

DESIGN AND FABRICATION OF FIRST RESPONSE DRONE

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Mechanical Engineering

By

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SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **B. VEERENDRA KUMAR (Reg. No. 37150027) and BHADRI NARAYANA. G (Reg. No. 37150029)** who carried out the project entitled "**DESIGN AND FABRICATION OF FIRST RESPONSE DRONE**" under my supervision from **August 2020 to March 2021.**

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Submitted for Viva voce Examination held on _____

Internal Examiner

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DECLARATION

I **B. VEERENDRA KUMAR (Reg. No. 37150027)** hereby declare that the Project Report entitled “**DESIGN AND FABRICATION OF FIRST RESPONSE DRONE**” done by us under the guidance of **Mr. S. YUVARAJA, M.E., Department of Automobile Engineering** is submitted in partial fulfilment of the requirements for the award of **Bachelor of Engineering** degree in **Mechanical Engineering**.

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PLACE: CHENNAI

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ABSTRACT

Unmanned aerial vehicles, also known as drones, can play a significant role in military and civil emergency medicine. The aim of the study was to present the real possibilities of using them in rescue operations and to provide examples from all over the world. Unmanned aerial vehicles can be applied to transport goods on demand, provide blood in urban areas, save sinking people, analyse the scale of damages, monitor large human gatherings, perform exploration activities, deliver blood samples and other analysis material, provide automated external defibrillators, support rescue operations and air transport, and perform agricultural activities. One must, however, be aware of the existing regulations regarding drone flights as an appearance of an unreported unmanned aircraft in the controlled space is identified worldwide as affecting aviation safety.

Transportation plays vital roles in lives. Its connections are associated with almost everything, from postal deliveries to multi-million cargo shipments. Currently, transportation of medical goods during critical need is limited to wheeled motor vehicles and manned aircrafts, which can be costly, slow, and sometimes impossible when emergency site is out of reach. Nowadays, drones revolutionize healthcare by transporting lifesaving medical supplies such as medical aids and blood. Unfortunately, with current technology, drone's battery lifespan is a limitation that can hinder the delivery process. This paper describes our study that concerns with design of mechanism that prolongs drone's battery life and offers effective delivery of medical first aids.

The mechanism is attached to the drone and carries medical aids safely while decreasing the number of take-off and landing by deploying the kits from air to land (using parachute method). The main objective of this study is to design a mechanism that can carry and release the medical kit with care at the targeted area. Based on the results, the mechanism was proven to be able to carry and release medical first aids securely during flight and landing.

Keywords: Drone, release mechanism, medical first aids kit, etc.

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LIST OF ABBREVIATIONS

'	MINUTE
°C	DEGREES CENTIGRADE
AAIU(Be)	AIR ACCIDENT INVESTIGATION UNIT (BELGIUM)
AD	AERODROME
AP	AUTO-PILOT
ATC	AIR TRAFFIC CONTROL
ATCC	AIR TRAFFIC CONTROL CENTER
ATCO	AIR TRAFFIC CONTROLLER
M	METER(S)
MAX	MAXIMUM
MHz	MEGAHERTZ
MNM	MINIMUM
MS	MINUS
N	NORTH
NOSIG	NO SIGNIFICANT CHANGE
NOTAM	NOTICE TO AIRMEN
PC	PERSONAL COMPUTER

CHAPTER 1

INTRODUCTION

1.1 HISTORY AND BACKGROUND OF FIRST RESPONSE DRONE

Unmanned aerial vehicle (UAVs), commonly known as drones, are not a new invention - they are the modern-day versions of remotely-flown target aircraft used for the practice firing of a battleship's guns in the 1920s and 1930s.

1. Drones have come a long way since then, and are today used for various purposes shooting videos, delivering packages, and even surveillance.
2. Drones are all set to become life-saving gear as well! The students have developed a drone which is capable of carrying a first aid kit to the scene of the accident in record time.
3. As per the Emergency Management Research Institute (EMRI), the average response time of an ambulance nowadays has come down to 9.33 minutes from 13 minutes.
4. However, this is the average time, and there can be variations in timings due to various reasons. For example, in cities, traffic jams can hold up ambulances, while in rural and remote areas, the condition of roads can affect the response time.



Fig 1.1: First response drone

Whenever a medical emergency occurs, quick response time is critical in terms of life saving. However, currently, the transportation of medical aids in times of critical need is limited to wheeled motor vehicles and manned aircraft, options that can be costly and slow and sometimes is impossible when the emergency site is out of reach.

Furthermore, traffic congestion is a major problem in big cities and ambulances can be stuck in a traffic jam and may not be able to arrive within the targeted emergency response time.

Drones can be seen as the innovative alternatives in enabling immediate help to victims suffering from health emergencies or traffic accidents before professional medical personnel arrive.

By speeding up emergency response, possible harms can be avoided and healthcare providers can prevent potential deaths and accelerate patient treatment.

Drones are commonly known as unmanned aerial vehicles (UAVs) that are remotely or automatically controlled. Nowadays, drones revolutionise the healthcare by transporting lifesaving medical equipment and supplies such as medical first aid kits, telemedicine or medical support such as diagnostics, drugs, or tools, blood, life-saving drugs, vaccines or anti-venom, defibrillators to patients in cardiac arrest, prescriptions and even organs for transplantation.

Drones are also capable of delivering medical supplies quickly and effectively to people in remote medical centres, disaster areas, and offshore vessels. Drones are useful for medical supplies delivery when the delivery involves small items, remote locations with difficult access, timely delivery, poor transportation infrastructure at destination, or roads blocked by severe weather, disasters or traffic congestion.

The use of small drones is subject to several limitations in relation to load capacity, flight duration, power supply, and other technical features. The flying range of small drones is between 1.5 km to 3 km per complete flight while a long-distance drone can fly up to a maximum of 80 km.

According to Hasan and Joffrey, drones are powered by lithium-ion batteries, which offer the highest power and energy density. According to SC Rosati, Croce, and Pinero, (2001) and Salameh and Kim (2009).

The drone batteries represent one of the most troublesome and potentially hazardous components of drone operations. The battery's power determines the drone's flight time and a more powerful battery keeps the drone in the air for a longer period. The flight time of normal drone ranges from 15 minutes up to 60 minutes. It can also last between two to four hours if the batteries are of military grade quality. Thus, a notable drawback of drones is the high power consumption, which is dependent on the batteries that influence the flight duration of the drone's mission. With the current technology, the drone's battery lifespan is a limitation that can hinder medical aids delivery process. The drone's battery lifespan also usually depends on the usage of the drone itself. Corral, Fronza, El Ioini, and Ibershimi (2016) states that the manoeuvres, movements and general aspects of the flight profile (load, altitude, speed) that involve more energy investment will result in faster battery discharge that leads to shorter drone autonomy.

Therefore, it is important to optimise the flight time of drone by reducing the number of drone's take-off and landing since taking off and landing increase the flight time and consume more energy. Optimising the batteries lifespan for the drones has then become the main motivation for us in conducting our study. This paper describes our study that concerns with the design of mechanism that prolongs drone's battery life and offers effective delivery of medical first aids.

The mechanism developed is attached to the drone. It will carry the medical aids safely while decreasing number of take-off and landing by deploying the kits from air to land (using parachute method).

1.2 DRONE

An unmanned aerial vehicle (UAV) (or uncrewed aerial vehicle, commonly known as a drone) is an aircraft without a human pilot on board. UAVs are a component of an unmanned aircraft system (UAS), which include a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy: either under remote control by a human operator or autonomously by onboard computers referred to as an autopilot.

1.3 DRONE TYPES

A wide variety of drones are already being used for humanitarian purposes and more applications are expected to emerge. Currently, the areas that have been explored the most for practical applications within the humanitarian context are mapping and monitoring. The choice for a particular drone platform and deployment strategy is guided by application type, environmental conditions, organizational needs and associated costs, among other considerations

1.3.1 Fixed-wing Drones

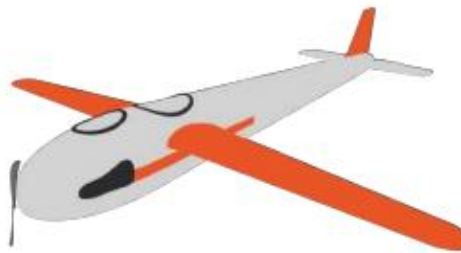


Fig 1.2: Fixed-wing Drones

Fixed-wing drones have a two-wing design, and are typically used to cover longer distances and carry heavier loads. Fixed-wing drones are often preferred for larger mapping projects or for projects that require the transportation of cargo over longer distances. They can operate in up to 50 km/hour winds and can typically stay in the air between 30 minutes and several hours, depending on the model. Most fixed wing drones fly on autopilot, following predetermined flight paths that are uploaded ahead of the flight. A pilot on the ground merely monitors the flight progress and makes adjustments when necessary. A major drawback of fixed wing drones is that they usually require a strip of open space for landing and take-off. Such spaces may be difficult to find in mountainous, densely forested or densely built environments.

1.3.2 Multi-rotor Drones

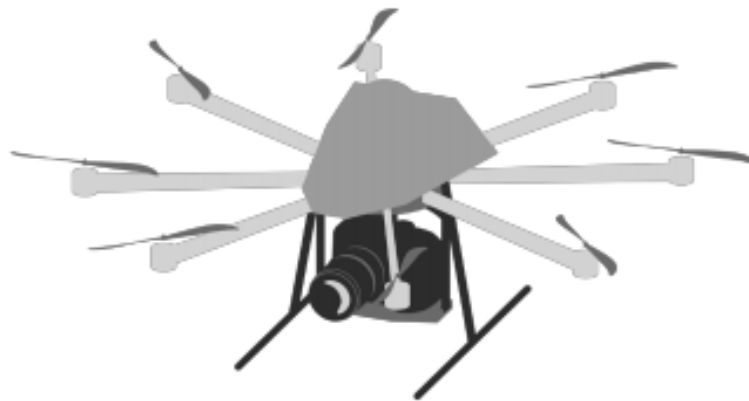


Fig 1.3: Multi-rotor Drones

Multi-rotor drones are typically used for shorter flight times and shorter distances to record pictures or to transport light cargo. The most widely used multi-rotor drones have four propellers, which is why they are often called quad-copters. But models with one rotor (helicopter) or with as many as eight rotors (octo-copters) exist as well. Their main advantage is that they take off and land vertically thus do not require much space, and improved controls and software enable automatic stabilization and steering by remote control or autopilot. The trade-off, however, is that flight times are severely shortened: many small consumer drones have a battery life of only about 10 minutes. Models that can fly longer are significantly more expensive.

1.3.3 Hybrid Drones



Figure 1.4: Hybrid drones

Hybrid drones are relatively new and are equipped with both wings and rotors. This hybrid configuration allows for vertical take-off and landing, and provides the drones with the ability to fly horizontally like fixed-wing drones. This means that

they can cover far longer distances and carry heavier cargo than multi-rotor drones. These hybrid drones look promising for cargo delivery where the combination of long flight time and vertical take-off and landing are important features.

1.4 SAFETY

Drone systems can be used to inspect remote sites for hazardous conditions or unstable structures without placing workers at risk. This is especially true for awkward or difficult-to-reach locations such as tall structures, on and under bridges and along busy highways.

1.5 APPLICATIONS

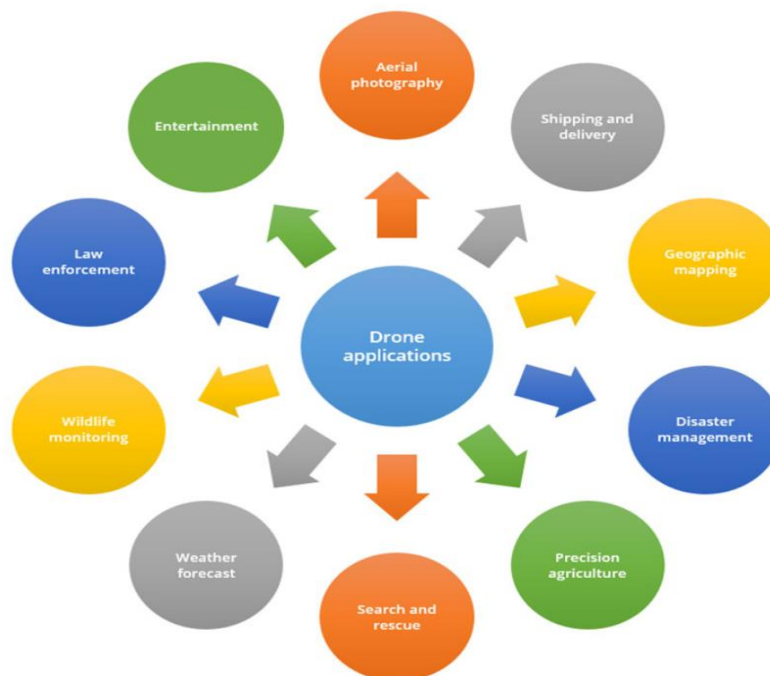


Figure 1.5: Applications

Captured below are 10 stunning applications of drone technology

- Aerial photography.
- Shipping and delivery.
- Geographic mapping.
- Disaster management.
- Precision agriculture.
- Search and rescue.

- Weather forecast.
- Wildlife monitoring.

The following chapters discuss the four most common applications: mapping, search and rescue, monitoring, and cargo delivery. Drones have been used to speed up or increase the quality of localized damage assessments, planning for disaster risk reduction, planning of humanitarian interventions, improving camps and shelter units and in the delivery of small essential items. Drones also show great potential in tactical settings such as supporting the work of search and rescue teams and field teams. Other functions, such as the provision of Internet and the use of drone-derived footage for public relations are not treated in detail here. Large technology companies such as Facebook and Google are currently exploring the provision of Internet and connectivity, and the service will presumably become available to humanitarians once the technology reaches civilian markets.

1.6 METHODS OF DRONES

Our study has three objectives. The first objective is to identify the main features for suitable deployment mechanism for holding and releasing the first aids. The second is to design a mechanism that can be attached to the drone and can carry medical aids with care. Meanwhile, the last objective is to test the mechanism using real experiments with an actual scale prototype.

As mentioned earlier, drones have a notable limitation in terms of high power consumption which influences the flight duration. Thus, strategy or mechanism that leads towards efficient power consumption must be sought. In drones operations, the most important quality requirement is airworthiness, which refers to an aircraft's suitability for safe flight.

Based on Corral, Fronza, and El Ioini (2015), a drone is considered airworthy if it is able to take off, conduct its mission and land safely. Therefore, in this study, when designing the mechanism for the drones, the energy efficiency towards airworthiness has been the prime concern. Prior to designing the mechanism for the drone, the type of drone to be used in delivering the medical first aid kits has to be selected. Basically, there are two main types of drones (UAVs) in the commercial market, which are the fixed wing and the multi-rotor ones.

Both have their advantages and disadvantages including their suitability for certain applications. Fixed-wing UAVs normally have longer flight endurance capabilities while multi-rotors can provide stable image capturing and easy vertical take-off and landing. Fixed-wing UAVs can cover large areas in one flight, however they require a suitable landing area and some skills of the pilot to land them softly to avoid damage to the craft and sensors. On the other hand, multi-rotor drone is easy to control and manoeuvre. The multi-rotor drones are easy to fly, to take off including landing, and they can easily perform autonomous flights. Thus, with some training, one can control this drone without much difficulty. Another big advantage is that a landing strip is not required for this kind of drones, making them suitable to be used in fields, forests or in urban environments. However, the multi-rotor drones have to create their lift during the complete flight actively, hence their endurance and their operation speed is restricted and they can only cover limited areas.

In this study, a multi-rotor drone is considered as a more suitable aerial vehicle for transporting the first aid kits. It is easy to handle and it has the ability of multi-rotor to hover in a more stable manner as compared to the other type of drone. These advantages can help the developed mechanism to release the medical kits in stable condition during in the air, which may contribute towards safe and accurate landing of the kits at the targeted area.

For our study, the DJI Phantom 3 drone has been used. Its main specifications include: weight (battery & propellers included) is about 1216g, maximum flight time is approximately 25 minutes, GPS for satellite positioning system, uses LiPo 4S as intelligent flight battery and 2600 mAh LiPo 18650 battery for the remote controller.

The conceptual design is the first phase of the design process, where it outlines the features and structure of the preliminary stage.

The process flow steps are as the following:

- The drone will be equipped with the mechanism that is able to carry the medical first aid kits (30 items with max. weight of 500 grams).
- The drone will be able to fly and maintain hovering at the altitude of 30, 50, 70, 80 and 100 meters from ground.
- The drone will be able to fly to the selected area

- The Wi-Fi module will receive the input from the browser to release the medical box from the air.
- The medical first aid kits box will be dropped on the targeted area with the assistance of the parachute.
- The time of the medical kit landed based on different altitude will be recorded.

1.7 HOW A DRONE COULD SAVE A LIFE

In the drone scenario, you may be able to use your phone, Skype, or FaceTime to get instructions from medical professionals to administer the medication and use the equipment.

Now, instead of minutes waiting on the side-lines, you become the EMT. You begin to do as instructed. You stabilize the patient. A few minutes later, the ambulance shows up to take them to the hospital.

“We found that overall velocity of travel was faster with drones and that time to arrival on average based on distance was also faster,” said the abstract’s author, Dr. Mark Hanna, a fellow in paediatric emergency medicine at Maimonides Medical Centre in Brooklyn, New York.

Obviously, a drone wouldn’t be the correct responder for all scenarios, such as if a patient broke a leg or had a major trauma injury. But Hanna theorizes that drones could help with a specific niche of emergency scenarios in which the medication or intervention is relatively easy to perform and time is of the absolute most importance to saving an individual’s life.

Specifically, he notes emergencies such as acute anaphylaxis, which is treated with injectable epinephrine; opioid overdose, which is reversed through the intranasal medication Narcan; asthma; cardiac arrest; and even certain types of poisoning.

“I don’t think this will ever replace EMS response at all. I just think that it’s an excellent augmentation,” said Hanna.

In order to compare drone response time to traditional EMS response, Hanna and his team combed through public records for ambulance response times in Brooklyn, combing through more than 4,000 ambulance calls.

Hanna and his team then tested drone flight response times by flying a drone while attempting to replicate time and weather conditions of some of those ambulance calls. In total, they conducted 50 drone test flights. While Hanna admits they need more robust data by flying many more drones, the results are promising.

On average, drones were faster, with a travel velocity of 6.54 mph, compared with 5.04 mph of an ambulance. Unsurprisingly, they also arrived faster to the scene, with an average time to first response of 6.48 minutes compared to 9.54 minutes of an ambulance arriving about 30 percent faster to emergency situations.

However, time isn't the only factor in emergency situations, and the potential use of drones raises additional concerns that would need to be addressed.

"Faster response times would certainly help to increase delivery of care in life threatening situations. But delivery of medications and equipment without ready, willing, and able lay or even medical providers may be a rate limiting step that must be considered in actual delivery of care itself," said Dr. Robert Glatter, an emergency physician at Lenox Hill Hospital in New York City.

1.8 REGULATING THE USE OF DRONES

Those seeking authorization for the use of drones in humanitarian contexts face uncertainty in the regulatory environment at this time. Many countries still lack a clear regulatory framework for drones, or, in many places, their use is regulated to the extent that requirements are nearly impossible to fulfil for humanitarian actors in urgent humanitarian contexts. Governments around the world are currently working on creating and adapting legislation to ensure both safety and development, and the regulatory landscape is rapidly evolving. A coalition of non-profit actors and researchers is providing regulatory updates at: www.droneregulations.info.

CHAPTER 2

LITERATURE REVIEW

2.1 DESIGN, FABRICATION, AND SIMULATION OF HEXACOPTER DRONE (2018) Author: Vijayanandh Raja, M. Dinesh (Kumaraguru College of Technology): Unmanned Aerial Vehicles (UAV) is being suggested for essential applications like limit perception, problematic arranging and climate consider. Especially in military application, it puts to the side money and lives of officials diverged from the mama observed military aero plane Serious issues inside the woods line locale are human creature collaboration and creatures poaching. With the help of the whole reconnaissance, issues can prepare to tackle. These days the reconnaissance round the woodland has been regulated by timberland officials. Checking the woodland through officials isn't finished observation, because of the common elements of the populace could likewise be the blunder will happen inside the checking. To stay away from this issue, the seeing of the backwoods district is to be covered by UAV. Creature exercises and colossal backwoods inclusion territory is a troublesome undertaking to deal with in woods observing, so a conventional UAV isn't reasonable for this interaction, subsequently drone might be a superior response for this checking in light of the fact that it's a have special characters like high operational speed, greater steadiness, and so on The proposed response drone would be fit for the vertical take-off and landing highlight kind of a rotor edge airplane and furthermore the six propellers give greater strength and high moving capacity during the checking cycle. This drone payload is about 1kg and the complete measurement is 500mm x 500mm, the preeminent motivation behind this hexacopter drone is to give rich reconnaissance inside the woodland and gives alert about the creature's unmistakable position and makes an important move. The surveyed plan of hexacopter has been shown by CATIA. With the help of MATLAB 10.0 the picture preparing has been directed in order to search out creature discovery, creature chasing and creature. The crisis framework will be instituted in the record of slip-up creature coordinating with rate yield from picture handling. the proposed Hexacopter drone might be a superior answer for creature poaching, creature human collaboration issue and creature tallying's and furthermore it's one-of-a-kind characters like simpler flight, less vibration so it can prepared to solid and able to 9 look up to any basic climate for an application like creature recognition,

enactment of the notice framework. With the help of six propellers hexacopter can prepared to follow any moving creature additionally as cover the whole predefined woods locale. Picture preparing has been done in various cases by MATLAB for ready enactment reason. The Distant Controlled hexacopter model has been managed and subsequently the picture handling results are plotted. The completely independent hexacopter and its continuous recreation results will be directed .and its ongoing reproduction results will be regulated.

