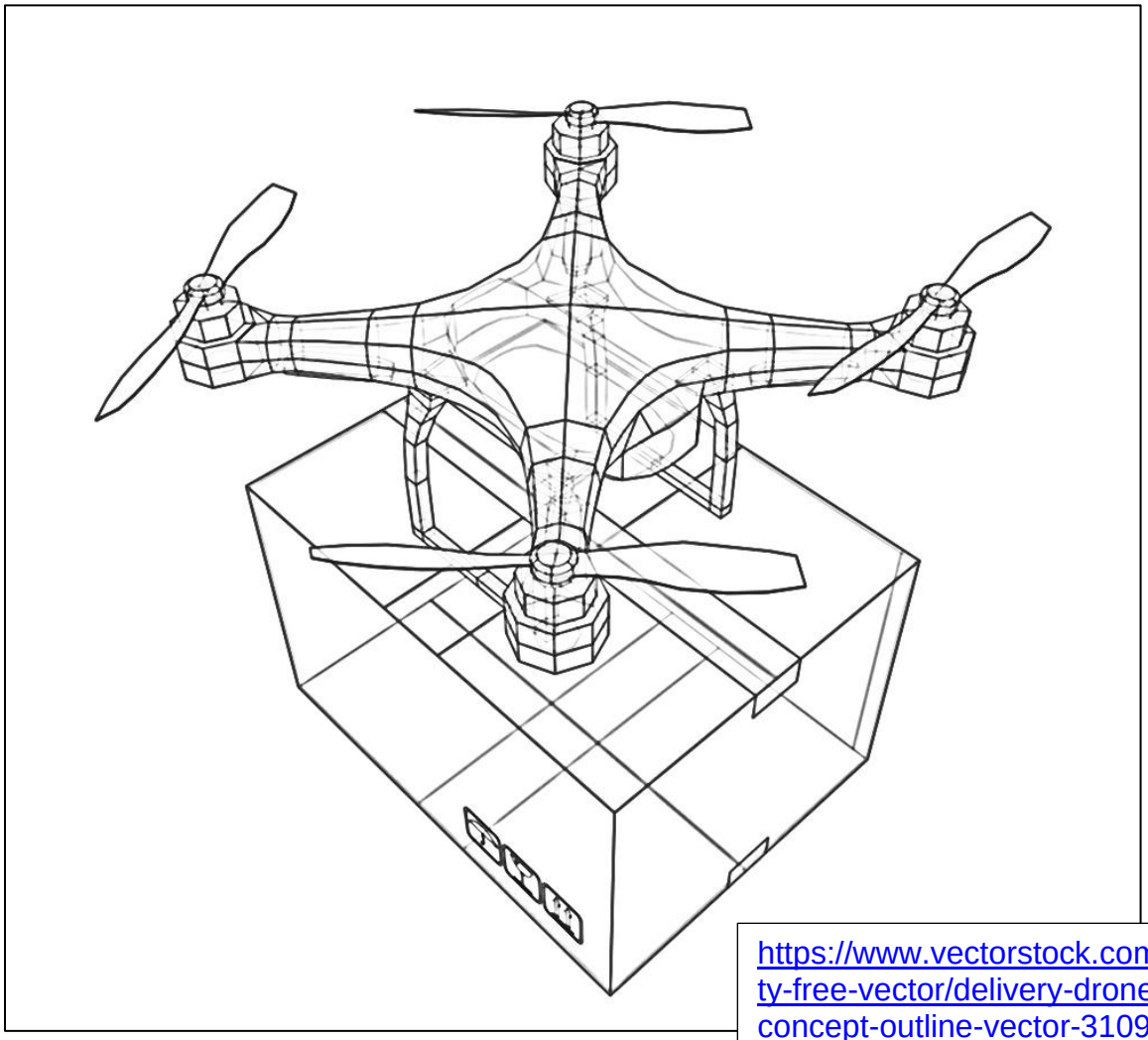
ES101

Quadcopter Delivery Drone

Project Proposal



https://www.vectorstock.com/royalty-free-vector/delivery-drone-concept-outline-vector-31099066

Fig 1 (a) Sketch Drone

Prepared by: Group 2

Quadcopter Delivery Drone

Term: Spring 2022

Group 2

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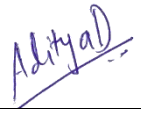
4	Aditya Deshmukh (21110014)	
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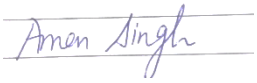
9	Aman Singh (21110020)	
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Introduction and Motivation

Back in 1940, Henry Ford said, "Mark my word: A combination airplane and motorcar is coming. You may smile, but it will come." A hundred years later, that is, by 2040, Morgan Stanley predicts an addressable market of $1.5 trillion in autonomous urban aircraft. Henry Ford and the Wright brothers, the pioneers of both fields of automobiles and aircraft, had, to quote the spokesman for the US Experimental Aircraft Association 'dreamt of marrying the plane and the car, but engineering, regulations, and cultural hurdles have always got in the way. '

Our primary motivation in choosing this specific project is to appreciate that it will soon be possible to integrate what seemed to be an unachievable feat of engineering into our daily lives. And thus, we present a quadcopter whose primary task is the end-to-end delivery of everyday essentials. We have a three-pronged approach to the quadcopter's regular focus: medical requirements, food, and e-commerce delivery.

Aside from an academic thrill, we are also motivated to do this project by virtue of various social and societal perspectives. A functional drone delivery system will be a great service to certain communities. For example, Zipline has made fast, dependable drone delivery a critical part of medical supply infrastructure in Rwanda on a national scale. In fact, Zipline was also able to launch an Emergency Long-Distance Covid-19 Supply System in North Carolina, USA. A subdivision Wing of Google's parent company Alphabet has also successfully forged a functional suburban drone delivery system in Logan, Australia.

And last but highly relevant in these times is the environmental impact of technology. Drones yield lower energy consumption and reduce greenhouse gas emissions, thus reducing the carbon footprint and enhancing environmental sustainability. Optimally routing and delivering packages with unmanned aerial vehicles (UAV's) would save energy and reduce carbon emissions. Computational results in various researches strongly support the notion that using UAVs for last-mile logistics is not only cost-effective but also environmentally friendly.

A drone is proved to be one of the greatest inventions of mankind. Almost every industry is using it in one way or another. It has become the fastest delivery system for various companies like Amazon, designed to safely get packages to customers in minimal time using autonomous aerial vehicles, also called drones. It provides rapid parcel delivery that will also increase the overall safety and efficiency of the transportation system.

The drone's frame comprises different kinds of light composite material to reduce its weight and increase its manufacturing efficiency and maneuvering speed. The structure includes the arms to hold the motor and other parts like the battery, propellers, etc. The

Controller communicates with the drone using radiofrequency. The drone consists of a propulsion system that moves it into the air and allows it to fly in any direction. Electronic Speed Controllers act as an interface between the motor and the flight controller. The Flight Controller coordinates the RPM of each motor in light of input. An order from the pilot for the Quad-copter to push ahead is taken care of into the flight regulator, which decides how to control the motors likewise.

Quadcopter moves with the help of its four motors. The motors and propellers work in pairs, with two motors rotating clockwise (CW Propellers) and the other two rotating counter-clockwise (CCW Propellers). ESCs convert the signals from the Controller and send them to motors to control their speed. Drone requires a controller which allows the operator to use remote controls to launch, navigate and move the drone smoothly according to one's requirements. The battery of a quadcopter is the primary source that supplies the power to drive the drone and all its other parts. The drone's flight time will entirely depend on the battery's capacity.

Drone delivery is a moderately new idea, and there are a ton of angles that should be dealt with. Nobody is clear about how the drone delivery framework will turn out in the coming years. nonetheless, one thing is certain: drone delivery will forever be the best option for the last-mile delivery framework. Drone delivery is like how robots work. For instance, UPS collaborated with a drone innovation organization called Matternet to develop professionally prescribed medication tests, including organ and blood tests. In light of a specialist's example prerequisites, a drone picks up the medicines from the origin and delivers them to the destination. The development of medication and other related examples in WakeMed, Carolina, required over 30 minutes in a typical situation since the grounds are colossal. With the assistance of drone delivery, they could finish the movement within 3 minutes. This was the main effective drone delivery that produced income.

The future looks splendid for the drone delivery framework. The last-mile delivery system will change once the drones are incorporated into the delivery mechanism.

Fig 1 (b) Drone Graphics GPS

Fig 1 (c) Delivery Drone

Sources

1- Chiang, Wen-Chyuan & Li, Yuyu & Shang, Jennifer & Urban, Timothy. (2019). Impact of drone delivery on sustainability and cost: Realizing the UAV potential through vehicle routing optimization. Applied Energy. 242. 1164-1175. 10.1016/j.apenergy.2019.03.117.

2- https://time.com/6093371/amazon-drone-delivery-service/

3- https://spectrum.ieee.org/zipline-long-distance-delivery-covid19-supplies

4- https://www.bbc.com/news/technology-24635758#:~:text=In%201940%20Henry%20Ford%20famously,airplane%20and%20motorcar%20is%20coming.&text=Technology%20%2D%20%22sense%20and%20avoid%22,full%20approval%20to%20flying%20cars

5- https://robu.in/understanding-various-components-used-for-quadcopter-2/

Part Name: - Battery, Power distribution Board and Obstacle Avoidance Sensor

Ahaan Giriya (21110015)

Introduction

Our group is working on modeling a drone or specifically a quadcopter. According to Wikipedia, "An **unmanned aerial vehicle** (**UAV**), commonly known as a **drone**, is an aircraft without any human pilot, crew or passengers on board." They were initially developed in the twentieth century to serve military purposes, but as technology improved and costs fell, their use expanded to many non-military applications. These include aerial photography, policing and surveillance, product deliveries, agriculture and forestry, monitoring and inspection, etc.

Our model has about 15 parts, of which I have been assigned the work of modeling two parts, namely the battery and the power Distribution board. Both play a critical role in the functioning of the drone.

Battery

- ### Structure and Functions

The battery is a fundamental component and acts as the power source for the drone. It supplies energy to all the electronics via the power distribution board. Flight time of the drone depends on the battery capacity, and accordingly, it should be chosen to achieve an ideal balance between performance and flight time. It is additionally perhaps the heaviest part of a drone, so one must choose the battery carefully. To sum it up, the factors that play a role in selecting a battery are its size, capacity, voltage, charge & discharge rates. The battery is placed on the top of the drone's frame in our model.

- ### Possible Challenges

I believe that this part of the drone is relatively easy to design as there isn't really a need to make the inner components of the battery, so there are hardly any challenges that I might have to face while modelling this part.

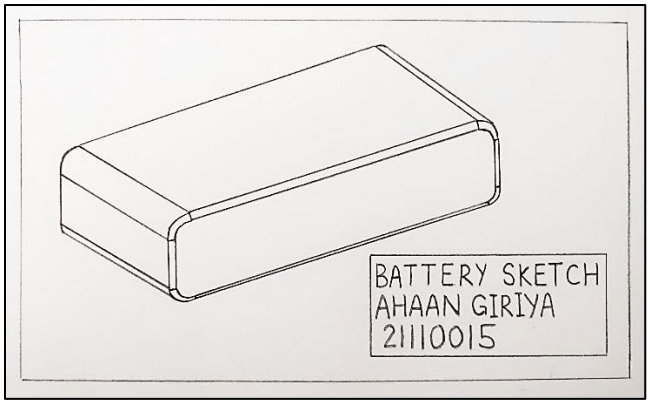


Fig 1.1(a) Battery Sketch

Fig 1.1(b) Battery

Power Distribution Board

- ### Structure and Functions

The Power Distribution Board (PDB) does exactly what its name suggests. It essentially distributes the power from the battery to various drone components such as motors, electronic speed controllers (ESC's), LED lights, flight controllers, cameras, etc. There is not much to the working of the PDB as it is simply a basic circuit board with positive terminals that are all connected and similarly negative terminals that are all connected. In this way, when all the positive and negative wires are soldered on their corresponding terminals on the PDB, they will become connected, allowing the battery to power all the components through the distribution board efficiently and systematically instead of having a messy nest of tangled wires going between all the components. In our model, the distribution board is placed between the central part of the drone's frame.

- ### Possible Challenges

This part of the drone is fairly simple to design. I don't think I will face any issues in modeling this part. However, we might face some challenges in the later stages of assembling the model, specifically in this part.

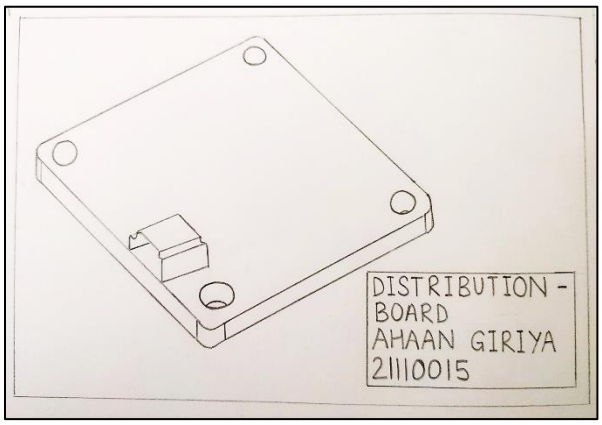


Fig 1.3(a) Distribution board Sketch

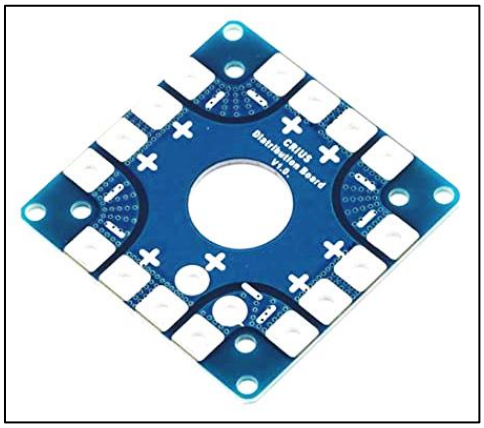


Fig 1.3(b) Distribution Board

Infrared Obstacle Avoidance Sensor Module

- ### Structure and Functions

An infrared sensor is an electronic device that emits light in order to sense some object in the surrounding. It can measure the heat of an object as well as detect motion. Usually, all objects radiate some form of thermal radiation. These types of radiation are invisible to our eyes but the infrared sensor can detect them. The emitter is simply an infrared LED and the detector, an IR photodiode. The photodiode is sensitive to IR light of the same wavelength that is emitted by the IR LED. When IR light falls on the photodiode, the output voltages and resistance will adjust in proportion to the intensity of IR light captured.

The IR obstacle avoidance sensor module has a pair of infrared transmitting and receiving tubes. When the transmitted light is reflected back from an object and received by the receiver tube, the direction of the object is determined and an output signal is given to the flight controller. It changes the flight path of the drone to evade the obstacle and avoid damage to the drone, the package, and the obstacle itself. This function is crucial to a delivery drone because it is automated and not controlled by someone. This will help the drone to avoid birds, high-rise buildings, and other objects in its path when flying low.

- ### Possible Challenges

There are some intricate parts in the sensor module that might pose challenges while modeling the part in Autodesk. I may also face difficulty in making the LED's.

- **Sketches and Images**

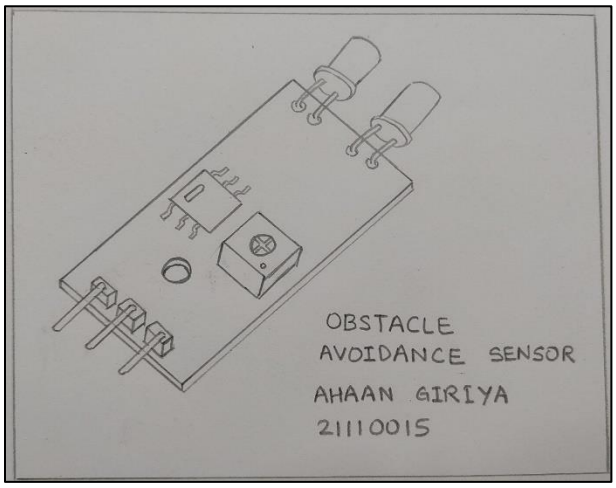


Fig 1.4(a) Obstacle avoidance sensor Sketch

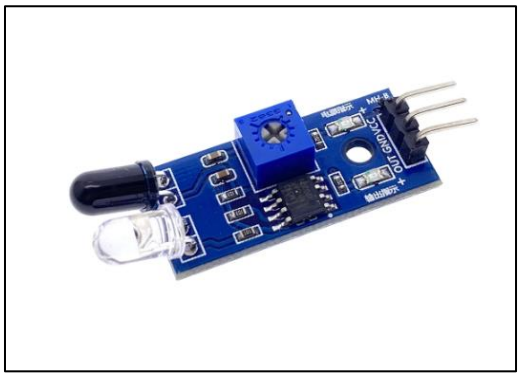


Fig 1.4(b) Obstacle avoidance sensor

Sources

1. https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle
2. https://www.dronetrest.com/t/power-distribution-boards-how-to-choose-the-right-one/1259
3. https://medium.com/@UAVLance/drone-parts-and-components-15582f68e920
4. https://www.indiamart.com/proddetail/drone-quadcoptor-lipo-battery-3-7v-1500mah-1800mah-750mah-800mah-500mah-20918224533.html
5. https://www.getfpv.com/learn/new-to-fpv/all-about-multirotor-fpv-drone-battery/
6. https://www.filotronix.com/embedded/373-ir-infrared-obstacle-avoidance-sensor-module.html
7. https://robu.in/product/ir-infrared-obstacle-avoidance-sensor-module/

Part Name: - GPS Unit and 360° Camera

Alok Kumar Vidyarthi (21110019)

Introduction

Our team has decided to make a quadcopter delivery drone. Drones are becoming a part of our day-to-day life. As technology advances, people prefer to get their product at their home, without visiting the busy markets. These quadcopters will reduce human efforts of serving door to door. The valuable time can be saved, and it will increase the accuracy of the timely delivery of the product. The money spent by companies will be reduced as they do not have to hire workers for delivery. They can get quadcopters at cheap rates. GPS (Global Positioning System) systems help deliver the products even in remote areas. There could not be any network issue as the GPS systems are directly connected with the satellites. The 360-degree the camera will help protect the quadcopter, and the whole journey can be seen easily. It can Also be verified by images that the product has reached its destination.

- ### Basic Structure

The shape of the GPS and the 360-degree camera is so adjusted, that they may not affect the other parts. The GPS consists of three segments:
1 - Space Segment
2 - Control Segment
3 - User Segment

The GPS helps navigate the drone path, giving more freedom. We can control the quadcopter using the mobile phone by some programming. GPS receiver modules have TX and RX antennas. The circuiting in it is complex. The 360-degree camera has image sensors and chips to record the video and storage. The 360-degree cameras are rounded eyeballs in shape. It has a camera status screen on the top of the camera. A small microphone adjacent to the camera. It has a cover, and inside the cover, there is A battery.

- ### Working

GPS works based on trilateration. Trilateration is the process of confirming the user's location with time. Trilateration accuracy is about 1-2m, while triangulation has an accuracy of about 0.5m. The working of GPS is based on satellite signals. The satellites send signals to the earth, and the receiver in the GPS receives the signals. Atomic clocks are used in satellites which provide accurate time for a long time. When the receiver receives the signals, it calculates the timing and distance between the sending and receiving alerts. Then, it solves the equations to get the receiver location data. The receiver verifies its location by four satellite signals. So basically computes the latitude,

longitude, altitude, and time. The location will be more accurate if the receiver gets the signals from multiple satellites. The light rays enter from the aperture and fall on the convex lens. The convex lens concentrates the falling rays on the CCD (Charged Coupled Device). Then after a specific electronic procedure, the image is shown on the device's display.

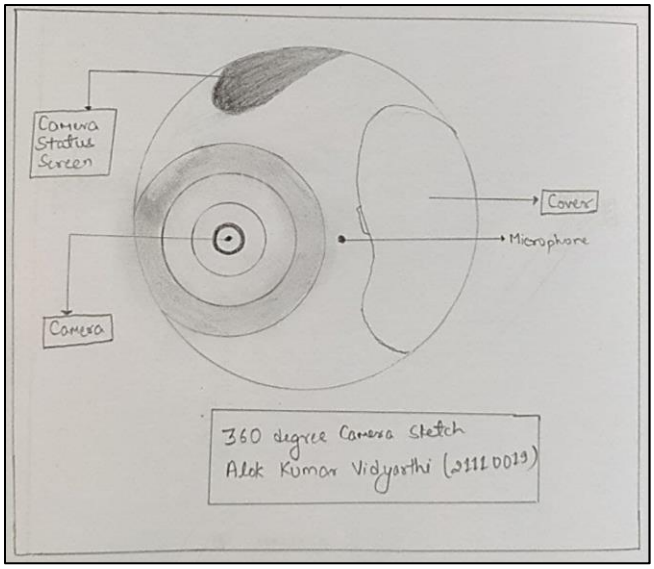


Fig 2.1(a) 360 Camera Sketch

Fig 2.2(b) 360 Camera

- ## Science Behind it

GPS works from the signals of the satellites. The 360-degree camera can cover a wide range because of its rotation. The camera follows the laws of reflection refraction. Aperture allows the number of light rays that will fall on the convex lens. The convex lens then converges (according to refraction laws) the rays on the sensor like CCD. The sensor then converts the light signals to electric signals. The science in the 360-degree camera is the same as ordinary cameras except for some advanced technology. The AI systems in the camera have motion detection techniques so that if anything happens around the camera, it will alert you.

- ## Possible Challenges

We are thinking of putting the GPS at the top of the battery with the help of a stand. Some team members are thinking of putting it adjacent to the motor. If the quadcopter loses the connection from the initial point of flight, it will be RTL(Return To Launch mode) mode. The resolutions of the 360-degree cameras are pretty high. Instead, it may not capture the images or take a video of the ground from a certain height. We may not get the live video

of the journey. Also, the camera will not capture the images at night if it does not have infrared night vision. We may have to set up a flashlight, and extra power consumption will be required. The size of the 360-degree cameras is significant compared to other ordinary cameras, and weight is also high.

- ## Future aspects

GPS is going to evolve in upcoming years. NavIC is the Indian regional satellite system developed by the ISRO. It is not common in India, but it has a lot of scopes to build here.

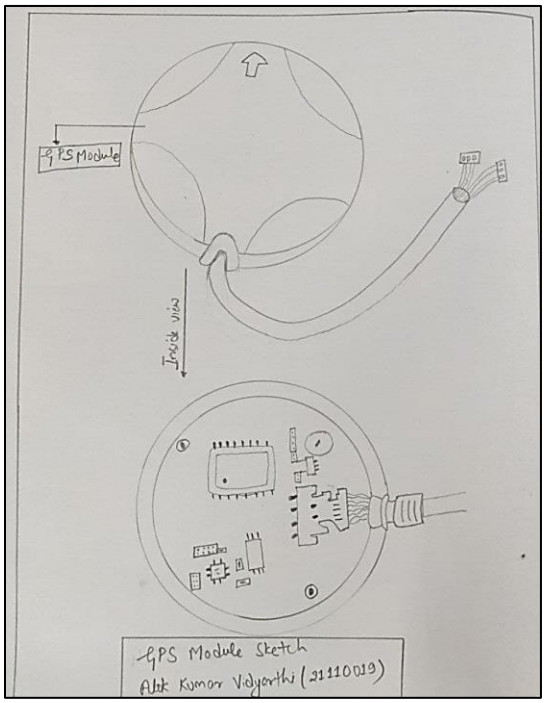


Fig 2.2(a) GPS Module Sketch

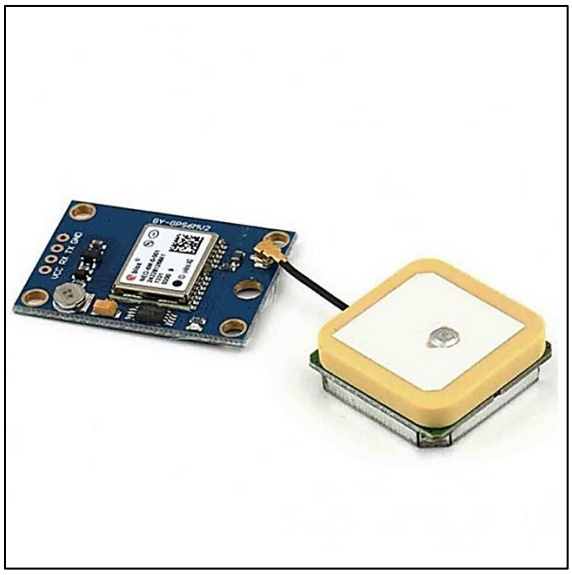


Fig 2.2(b) GPS Module

Sources

1 - https://www.youtube.com/watch?v=3dyiiDlUF1w&list=WL&index=2
2 - https://www.isro.gov.in/irnss-programme
3 - https://www.yangdaonline.com/eagle-eye-30ie-360-30x-eo-ir-dual-sensor-drone-zoom-camera-with-360-degree-rotation/
4 - https://www.electronicscomp.com/neo-6m-gps-module?gclid=Cj0KCQiAip-PBhDVARIsAPP2xc3OrioacriKkUIZN_BgfaszCWNcwxtoT86eG6QyimskyK4WUp2ACTcaAoAQEALw_wcB

Part Name: - Box Holder and Motor

Yash Ahire (21110016)

Introduction

We have chosen to plan a three-dimensional model of a delivery drone. A delivery drone is an airborne vehicle that can fly in the sky through Quadcopters. The delivery drone can give lots of benefits over traditional methods for transport, and it diminishes the expense of our items. The primary reason for the model is to deliver essential and emergency items like clinical supplies to help needy individuals. It can likewise be utilized to move transport packages, food sources, and other needful goods upon the heaviness of the payload it could deliver. The most important use is that it lessens pollution, increasing using transportation every day. It can likewise decrease the delivery expense as it is an innovatively running framework and by transport implies, we require a driver, which builds the cost of transportation. The robot can be effortlessly reached even where it is somewhat troublesome or totally unthinkable for people to go, so this feature of the drone also moreover makes it a decent choice to use in disaster management. Remembering this multitude of things, our group is working on a project to make a quadcopter delivery drone. This drone will be solid and simple to work. Our model appears to be an extremely intricate model, so it may have countless parts yet we can't make every one of the parts, so we have recently separated this drone into 10-15 little parts. I will be going to plan two pieces of it, the one is a motor and the other will be a Box holder.

Fig 3.1 (a) Box Holder

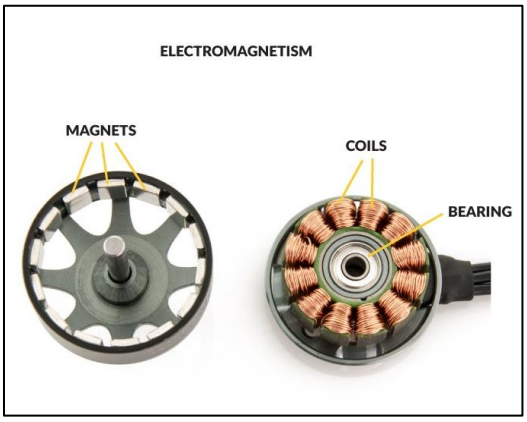
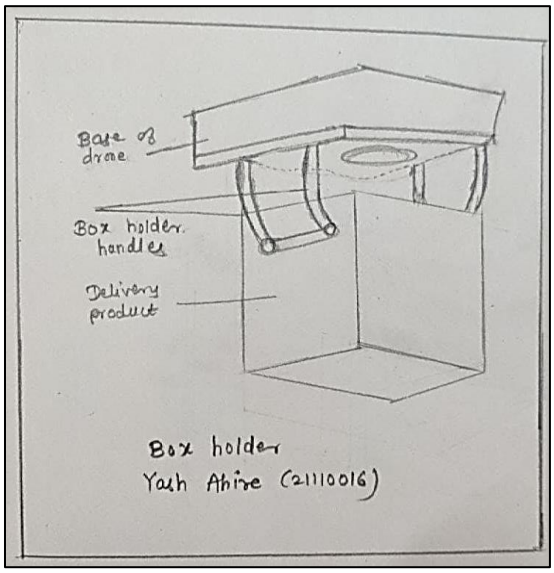


Fig 3.1 (b) Motor

- **Basic Structure**

Box Holders

Box holders are one of the primary pieces of our model. It associates or joins the delivery box in which the products will be kept. It will contain four cuboidal-molded poles, two round and hollow formed poles, and a few screws and bolts. The two cuboidal-molded bars will have fillets and broaden somewhat from the fillet horizontal to the bar from the two closures. These box holders are made packed so that the product box does not fall while delivering. Box holders are made to handle the appropriate weight of a package, to avoid the drone clash or drone accidents by overweight. The reason for the design is to expand the strength of the box holder part. It will be useful to protect the product in the box appended to the drone since, in such a case that we use something like a snare rather than this, that won't be protected however viable as this seems to be. The corner parts have appropriately completed as bends like a filet is just for a decent appearance not so much for a particular explanation.



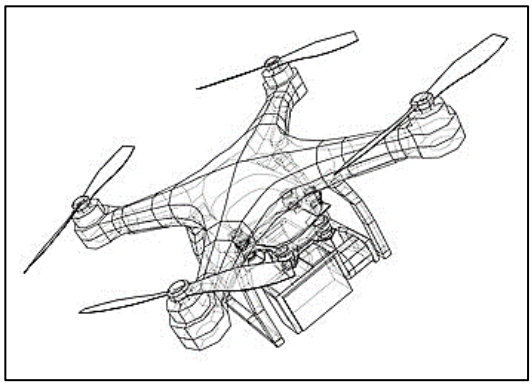


Fig 3.2 (a) Box Holder Sketch

Fig 3.2 (b) Box Holder Drone

Motor

The most well-known utilization of motors for drones and UAVs is to turn the propellers of multirotor drones to empower them to fly. Drone motors may likewise be found in other automated vehicle subsystems, for example, camera and payload gimbals, flight surfaces, radio wire rotators, and landing gear. The determination of a drone motor for a specific drone impetus framework will rely upon many elements, especially the heaviness of the drone. A drone motor should have the option to produce

sufficient push to check the heaviness of the drone and empower it to accomplish take-off. Higher torque esteem engines are needed for bigger propellers and will draw more current than lower-torque motors. Larger drones and UAVs will involve brushless motors as they can convey the additional load of the extra gadgets. Brushless drone motors likewise require an electronic speed regulator (ESC) to work.

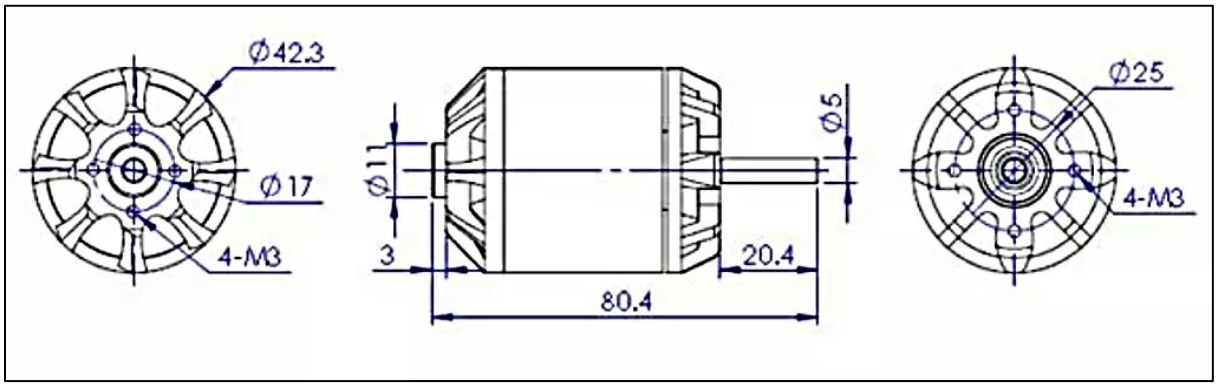


Fig 3.3(a) Dimensions Sketch of Motor

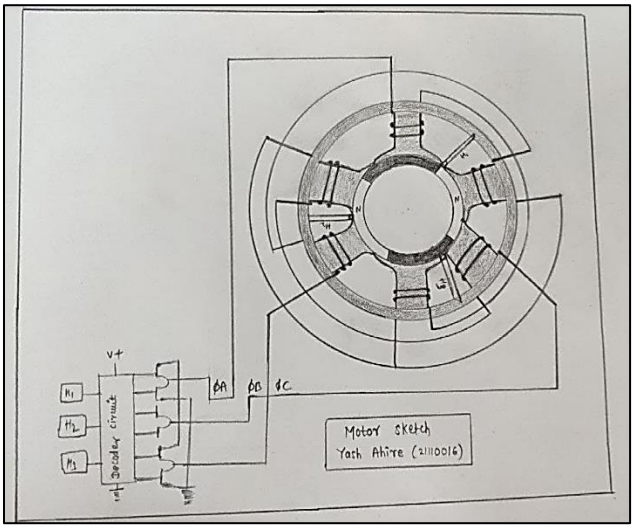


Fig 3.3(b) Motor Sketch

- **Challenges to be faced**

While fitting the motor, we may deal with issues since we are new to Autodesk Inventor, we don't be aware of its highlights like how to utilize it and some more challenges we can look at while dealing with it. Designing the container holder part won't be a simple task. We are additionally not satisfactory with regards to where to fix the engine precisely and what aspects would suit the robot. As we are in an extremely introductory phase of

learning Autodesk inventor so at this moment making a legitimate completed product with an expert plan appears to be a test.

Sources

1- https://www.alibaba.com/product-detail/NEW-design-ST-model-4260-300KV_60364519875.html
2- https://www.unmannedsystemstechnology.com/category/supplier-directory/system-mechanical-components/motors-drives/#:~:text=Generally%20speaking%2C%20brushed%20motors%20are,controller%20(ESC)%20to%20operate
3- https://youtu.be/mzhvR4wm__M

Part Name: - Propeller

Ananya Shajeev (21110021)

- ## Introduction

A propeller is a device that induces relative motion in a fluid. It utilizes rotating blades mounted on a shaft driven by an engine. The radial aerofoil-shaped blades rotate to create a pressure difference on either surface and produce a thrust. This thrust force is transmitted to the shaft and propels a body through a fluid. The earliest references to a propeller-driven vertical flying system come from China in bamboo flying toys around 400 BC. Among the few other attempts is Leonardo da Vinci's aerial screw in the early 1480s and Mikhail Lomonosov's spring-powered propeller modeled after the bamboo-copter in 1754. It was much later in 1903 when the Wright brothers proposed that the mechanism of a propeller is essentially the same as that of an aircraft wing.

- ## Principles

By Bernoulli's principle, the rotational motion of the blades through the fluid causes a pressure difference between the two surfaces of the blade, which in turn exerts a force on the fluid on one side. By Newton's third law of movement, the reaction force on the propeller creates a thrust that propels the body through the fluid.

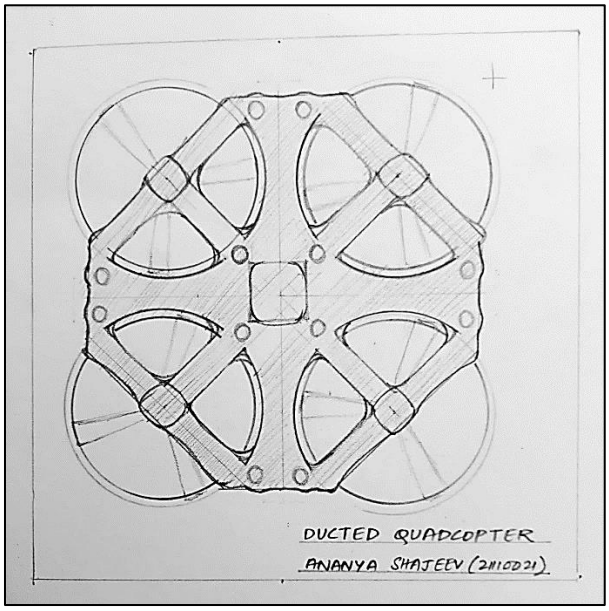


Fig 4.1(a) Ducted Quadcopter Sketch

- **Design**

We plan to modify the basic quadcopter propeller model by using a ducted propeller system and, if possible, q-tip propeller blades. Ducting the propellor system will create a greater pressure difference between the two surfaces of the blades and produce more thrust. We will attempt to employ a counter-rotatory motion. It will balance out torque and asymmetric blade defects and increase efficiency by directing excess airflow in our favour. This will also be used to tilt the drone by adjusting the rotor speeds individually and accordingly. The modifications are being done to improve the system's efficiency, stability, and speed. The following are the parameters that affect the propeller:

--Number of propellers: The Quadcopter will have, by definition, four rotors. Each rotor will be connected to a propeller by a shaft.

--Number of blades: A higher number of blades will slightly decrease the propulsion efficiency by inducing a higher drag force but will increase the stability of the system and reduce vibrations. We will attempt to stabilize the model with three blades using the counter-rotatory motion. The model can be modified to accommodate propellers with a higher blade count at higher speeds.

--Length: The propeller blade length is defined as the diameter of the locus of the tip of the blades. Ideally, a longer blade will distribute the thrust force and power and offer higher stability and efficiency.

--Area: Maximum thrust will be delivered by a blade of maximum surface area. This is because the thrust is an effect of the pressure difference between the two surfaces of the blades. Blades with a large surface area will produce the same thrust force as ones with smaller areas at a lower angular velocity.

--Blade pitch angle: It is the angle between the chord of the blade and the plane of rotation and is measured at a specific point along the length of the blade. Propeller blades are twisted to change the angle of attack in proportion to the differences in speed of rotation along the length of the propeller and thereby keep thrust equalized along this length.

- ## Challenges to be faced

The following are the challenges I expect to face:

--Researching and designing the most efficient model possible for our scenario with limited and preliminary knowledge of fluid dynamics.

--Getting accustomed to the techniques in Autodesk Inventor, particularly with all support being exclusively online.

--Using the constraint function in the software to assign dimensions accurately.

--Difficulty in editing the dimensions of a sketch in the software after extrusion

--Working in sync with the group members and smoothly integrating all the parts.

--Communicating effectively in online discussions

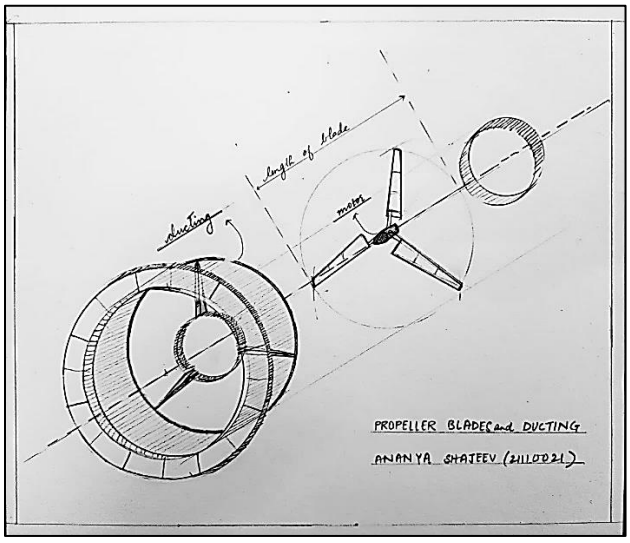


Fig 4.2(a) Propeller Blades sketch

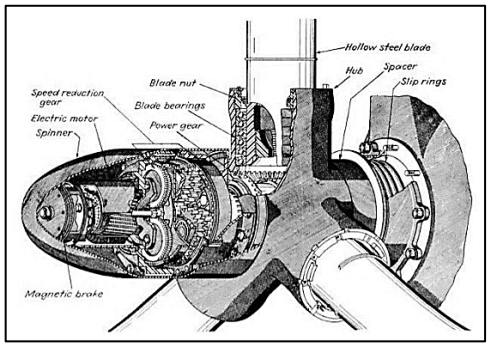


Fig 4.2(b) Propeller

Sources

1- Harold Warden, Propeller Division, Curtiss-Wright Corporation. Designing Propellers to Meet Performance Requirements
2- Professor Isidoro Martinez, European Space Agency (ESA). Propellers
3- Flight Training Handbook by Aviation Online Magazine
4- Bontempo, Rodolfo & Cardone, Massimo & Manna, Marcello & Vorraro, Giovanni. (2014). Ducted Propeller Flow Analysis by Means of a Generalized Actuator Disk Model
5- http://www.shendrones.com/

Part Name: - Top Spider (Top Frame)

Aditi Garg (21110011)

- ### Introduction

A drone is an unmanned aerial vehicle that can be controlled remotely or with various degrees of autonomy. The invention of quadcopters has proved to be of great importance in every field of industry. The frame of the quadcopter is the thing that makes the quadcopter as a whole.It is made up of different kinds of light composite material to reduce its weight and increase its maneuvering speed. The frame of the quadcopter should be of enough strength to protect all the other electronic components. Nowadays, carbon fibre is preferred for designing the frame of the quadcopter as it is light in weight and provides a rigid structure to the quadcopter. The frames are usually measured by diagonal distance between motors. However, it is common to refer to quads by their propeller's size. The earliest recorded use of an unmanned aerial vehicle for warfighting occurred in July 1849, with a balloon carrier (the precursor to the aircraft carrier) in the first offensive use of air power in naval aviation. With the maturing and miniaturization of applicable technologies in the 1980s and 1990s, interest in UAVs grew within the higher echelons of the U.S. military. The development of smart technologies and improved electrical-power systems led to a parallel increase in the use of quadcopters for consumer and general aviation activities. An **unmanned aerial vehicle** (UAV) uses aerodynamics forces to provide vehicle lift and can be expendable or recoverable, and can carry a lethal or nonlethal payload.

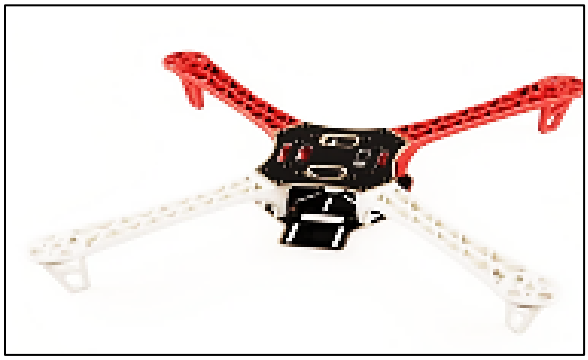


Fig 5.1(a) Spider Top

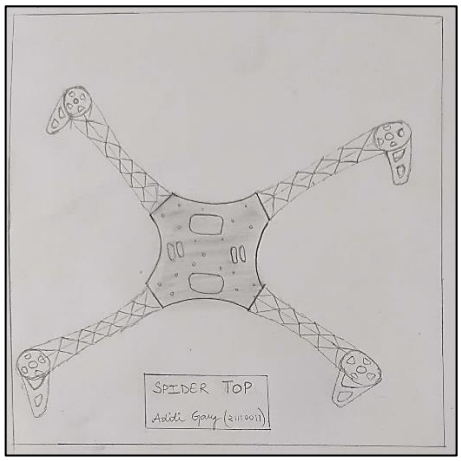


Fig 5.2(b) Spider Top Sketch

- ## Challenges to be Faced

The Spider top is one of the essential components of the quadcopter. It is one of the components we decided to make first as other parts will be designed according to it. I'd faced difficulty in managing the size, thickness and style of the Spider top. Even the geometry of it plays a crucial part while designing the top. Among all the shapes of a quadcopter, the one with a square cross-section will have minimal weight. Aerodynamics also plays an vital role in designing some of its parts as the main focus while designing it will be to reduce the drag and limit the effect the arms will have on the thrust from the propellers.

I also faced a problem while fitting the arms as I took the wrong dimensions as it was not large enough to contain all the arms effectively. While designing the Spider top, I'd to be careful with the size of it as it should be spacious enough to include all the other parts of the quadcopter. Another important measure was the stiffness to weight ratio. A stiffer material will stretch a smaller amount for a given load than a less stiff material. The higher the specific stiffness, the better the material for a given stiffness critical structural application. High specific stiffness materials are generally used in aerospace. It is essential to reduce the weight of the Quadcopter frame so that the Quadcopter can carry better payloads. Hence, optimization with regards to lower weight and high strength is of utmost importance.

Our group aimed to design a quadcopter in such a way that its structural integrity will be enhanced. One of the critical advancements that took the design of light-in-weight Quadcopters to another level is to fabricate the structure using additive manufacturing. In general, the structural frame of the Quadcopter constitutes 30% of its total weight due to which it is essential to work on reducing the weight of the frame. Also, it was a bit difficult to design the exact shape as the Spider Top contains thinner holes. I'd to manage the size of the hole as it should be large enough to tie the cables and battery straps.

One must be cautious while selecting the material of the frame. The material chosen should be light weight and these days carbon fibre is preferred. Still, one of the disadvantages of using carbon fibre is, they block radio frequency, so one needs to be careful while placing the antennas. Also, they're very costly and not everybody can afford it and they conduct electricity so one will need to insulate the wires. While the frames made up of plastic are comparatively of more weight and need more working area. Whether the material used will be carbon, wood, metal, plastic or fiberglass, the frame would be strong enough to withstand the quadcopter together. The strength of the quadcopter also plays an essential role in protecting all the electronics that will be built into it. Without a proper frame, it would not be able to fly high enough to meet the requirements of the developer. It seems very simple, but one needs to take lots of things into consideration while designing it.

- ## Conclusion

Spider Top is one of the essential components of a quadcopter but one has to take lots of precautions while designing it. One has to be very specific while designing the shape and size of it. It was a bit difficult, and I faced many challenges, but with challenges I learnt a lot. I was always fascinated by the design of the quadcopter and it was really fun to design the quadcopter by ourselves. In starting, we were not sure enough about the idea but as the project progressed, we started enjoying it. Some of the sources I referred to while designing the quadcopter were mentioned below. These sources proved to be of great help to me

Sources

1. https://dronenodes.com/drone-frame-racing-freestyle/
2. https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle
3. https://robu.in/product/q450-quadcopter-frame-with-arm-with-integrated-pcb/
4. https://www.mdpi.com/2411-9660/6/1/8/pdf

Part Name: - Electrical Connector and Loudspeakers

Aman Singh (21110020)

- ### Introduction

We had chosen a drone for our project because of its crucial importance. A drone can also make our work very easy, fast, and cheap. Regardless of any situation, any path, the drone can reach there. Our primary motivation came from the vital role played by drones in this covid pandemic. We will try to make a drone model that primarily focuses on delivering small-size objects like medicines, fruits, vegetables, etc. A camera will also be present, which will help us monitor areas of different types like disaster-facing areas or terrorist areas etc. We will also enable our drone with a specific size of loudspeaker which will help us to spread any crucial announcements to some vulnerable areas. In the contest of delivering items, it will help buyers to follow the process of payment and accepting items. A drone is one of the newest inventions and it draws the attention of all people because of its small size and valuable work. In our childhood, we are generally creating a small airplane-type structure toy that flies but scientists have converted our toy into a machine. In this project, we will just rewind our childhood and will be making our toy again, only with a changed name(drone) and in place of paper, we will use auto desk invention.

A drone is a common name for UAVs (Unnamed Aerial Vehicle). I have been assigned to work on 'Electrical Connector'and 'Loudspeaker'.Electrical Connector is an electromechanical device used to join two subsections in a circuit together. Basically, the connector is used on that part which is to be connected temporarily and can be plugged out in the future. Connectors are more durable also. It is one of the handiest parts of all the unnamed aerial vehicles. We all know the common function of the loudspeaker. In some sophisticated way, we can say that a speaker is a device that converts electrical energy into sound energy.

- ### Structure and Properties

Generally, an electrical connector is made up of two parts one is called the male part, which is the plug, and the other is the female part, which is the socket—plugging in means joining the plug into the socket. Copper is the main component used to make electrodes of the electric connector due to its good conductivity and malleability. Alternative elements are brass, bronze, and beryllium copper. The electrical connector is like an adapter in which one end is permanently connected, and another end is detachable. My chosen electrical connector has a cuboidal-type body that is curved at the edges. It contains five cylindrical and one cuboidal electrode. Many electrical connectors have been keyed to prevent them from being connected to the wrong pins or incorrectly inserted.

A loudspeaker has different parts like a dust cap, cone, spider, voice coil, basket, magnet, pole, rear plate, etc. Dust cap and cone move air and produce sound, spiders hold the cone in place, the magnet and the voice coil interact to convert electric energy into motion. On physical appearance, we can only see the cone part which is relatively bigger than others.

- ## Challenges to be faced

If I talk about the whole drone model, initially it looked very tough and impossible to make. But as we had started to break down the whole model into smaller parts then all the single parts look achievable. (I think the part assigned for me by the group leader is a bit easier and achievable.) The two parts which are assigned for me look achievable too. The connector part is very easy but I doubt about making the loudspeaker because of its complex structure. But as I am very new to this Autodesk technology so offcourse it will be a good challenge to face and make a complete model which we had decided.

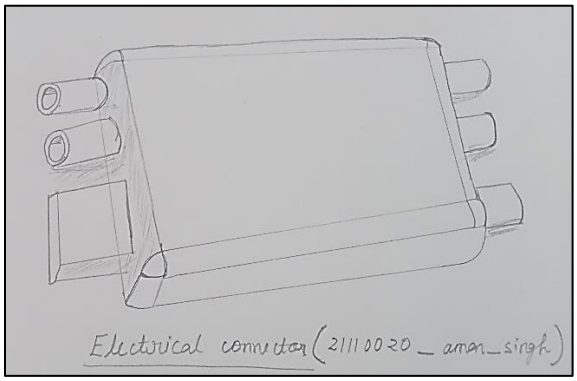


Fig 6.1(a) Electrical Connector

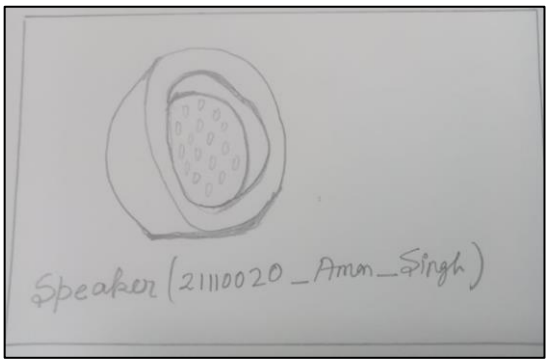


Fig 6.1(b) Speakers

- ## Conclusion

This is a fascinating project for me. In my childhood, I had thought about designing these unique and complex devices, and also I had tried to make many models of buildings and machines through paper and thermocol. It was not up to the level. I had wondered how engineers made so accurate machines irrespective of their small or large size. I think this project helps me answer some of my curious questions and develop many new questions as well, which I love to do.

Sources

1- https://en.wikipedia.org/wiki/Electrical_connector

2- https://connectorsupplier.com/how-to-specify-connectors-for-drones/

3- https://www.starengineeringinc.com/properties-of-electrical-connectors/

4- https://blog.landr.com/how-do-speakers-work/#:~:text=Speakers%20work%20by%20converting%20electrical,it%20induces%20a%20magnetic%20field

Part Name: - Pillars and Propeller ducting

Aditya Nama (21110013)

- ### Introduction

Our team is working on Quadcopter Delivery Drone as our project. In the era of fast-growing technology drone is going to be a valuable asset for mankind. It can be controlled by anyone having a remote controller. It can be used to deliver goods from one place to another, thus making transportation very comfortable and more accessible. Moreover, saving money also keeps our time as there is no hurdle of traffic in between. It is not significant in size and is easy to operate. Different types of drones are available as per their use. Like in weddings, we have seen the drone take pictures or shoot videos of the function. The drone can be easily reached even in places where it is relatively complex or entirely impossible for humans to go, so this drone feature also makes it an excellent option to use in disaster management. Also, in military operations, drones are used to prove important information that we can't reach easily. Remembering this, we have to work on it as our project in 'Engineering Graphics.' The drone comprises several parts such as Spider base, Spider Top, Spider arm, Spinner, Spacer, Distribution Boards, Electrical Connector, Motor, Piller Battery. I am working on the piller part.

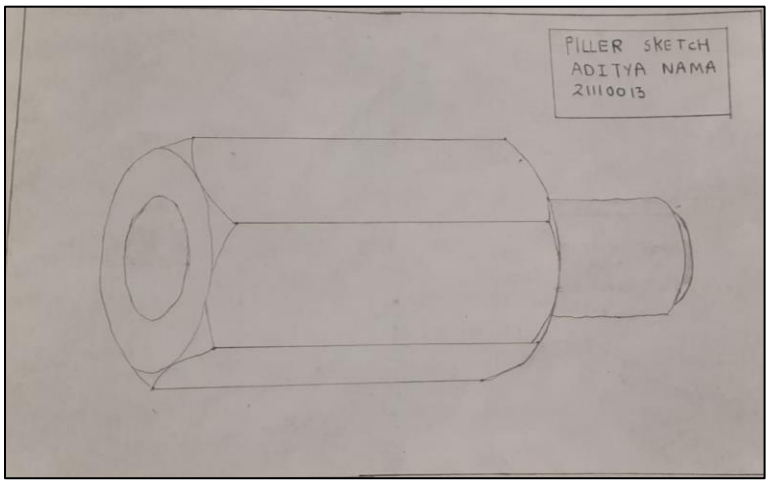
- ### Working and Basic structure

Piller is a small part present in the quadcopter drone. They are present in a group of four in a single model. Each pillar is located in each of the four arms at the bottom surface. It is similar in shape to a normal piller. It is composed of two cylindrical-like parts having different radii in which one part is hollow. They are connected. Though it is a small part, it is essential in the drone structure. It is used to support the drone as they are placed in each of the four arms. When the drone is dropped on the ground pillars, keep it still and perfectly balance it. Also, while in the air, they help maintain the weight of the drone. They are usually made up of aluminum metal.

Fig 7.1(a) Pillar

Challenges to be faced

As this is our first project in Autodesk Inventor, and we are using it for the first time, we will face several problems during our project. In a drone, we need to take care of the dimensions of each part. So, while designing the parts, we should carefully check the dimensions. Piller is not much difficult to construct in Autodesk Inventor. Firstly, we need to draw a circle of appropriate diameter and then extrude it to convert it into a cylinder. Then we need to draw a hexagon on the plane of the upper loop of the cylinder. Now extrude it to convert it into a cylindrical-like shape. If we know the basics of Autodesk Inventor, we can develop it quickly.



Propeller Drafting

We plan to modify the basic quadcopter propeller model by using a ducted propeller system and, if possible, q-tip propeller blades. Ducted Propeller or kort nozzle is a marine propeller which contains a non rotating nozzle. Generally used in increasing efficiency and used on heavily loaded propellers or propellers with limited diameter. Ducting the propellor system will create a greater pressure difference between the two surfaces of the blades and produce more thrust. The inflow velocity is increased in a Kort nozzle, lowering pressure. The propeller's thrust and torque are reduced as a result. A circulation occurs at the same moment, resulting in an inward-directed force with a forward component. As a result, the duct has a positive thrust. This is usually greater than the propeller's thrust reduction. The close proximity of the propeller to the duct lowers tip vortex, improving efficiency. As the speed of the vehicle increases, the drag will eventually outweigh the extra push. Ducts are often not installed on vessels that run at speeds greater than this. Tugboats tow with slow speeds and heavy loaded propellers, and are frequently equipped with ducts. With ducts, bollard pull might rise by up to 30%. We will attempt to employ a counter-rotatory motion. It will balance out torque and asymmetric blade defects and increase efficiency by directing excess airflow in our favour.

This will also be used to tilt the drone by adjusting the rotor speeds individually and accordingly. The modifications are being done to improve the system's efficiency, stability, and speed.

Sources

1- https://youtu.be/8BchvQPJsL0

Part Name: - Spinner (Flange Shaft) and Pin Header Connector

Akshay Kumar Mishra (21110018)

- ### Introduction

We had decided on our project's topic as Drones because drones can be used for almost everything in every field. It can be used both for military and civilian purposes. It can be used for surveillance(military and environmental), monitoring, photography, delivery of products, etc. