the tenure successfully with enthusiasm, sincerity and regularity at their work.

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CHAPTER 1

INTRODUCTION

1.1 Prelude

DARE works on development of electronic warfare systems and mission avionics for aircraft. It is one the two laboratories of DRDO that works on electronic warfare systems, along with Defence Electronics Research Laboratory.

ASIEO developed the first mission computer for Light Combat Aircraft in 1991. The computer was responsible for managing the interaction between avionics, displays, sensors and weapon systems. It also developed a self-protection suite for the aircraft that included radar warning receiver, laser warning receiver, jammer, missile approach warning system, and countermeasure dispensers under a program named *Mayawi* in collaboration with Elisra. Sukhoi Su-30MKI uses Tarang Mk 2 radar warning receiver developed by DARE and manufactured by Bharat Electronics Limited.]Its mission computer, radar processor and indication management computer were also developed by DARE and manufactured by Hindustan Aeronautics Limited's Hyderabad division. In 2006, DARE partnered with EADS's defence electronics division to develop a missile approach warning system for the Indian Air Force based on the latter's AN/AAR-60 system. The jointly developed system was put into trials in 2008 and was planned to be co-produced with Alpha Technologies. DARE has also partnered with Elisra to jointly develop electronic warfare systems for Indian and Israeli aircraft. DARE has utilized this partnership to develop an electronic warfare suite for Mikoyan MiG-29 named D-29.

DARE has worked with Hindustan Aeronautics Limited to develop avionics for upgrade programs for several Indian Air Force aircraft. It participated in the development of a mission computer for SEPECAT Jaguar and in the development of navigation and electronic warfare systems for Mikoyan MiG-27M. DARE, in collaboration with Centre for Airborne Systems and Defence Electronics Research Laboratory, developed antennas for electronic warfare support measures and communication systems of DRDO AEW&CS. DARE also developed a unified electronic warfare suite with an integrated radar jammer and a radar warning receiver for HAL Tejas. The system was flown on a prototype aircraft, PV-1.

CHAPTER 2

OBJECTIVES

Consistent with the objective of the company, the personnel development of the office has adopted certain specific objectives which will act as a source of inspiration and guidance in involving personal policies and farming rules and regulation for the growth and development of employees and to ensure their deep commitment and sense of belonging to the company.

The specific objectives are stated below:

- Ensure quality of personnel of all level and provide them the right work environment, job satisfaction and professional challenges.
- Provide a healthy blend of employees who have growth with organization and those selected from outside.
- Ensure employment of minimum number of personnel and avoid surpluses.
- Motivate employees to be increasingly achievement oriented.
- Ensure uniformity in principal conditions of services.

CHAPTER 3

INTERNSHIP DICSUSSION

3.1 Basic Knowledge About Drone Technology

A rotor helicopter usually has one single lifting rotor with two or more blades. Helicopters are generally manually controlled and usually difficult to fly.

A multirotor is a drone with more than one rotor, generally four to eight rotors. The multirotor needs an internal flight controller, a computer that makes it easier to fly the drone. It simply would be too difficult to control the thrust of all the individual rotors in order to maintain the center of gravity meanwhile controlling the different tracks and movements in all axis.

The flight controller takes all the inputs from different sensors, such as altimeters, gyroscopes, magnetometers, etc. and combines it with the input from the operator. The flight controller can also be programmed to perform an automatic flight pattern without any involved operator.

A fixed-wing aircraft must have air moving over their wings to generate lift. This means they must stay in forward motion and cannot hover in one spot in the way a helicopter can. Usually the fixed wing will give you a longer flight time for less energy. Fixed wings will generally withstand stronger wind than multirotors.

3.2 To determine the drone that meets the requirement

In general, large drones can cost a lot of money while small drones will be cheaper. Large drones will lift heavy equipment while small ones will not. Everything is a trade-off and it is difficult to give any specific recommendations on what to choose. First of all, start by finding an answer to the question "what do you want to do"? This will hopefully tell you what type of sensor or equipment you want to carry.

Many of the commercial off the shelf drones will come with a camera and will have specific features for using it. This may not be optimal for the type of work you would like to do. Carrying of other sensors might need other types of drones that are custom made for that reason or mission. Another aspect to consider is the redundancy required for your mission. Depending on your sensors or in what type of environment you are going to fly, different drone types can give you a better redundancy.

Technically, this can be achieved by increase the rotors on a multirotor. Four rotors will not give any redundancy in an event of a rotor failure and the drone will crash. A six or eight rotor aircraft will continue to fly with one or even more rotor failures. A fixed wing will also give a sufficient redundancy to perform a controlled emergency landing without any motors as it will take advantage of the generated lift of the wings as long as it stays in a forward motion. Flying your drone might also require a certain amount of training and even crashing. In the end you might realize that buying a drone expert service rather than buying your own equipment is the way to continue.

3.3 Make sure the equipment's are in order

Batteries will lose much of their capacity when exposed to cold climates. This may result in a sudden drop of power to the motors without prior notice, resulting in a crash. Keep batteries warm until the second of take-off. Batteries can be stored inside a pocket of clothing or in insulated boxes or pouches that also might be equipped with extra heating to keep the temperature at a suitable level.

The UAV will use a compass to navigate. The compass is particularly important for a multi rotor, as it will hover in one position. High latitudes, which are common for many INTERACT stations, will alter the angle between the geographical and the magnetic north pole, which may influence the compass and sensors in your UAV. A fixed wing will maintain a continuous motion and can therefore navigate using GNSS.

Reception from the GNSS satellites can be less accurate in the polar region than in other places around the globe, but usually it should be sufficient to allow position lock. Make sure that your UAV can lock to the GNSS before take-off.

3.4 Payload

As a very rough rule of thumb, on a multi rotor drone, one gram extra weight of payload will reduce the flight time by one second. Small drones will not be able to carry any payload apart from small light devices.

Fig. 3.4 Payload Systems

3.5 Factors to be considered

Visual Line Of Sight (VLOS)

VLOS means keeping the drone in visual-line-of-sight at all times. This means that you cannot fly the drone into clouds or fog, behind trees, buildings or other (even partial) obstructions. VLOS also means un-aided vision, except for prescription glasses or sunglasses, and not having to use binoculars, telescopes or zoom lenses to see the drone. Maximum VLOS is typically set to no more than 120 m vertically and 500 m horizontally.

Extended Visual Line Of Sight (EVLOS)

This is the operating method whereby the Remote Pilot in command (PIC) relies on one or more Remote Observers to keep the drone in visual line of sight at all times, relaying critical flight information via radio and assisting the Remote Pilot in maintaining safe separation from other aircraft (manned or unmanned).

Beyond Visual Line Of Sight (BLVOS)

This means flying a drone without the Remote Pilot having to keep the drone in visual line of sight at all times. Instead, the Remote Pilot flies the aircraft by instruments from a Remote Pilot Station (RPS).

First Person View (FPV)

This refers to a Remote Pilot operating a drone by reference to an on-board video camera, providing the Remote Pilot on the ground with a live ‘cockpit-view’ from the drone.

3.6 Frequently occurring rules

Frequently occurring rules, found in the legislations of most countries and territories, were presented at the workshop and summarised below.

Never fly nearby an airport

Manned airports will establish a controlled airspace, which extends from surface to a specified upper limit together with positions in longitude and latitude, forming a protective “box” around the airport. This box is called Controlled Traffic Region (CTR) or control zone in US airspace class D. The CTR is controlled by the air traffic control (ATC) which will coordinate all aircrafts in that airspace. You need to coordinate with and get permission from the ATC in order to fly in a CTR. Unmanned airports usually don’t have any ATC and you need to coordinate directly with any manned aircrafts and pilots that are going to use that airport. This can be all from local private licenced pilots to commercial helicopter companies providing air services.

Essential things prior to flight

Get yourself an aeronautical chart. There are online charts or apps that will show no-fly zones but you can also buy a traditional paper printed aeronautical chart.

AIP

Aeronautical Information Publication, is an essential publication, issued by or with the civil aviation authority of state which contains important information about airports, regulations, procedures and so on. Basic information like opening hours or telephone number as well as more advanced information can be found in here. The AIP can usually be found on CAA internet homepage for the specific country.

NOTAM

Notice to Airmen, is also important information to keep track of. A NOTAM is created by government agencies and airport operators and contains for example changes in aeronautical facilities, hazards and restrictions. The NOTAM can usually also be found in the CAA internet homepage.

Insurance

Accidents involving aircrafts can be costly. An insurance covers damage to third party property or persons. Some countries legislation demands a mandatory insurance when operating drones commercially. It is important to sort this out prior to your flight.

Permission from authorities

In many countries, flying a drone for a scientific or commercial business might need a permission from civil aviation authorities (CAA). Make sure that you follow the procedures to obtain a valid license or permission. The authorization sometimes comes with a requirement to maintain a log for all flights performed.

Keep a safety distance

Rotating propellers, even on a small aircraft, may cut off your fingers. Place the drone a few meters away from people, animals or property before take-off.

Fly in a wide and open area away from people, animals and property

A falling or flying aircraft will have a lot of energy in the event of an impact.

Fly within safe altitudes

The height limits in the airspaces nearby INTERACT field stations may differ but usually no flights above 120m/400ft should be performed as this will interfere with regular, manned air traffic. Despite this, many INTERACT field stations do have regular helicopter or aircraft connectivity flying on low altitudes near ground.

Fly within line of sight (LOS)

Make sure you can see the drone with your eyes at all times. Generally, no regulatory framework on any INTERACT field station allows flying beyond visual line of sight (BVLOS), without a special permission or license.

Follow local rules and regulations

Local rules can apply to national parks, restricted areas, animal preservation areas, military areas, etc. Some of these areas can be marked in an aeronautical chart but some information needs to be obtained from elsewhere. In some countries and stations, there are exceptions for using drones for scientific research within restricted areas, which will make your life a bit easier. Just don’t forget to apply for that permission.

UAV TYPES

UAVs typically fall into one of six functional categories (although multi role airframe platforms are becoming more prevalent):

- Target and decoy – providing ground and aerial gunnery a target the simulates an enemy aircraft or missile.
- Reconnaissance – providing battle field intelligence.
- Combat – providing attacking capabilities for high risk missions (see unmanned aerial vehicle).
- Logistics – UAVs specially designed for cargo and logistics operations.
- Research and development – used to further develop UAV technologies to be integrated into field deployed UAV aircraft.
- Civil and Commercial UAVs – UAVs specifically designed for civil and commercial applications.

Fig. 3.6 Drone

3.7 Block Diagram of Proposed System

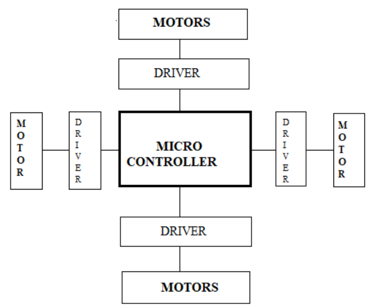

Figure 3.7Block Diagram of Drone Design

Basic Principle - How Do Quadcopters Work?

The 4 propellers of a quadcopter are fixed and vertically orientated. Each propeller has a variable and independent speed which allows a full range of movements. Shown below is the different propeller combinations that facilitate different drone movements.

This is unlike conventional helicopters which are controlled by propellers with blades that dynamically pitch around the rotor hub. The components required for blade pitch are expensive which is one of the reasons quadcopters are becoming so common with recreational UAV enthusiasts.

3.7.1 The core components of a QuadCopter are as follows;

- **Chassis** – the skeleton of the drone which all componentry is fixed to. The chassis design is a trade-off between strength (especially when additional weights such as cameras are attached) and additional weight, which will require longer propellers and stronger motors to lift.
- **Propellers** – principally effect the load that the quadcopter can carry, the speed it can fly, and the speed it can maneuver. The length can be modified; longer propellers can achieve greater lift at a lower rpm but take longer to speed up/slow down. Shorter propellers can change speed quicker and thus are more maneuverable; however they require a higher

rotational speed to achieve the same power as longer blades. This causes excess motor strain and thus reduces motor life span. A more aggressive pitch will allow quicker movement but reduced hovering efficiency.

- **Motors** – 1 per propeller, drone motors are rated in "Kv" units which equates to the number of revolutions per minute it can achieve when a voltage of 1 volt is supplied to the motor with no load. A faster motor spin will give more flight power, but requires more power from the battery resulting in a decreased flight time.
- **Electronic Speed Controller (ESC)** – provides a controlled current to each motor to produce the correct spin speed and direction.
- **Flight Controller** – the onboard computer which interprets incoming signals sent from the pilot and sends corresponding inputs to the ESC to control the quadcopter.
- **Radio Receiver** – receives the control signals from the pilot.
- **Battery** – generally lithium polymer batteries are used due to high power density and ability to recharge.

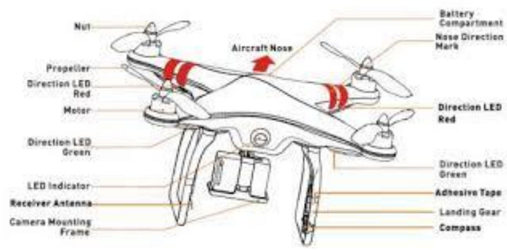

Fig. 3.7.1 Components of Quad Copter

3.7.2 How Do You Fly a Quadcopter Drone?

A quadcopter is controlled manually with a hand-held radio control transmitter which manually controls the propellers. Sticks on the controller allow movements in different directions and trim buttons allow the trim to be adjusted to balance the drone. Screens can also be used to receive live video footage from the on-board camera and to display sensor data.

Further to this, on-board sensors can provide helpful settings such as;

- Auto altitude where the quadcopter will move at a fixed altitude, and;
- GPS hold, where the quadcopter will remain at a fixed GPS position.

Quadcopters can also be flown autonomously, where modern flight controllers can use software to mark GPS waypoints that the vehicle will fly to and land or move to a set altitude. This kind of autonomy is becoming increasingly common and contributes to much of the increased interest in civilian drone technologies that has been observed in recent years.

3.8 Applications

As estimated by the US government, 110,000 drones are in US airspace and that figure is projected to more than quadruple by 2022. With this, drones will find themselves employed across a huge range of applications, including:

- Automatic Pollination of field of crops
- Search and rescue operations
- Traffic monitoring
- Exploring hazardous sites
- Military surveillance
- Weather and climatic mapping
- Photography
- Drone-delivery services
- Sport – drone racing
- Land surveying
- Sustainable agriculture

CHAPTER 4

CONCLUSION

On the whole, this internship was a useful experience. I have gained new knowledge, skills and met many new people. It was a complete useful experience working at the DRDO (DARE), the friendly welcoming staff and the space they created for a trainer/intern allowed with full opportunities to learn and know myself as a worker. This experience brought out my strength and also the areas I needed to make up. It added more confidence to my professional approach built a stronger positive attitude and thought me how to work in team as a player the primary objective of an internship is to gather a real life working experience and put their theoretical knowledge in practice. Related to my study I learned more about the Drone designing and technology and basics aviation technology.

In 45 days of internships at DRDO (DARE)., I have learned about the Drone designing methodology and its applications. Drones as observers in the sky will remain important for the indefinite future. They will grow easier to operate. The ease of flying and taking pictures can mask the fact that questions concerning how to use those pictures will not get any easier with higher sensor resolutions, better lenses, or cheaper memory.

“If there is a distinctive path that modern technological change has followed, it is that technology goes where it has never been,” Langdon Winner, a political scientist, wrote in 1980. The development of drones, surely enough, has followed this progression. As this book chronicles, within a few short years of coalescing as technological artifacts, drones have been deployed to the corners of the world, from the Arctic to the Antarctic, in mountains and in desert valleys below sea level, in cities and above isolated villages.

It is a truism that drone technology is rapidly changing. But this is not the whole truth. Some aspects are changing rapidly; others, such as propellers, are changing slowly, if at all. As a rule, those parts of a drone that have to do with information collection and processing are likely to continue to develop at a brisk pace; the parts that have to do with the physical movement of a drone through the air are also changing, but not as dramatically. Crucial infection points in the development of drones have come when innovations in microelectronics have enabled innovations in physical movement. This is true of the accelerometer and gyroscope data that make it possible for quadcopters to maintain stability, and of GPS devices that allow drones to navigate from one point in space to another. Another such infection point may come when the efficiency of photovoltaic cells in converting light to electricity becomes such that even small drones, if light enough in weight, will be able to loiter indefinitely.

Even though I encountered few problems during this training period, I am still glad that I have managed to learn a lot of new knowledge and gain more experience. Overall, in my internship I was able to gain practical skills, work in a fantastic environment, and make connections that will last a lifetime. One main thing that I have learned through this internship is time management skills as well as self-motivation. I must say that this experience will prove an objective in my carrier in the company.