2.2 ADAPTIVE NEURAL ALTITUDE CONTROL AND ATTITUDE STABILIZATION OF DRONE WITH UNCERTAIN DYNAMICS (2019) Author: Ahmad Jobran Al-Mahasneh; Sreenatha G Anavatti Robotized Flying Vehicles (UAVs) are as of late pulling in critical examination consideration because of their possible applications in numerous fields. UAV offers higher payloads taking care of and flaws resistance than a quadcopter yet its control could likewise be a requesting task. during this paper, a flexible Neural Organizations (NN) controller is proposed for tallness following and stature adjustment of a hexacopter UAV with dubious elements. The regulator plan, re-enactment and life against impact unsettling influences are examined. Likewise, the regulator execution is contrasted and a run of the mill Separated Corresponding Subsidiary Integrator (FPID) regulator for different control situations

2.3 REVIEW OF RESPONSE DRONE (2018) Author: B M Alba kier, Alaa H. Muttar, Ali J. Askir (Al-Iraqia University, Iraq) Numerous endeavors and work were at that point accomplished and accessible in the writing. The past accessible endeavors can be summed up as in the accompanying subsections. Helicopter Adding payload mass to a helicopter changes the unique reaction of the framework. The airplane's flight control framework should keep on keeping up strength with adjusted demeanor elements and should likewise dismiss any inclination force initiated by a moved focus of mass. On the off chance that the regulator doesn't keep up steadiness with changed mass boundaries, or can't dismiss the progression aggravations because of added force inclination from uneven stacking, the framework will be destabilized at whatever point an item is gotten a handle on. This is particularly significant where a direct business off the half framework is utilized, which may not be versatile to a

changing plant mid-flight. joining mass to the vehicle reduces the common recurrence of the disposition elements this has the benefit of sifting through high-recurrence unsettling influences 11 yet makes it harder to influence quick course corrections. While numerous programmed copters have flown with fastened burdens, the throw setup is explicitly intended to decouple the movement of the heap from the helicopter and separate the timescales of the demeanor and tie pendulum elements. On account of got a handle on and unbendingly appended loads, the payload is straightforwardly coupled to vehicle pitch and horizontal movements the shut circle framework should be appeared to stay stable inside the normal scope of framework mass and latency. This work includes the occasion and joining of drone utilizing an APM microcontroller to manage the whole UAV developments. It likewise includes the blending and utilization of a UAV's camera to naturally build a region map upheld by the photos gained from the UAV while flying through a devoted region of interest. The outcomes show an effective control for a to fly utilizing a ground pilot with RC control.

2.4 DESIGN OF FUZZY CONTROLLER FOR DRONE POSITION CONTROL.

Author: Jan Bacik, Palov Fedor (Technical University of Kosice, Kosice, Slovakia) (2017) This paper enlightens us concerning the arranging of a fluffy regulator for controlling the situation of a drone appeared by a recreation model in the Gazebo robot reproduction climate, which as far as control gives a high framework 6 levels of opportunity. The fluffy regulator configuration was upheld the pilot's insight and on investigation of exploratory information gathered during a controlled flight, without the information on its design and boundaries. The fluffy regulator properties were affirmed by continuous test esteems, with an examining season of 10 milliseconds. The outcomes have shown great unique properties of the PI fluffy regulator, which may in future be additionally applied during a genuine physical drone model

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 PROJECT OBJECTIVE

- Two objectives should be achieved from this project:
- To design a new First response drone that is high stability and portable.
- To fabricate and test the prototype of First response drone the fabrication processes involves various processes. The test run analysis of the new First response drone done by applying load and tries to lift it up. It will show whether the First response Drone can work effective and smooth or any problem occurs.

3.2 PROJECT SCOPE

Civilians and commercial users adopted drone technology after a long history in military usage across the world. The military application of drones experienced stability in their usage to gather valuable information for tactical planning and monitoring of enemy troops. The use of drones also conducted border patrol activities. The research indicated that drone technology has continued to penetrate the livelihoods of people who use them for commercial and recreational applications. The quick development of drone technology in the use of sensors, camera and video, burner detectors, and internet connectivity enabled the rapid adoption and acceptance of drone technology in people's lives. Further developments in drone technology indicate that the many commercial applications of drones will characterize future usage. In the long run, the high usage of the technology in business and the risks associated with the drones will also attract taxation and burdensome regulations, and the users will also develop secure and reliable components.

The research indicated that technology has been standardized and customized by manufacturers and software developers with controls and capabilities to suit different industry needs. The market of civilian and commercial drones has significantly grown with usage in industries increasing across the world. The industries where drones have been integrated into the operational process include:

- Mining industry: used for surveillance and data collection of mining operations, especially the analysis of resources, erosion monitoring and directing the ground vehicles.
- Construction companies' inspection of construction sites to monitor the progress of building activities, security assessment monitors manned and provide the contractors and builders with 3D mapping.

Agricultural sector the drone technology was adopted in agricultural activities monitor and survey the vast tracks of farms center teams.

3.3 PRESENT INVESTIGATION

The drones have a limited flying time as they significantly depend on the internally built battery that requires frequent charging and replacement. The limited-time hinders the conduct of lengthy operations that require consistency.

- The batteries used by the civilian and commercial drones are associated with fire risks; hence and damage can translate to severe injuries.
- The drones move at a lower speed hence and are substantially undermined by weather conditions where winds are prevailing. Besides, the use of drones is limited to clear weather conditions and cannot be operated in snow, rains, and other conditions due to the dangers exposed to electronic and software integrations.

Complimentary and rival technologies the drone technology market is experiencing a high growth rate with developers customizing software for commercial and civilian purposes. The developing market is has improved the functioning of other industries that have engaged in developing products to operationalize the drone industry fully.

Additionally, the drone industry has created rival within the aviation industries as they directly replace the operations of other industry players like satellite companies, and airplanes.

CHAPTER 4

EXPERIMENTAL OR MATERIALS AND METHODS ALGORITHMS

4.1 EXPERIMENTAL OF PROTOTYPE MODEL

Drones are complex machines that have the potential to change various industries, from to police work. There are a lot of things happening within these small aerial devices. They must be light enough to fly whilst containing the various components that make them worth flying, such as remote control capabilities and cameras.

As technology advances and drones become more accessible to consumers, many are left wondering how these incredible devices are made. It's a substantial manufacturing process that all starts with a plan Components of a Drone:



Fig. 4.1: Prototype Model

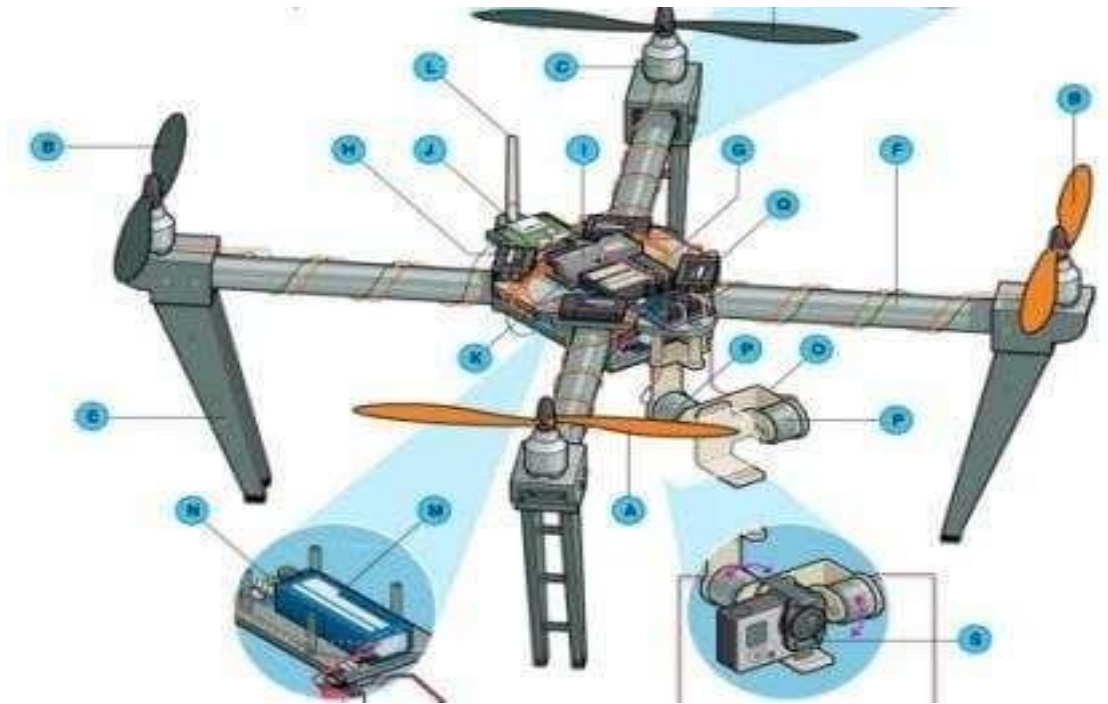


Fig. 4.2: Parts of Drone

4.1.1 Standard Prop



Fig. 4.3: Standard Prop

While some drones like the DJI Phantom look more or less the same from any angle, there is a front and back. The “tractor” propeller are the props at the front of the quadcopter. These props pull the quadcopter through the air like a tractor. Most drone propellers are made of plastic and the better quality made of carbon fiber. You can also buy drone prop guards which you need especially if you are flying indoors or near people.

This is also an area where we are seeing plenty of innovation. Better prop design will assist with giving a better flying experience and longer flight times. There is also some big innovation towards low noise uav props.

Always good practice to inspect your props before flying and carry an extra set in case you notice some damage on a prop. Never fly with a damaged or bent prop.

4.1.2 Pusher Prop



Fig. 4.4: Pusher Prop

The Pusher props are at the back and push the UAV forward hence the name “Pusher props”. These contra-rotating props exactly cancel out motor torques during stationary level flight. Opposite pitch gives downdraft. Again, can be made of plastic with the better pusher props made of carbon fiber. You can also purchase guards for the pusher props. Same as for tractor props. Inspect before each flight and carry a spare set.

4.1.3 Brushless Motor



Fig. 4.5: Brushless Motor

Practically all the latest drones use a brushless electric “outrunner” type, which is more efficient, more reliable, and quieter than a brushed motor.

Motor design is important. More efficient motors save battery life and give the owner more flying time which is what every pilot wants.

DJI developed and patented a new curved magnet which fits perfectly around the motor allowing the motor to run more efficiently.

Examine the motors regularly. Make sure they are clean and free from dust. Get to know how your drone sounds. Listen to it. Most of the sound comes from the motors. If it doesn't sound right, then examine your drone. Fly a couple of feet off the ground and close to you and see if one of the motor is failing. It's not a bad option to have a spare motor or 2.

4.1.4 Motor Mount



Fig. 4.6: Motor Mount

Sometimes built into combination fittings with landing struts or can be part of the UAV frame.

Check the motor mounts and areas close to the motors for stress cracks. If you find stress cracks and your quadcopter is under warranty, then you can send it back and have it fixed. Alternatively the manufacturer may have some strengthener motor mounts.

When you first receive your new drone, it is also a good to examine areas around the motor mounts or where screws are used. Sometimes, screws can be wound in too tight and actually can crack the frame. It may be just a hairline crack but these won't fix themselves.

4.1.5 Landing Gear



Fig. 4.7: Landing Gear

Drones which need high ground clearance may adopt helicopter-style skids mounted directly to the body, while other drones which have no hanging payload may omit landing gear altogether.

Many fixed wing drones which cover large distances such as the Sensefly eBey, Trimble UX5 or the 3DR Aero-M don't have landing gear and land perfectly fine on their belly. Most drone has a fixed landing gear. However, the best drones will have retractable landing gear giving a full 360 degree view.

Retractable Landing Gear Drones, DJI – Spreading Wings S1000+, Inspire 1Walkera – Voyager 3, Scout x4, QR X900

Examine your landing gear and especially if you've had a bit of a rough landing. This protects the drone, expensive camera or sensors.

4.1.6 Boom

Shorter booms increase maneuverability, while longer booms increase stability. Booms must be tough to hold up in a crash while interfering with prop downdraft as little as possible. In many drones the boom is part of the main body. Other drone have a definite boom as a separate part.

Examine and insure that the boom has not become bent as this would effect the flying capabilities.

4.1.7 Main Drone Body Part



Figure 4.8: Main Drone Body Part

This is the central hub from which booms radiate like spokes on a wheel. It houses battery, main boards, processors avionics, cameras, and sensors. Most drones are not waterproof so it is vital that the internal components of the main body do not get wet.

A hard landing may not break the body of the drone but the shock could damage the internal drone components in the main bod.

4.1.8 Electronic Speed Controllers (ESC)



Fig. 4.9: Electronic Speed Controllers (ESC)

Electronic Speed Controllers are an essential component of modern quadcopters (and all multirotor) which offer high power, high frequency, high resolution 3- phase AC power to the motors in an extremely compact miniature package.

An electronic speed controller or ESC is an electronic circuit with the purpose to vary an electric motor's speed, its direction and possibly also to act as a dynamic brake. It converts DC battery power into 3-phase AC for driving brushless motors.

The latest ESC innovation was on the DJI Inspire 1 which uses new sinusoidal drive ESC which replace the more square wave drive of traditional ESCs. The Inspire 1 goes further by using closed loop torque control and distinct functional redundancy which adds extra efficiency and reliability to the motors.

The ESC are inside the main frame of the drone and most drone owners won't need to do anything with these. However, companies such as DJI, 3DR and Parrot develop drones which can be customized. What allows this drone to be customized is a Special Development Kit (SDK). With the SDK, then you could re- program the electronic speed controllers and many other drone components.

4.1.9 Flight Controller

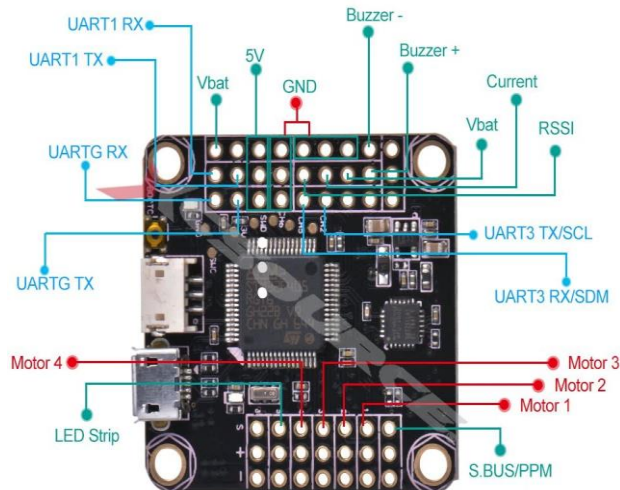


Figure 4.10: Flight Controller

The flight controller:

- interprets input from receiver, GPS module, battery monitor, IMU and other onboard sensors
- Regulates motor speeds, via ESCs, to provide steering, as well as triggering cameras or other payloads.
- Controls autopilot, waypoints, follow me, failsafe and many other autonomous functions. It's central to the whole functioning of your UAV.

Most owner won't need to do anything or modify the flight controller by reprogramming. If you needed to create a customized solution then a drone with SDK as mentioned about would allow this.

4.1.10 GPS Module



Fig. 4.11: GPS Module

GPS stands for Global Positioning System. It is an American standard which provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

Often combines GPS receiver and magnetometer to provide latitude, longitude, elevation, and compass heading from a single device.

GPS is an important requirement for waypoint navigation and many other autonomous flight modes. Without GPS drones would have very limited uses. Along with FPV, drones can navigate long distances and be used for exiting applications such as lidar and photogrammetry.

Some of the latest drones have added Glomus, which is the Russian equivalent of GPS. This means your drone is almost guaranteed to find many satellites to get its positioning from. With both systems you can fly more accurately and also can fly safer as you know you won't loose satellite connection.

Most drones allow you to program in a failsafe home point. This allows the drone to fly back to a point if it loses connection to your remote controller. Most drones have a minimum requirement of satellites before the home point can be set. But always set a home point. When buying a drone, keep an eye out for drones which come with both GPS and Glomus.

4.1.11 Receiver



Fig. 4.12: Receiver

Often a standard r/c radio receiver unit. The minimum number of channels needed to control a quad is 4, but 5 is usually recommended. There are many manufacturers of receivers on the market if you are building your own drone.

4.1.12 Antenna



• **Fig. 4.13: Antenna**

Depending on your receiver, it may be a loose wire whip or helical “rubber ducky” type. Pretty easy to upgrade. Circularly polarized cloverleaf antenna gives you further video signal distance and improves the video stability. A very good antenna stops the problem of the multi-path effect and also blind angle.

4.1.13 Battery



Fig. 4.14: Battery

Lithium polymer (LiPo) batteries offer the best combination of energy density, power density, and lifetime on the market. It’s always great to carry a spare battery or 2. Read and follow the instructions for charging and storing your battery to make sure it lasts a long time.

Every so often is always good to fully discharge and recharge your battery.

Check to make sure your battery doesn’t overheat.

All batteries are dangerous when are physically damaged so never install a damaged battery into your drone.

Also never try to recharge a battery that has physical damage. Make sure you drone components are in good physical conditions. Always think safety.

4.1.14 Battery Monitor

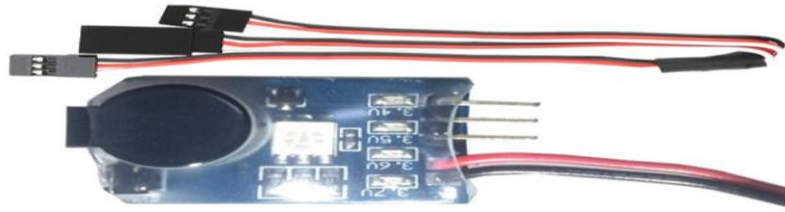


Fig. 4.15: Battery Monitor

Provides in-flight power level monitoring to flight controller. Your battery is critical to flying safely. If you fly to far out and your quadcopter runs out of battery then it will either make an emergency landing or will crash. Know your drones flying time, battery levels and where to read these levels. Don't push the boundaries of flying on low battery power.

4.1.15 Gimbal



Fig. 4.16: Gimbal

The drone gimbal is the pivoting mount that rotates about the x, y, and z axes to provide stabilization and pointing of cameras or other sensors. If you don't have a great gimbal, then it doesn't matter how good the camera is.

The gimbal is all important to taking great photo and video. If you are having problem with jello effect, which is caused by vibration from the drone getting to the camera, then look at installing or changing the gimbal dampers. This change alone can make a big difference.

4.1.16 Gimbal Motor



Fig. 4.17: Gimbal Motor

Brushless DC motors can be used for direct-drive angular positioning, too, which requires specially-wound coils and dedicated control circuitry that have only recently become commercially available.

4.1.17 Gimbal Controller Unit



Fig. 4.18: Gimbal Controller Unit

Allows control of direct-drive brushless gimbal motors as if they were standard hobby servos.

4.1.18 Camera and Sensors



Fig. 4.19: Camera and Sensor

GoPro or other compact high definition video unit with onboard storage. Real-time streaming is possible on the latest drones such as the DJI Mavic Pro, the new

Phantom 4 Pro and the top professional Inspire 2 filming quadcopter. With the wrong camera on your drone, you will never be able to take professional videos or photos. Some of the problems are rolling shutter, jell and barrel effect.

Many drone manufacturers produced gimbals which are compatible with the GoPro Hero camera range. The latest drone from 3DR called the SOLO was designed specifically with the GoPro Hero cameras in mind.

However, this year we also seen a move towards all in one drones with come with an integrated gimbal and camera. The camera is specifically designed for aerial filming and photography.

4.2 PLANNING AND PROTOTYPING

Resource and design planning is a key element in any manufacturing process, as it ensures that all potential issues are addressed before large-scale production. This step of the manufacturing process becomes even more important in low-volume manufacturing, as the costs are higher. So, for those looking to craft their own drone, plenty of time and attention should be dedicated to this phase.

A drone prototype starts with a proposed design, which should be completed to scale before any parts are purchased. The plan should also clearly indicate the purpose of the drone. Is it a multi-purpose device that does a few basic functions or will it serve a specific purpose, such as aerial photography or transportation? These decisions indicate key considerations, such as how much it will need to be able to carry which translates into the weight of the materials and the size of the motor.

A prototype may be assembled and found wanting, requiring changes to the original design to get it right before final production.

4.3 FRAMING

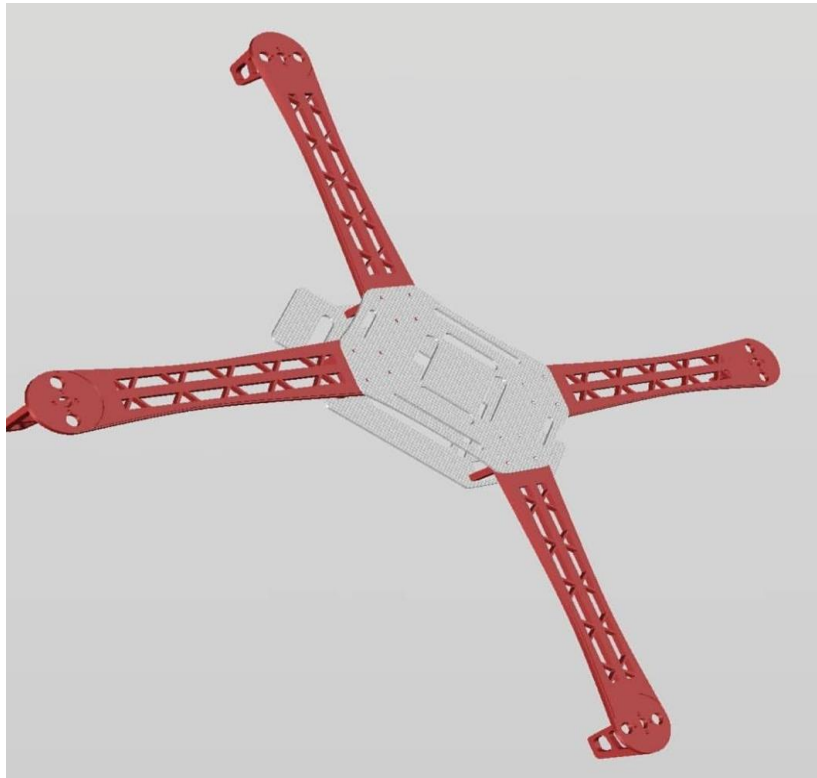


Fig. 4.20: Frame

The frame of a drone is the main contributor to structural integrity. This is often comprised of a sturdy, yet lightweight material to find a balance between aerodynamics and durability. This could be a plastic blend or even hollow metal.

In most cases, the frame is assembled in an X formation to provide additional support for the motors and added durability overall.

4.4 MOTOR ASSEMBLY

Putting together the motor and connecting the propellers is an integral step in the drone manufacturing process. Depending on the style of drone, the device could have upward of eight motors and propellers. Traditional drones typically have four brushless motors to improve air travel time.

The assembly of the motors is a complex process. For drone manufacturers with specialized equipment, putting the motors together is a standardized manufacturing effort. Highly specialized drones will have engineers in place to put together the motor in the desired way for max effectiveness. It's recommended that those experimenting with building a drone for personal use should purchase prefabricated motor parts.

To adhere the motors and propellers to the drone, holes must be drilled in the frame in the right spot as to not cause imbalance.

4.5 THE INNER WORKINGS



Fig. 4.21: The Inner Working

After the propellers are attached to the motors and frames, it's time to make the drone operational. The drone will require electronic speed control (ESC), an RC receiver, batteries, a power distribution board, and connectors to complete the internal circuitry that allows the motors to run.

The ESC devices will ultimately direct power from the battery to the motors to make them run; thus, one is required for each motor. The RC receiver receives signals from the transmitter, which is how the user controls the device. The battery is connected to the power distribution board and the connectors, to generate energy to power the motors; this completes the circuitry at a very basic level.

Other components include the wiring used within and adherence methods to stabilize the circuit board. Additionally, a mounting pad may be installed to reduce vibration. A flight controller may also be added to help with stability in the air. More complex drones will have additional components to house a camera and photo storage or control arms, depending on the purpose of the drone.

4.6 EXTERNAL GEAR AND PROGRAMMING

Once the inner workings of a drone have been deemed functional, the device must be programmed to respond to the transmitter. Additionally, the drone will require landing equipment to protect the device when it lands-- whether intentionally or unintentionally-- on the ground.

This gear is often quite simple, mimicking that of a helicopter. Lightweight metal pegs or bars are added to the side arms or bottom of the drone to ease the transition from flight to ground. This gear also helps with storage and stability during take off.

Manufactured drones and drone prototypes will often go through rigorous testing protocols for quality assurance. Those building their own drones should take it slow, starting with a small area in which to work and expanding to test transmission signals and stability. Once everything is tested, it's time to take off!

CHAPTER 5

RESULTS AND DISCUSSION PERFORMANCE ANALYSIS

5.1 INTRODUCTION TO CAD

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the use of computer technology for the process of design and design-documentation. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provides the user with input-tools for the purpose of streamlining design processes; drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD-based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, etc.) typically uses vector-based (linear) environments whereas graphic-based software utilizes raster-based (pixilated) environments.

5.2 SOLIDWORKS

Solid Works is mechanical design automation software that takes advantage of the familiar Microsoft Windows graphical user interface.

It is an easy-to-learn tool which makes it possible for mechanical designers to quickly sketch ideas, experiment with features and dimensions, and produce models and detailed drawings.

A Solid Works model consists of parts, assemblies, and drawings.

- Typically, we begin with a sketch, create a base feature, and then add more features to the model. (One can also begin with an imported surface or solid geometry).
- We are free to refine our design by adding, changing, or reordering features.
- Associativity between parts, assemblies, and drawings assures that changes made to one view are automatically made to all other views.
- We can generate drawings or assemblies at any time in the design process.
- The SolidWorks software lets us customize functionality to suit our needs.

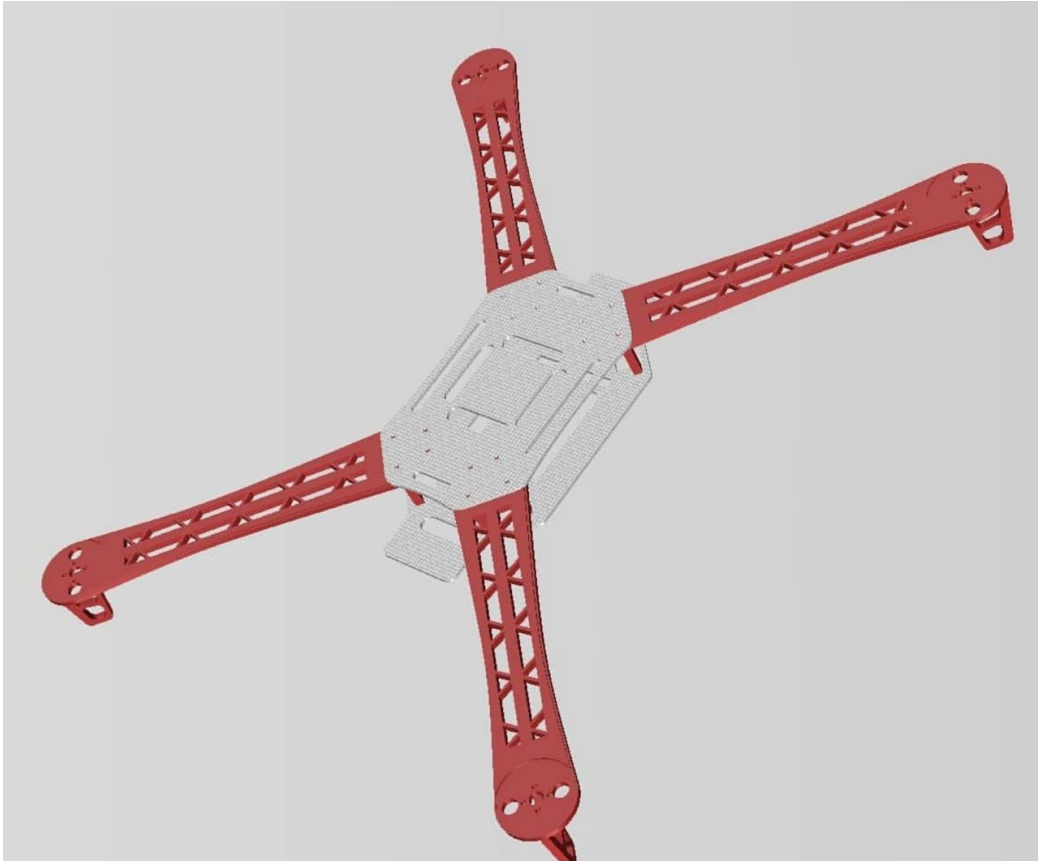


Fig. 5.1: 3D Diagram

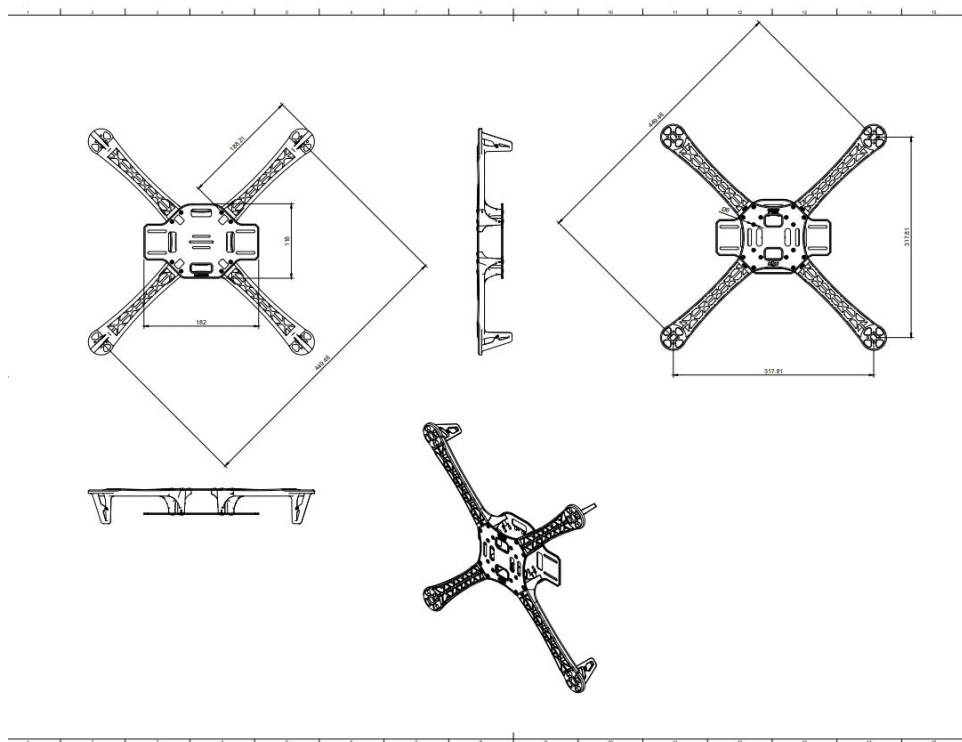


Fig. 5.2: Top, Side, Front View of Diagram



Fig 5.3(a): Out Come of First Response Drone

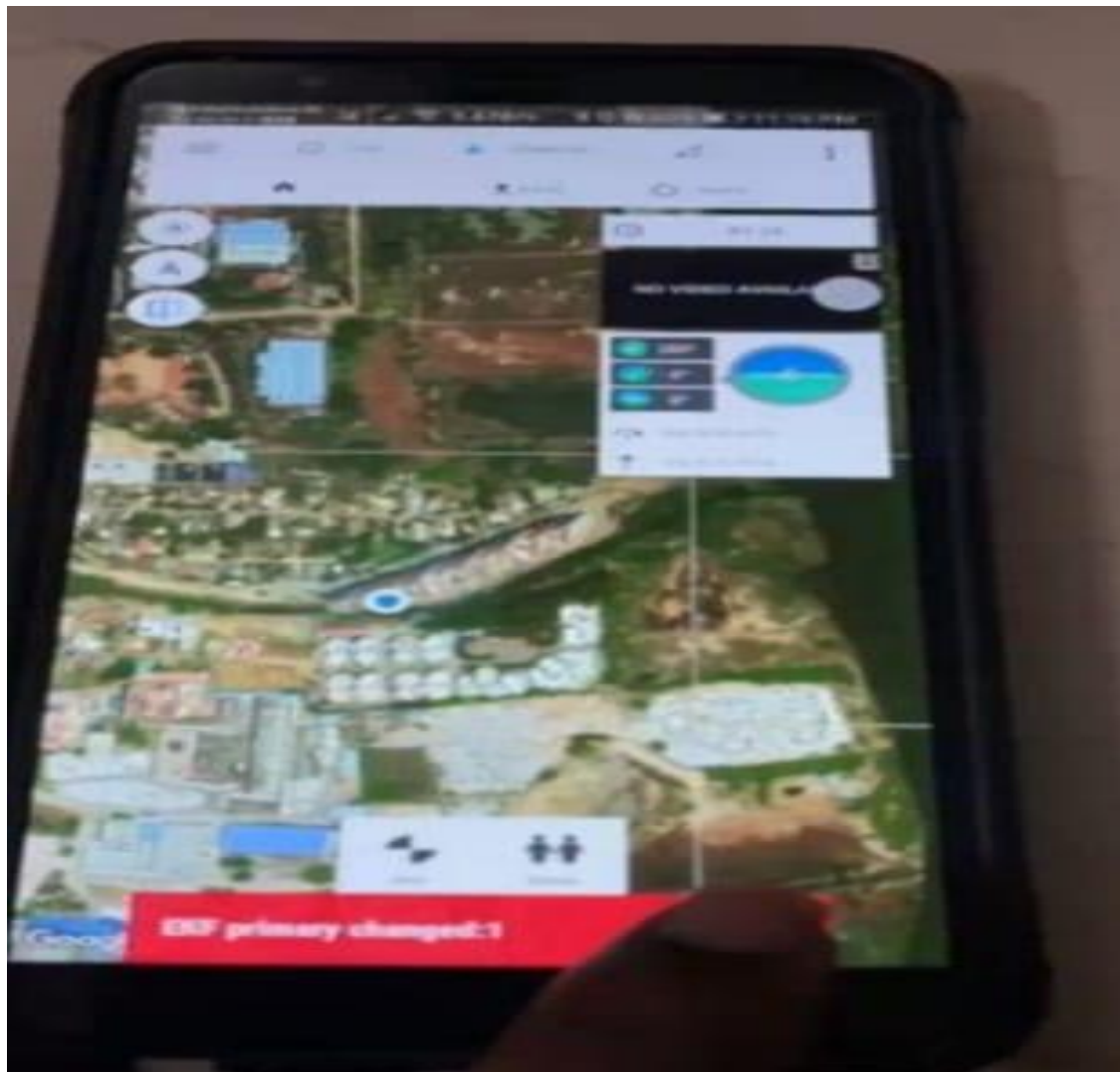


Fig5.3(b): Out Come of First Response Drone

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY OF PROJECT

Drones (aka Unmanned Aerial Vehicles (UAVs)) have been used in military for many years now and recently, there has been a drastic increase in the usage of UAVs in other fields such as precision agriculture, security and surveillance, and delivery of goods and services. For instance, Amazon and Wal-mart have been working on a new platform that uses UAVs to deliver shipments to customers over the air. Similarly, China's largest mailing company has already started its own experiments with a fleet of UAVs that could deliver around 500 parcels every day. The usage of UAVs for daily consumer-oriented services is expanding and becoming a reality.

Such intelligent UAVs (ITS drones) can provide an efficient mean not only to enforce the traffic rules and support the traffic police on ground, but also provide the road users with efficient information on traffic (aka intelligent traffic management).

In Drone TS, the ITS UAVs will be enabled by a Dedicated Short Range Communication (DSRC) interface, which will be part of any modern vehicle within the next few years to provide Vehicle to Vehicle and Vehicle to Infrastructure (V2X) communications. Such a technology will allow the ITS UAVs to communicate through a direct wireless link with the vehicles in proximity to better enforce road safety and better support traffic efficiency. For sure, our experience and accomplishments in the field of V2X communications through previous NPRP and other projects will be used as input into this new research work.

To the best of our knowledge, applying DSRC-enabled Indeed, Intelligent Transport Systems (ITS) and road safety can greatly benefit from the use of drones. If dedicated intelligent UAVs are employed, road safety can be improved drastically to reduce the number of UAVs to enforce road safety and to improve traffic efficiency has never been explored elsewhere, and therefore such a research project will put Qatar under a worldwide spotlight.

6.2 CONCLUSIONS

The use of drones for medical purposes brings many advantages, such as quick help, shortening the time of traveling to the patient, reduction of complications in the injured owing to a short time to wait for rescue, support and improvement of basic operations of medical emergency teams, and the opportunity to reach places inaccessible for basic means of medical transport (e.g., because of floods and blocked roads). It is very important, however, to be aware of the existing regulations. Here are several safety information campaigns but neither information campaigns nor the most perfect regulations will protect against threats that may be caused by the presence of a drone in a place not intended for. An appearance of an unreported unmanned aircraft in the controlled space is an issue identified worldwide as affecting aviation safety.

Examples may be filming a large passenger aircraft from a close distance, or an interruption of approach to an international airport associated with an identification of a drone.

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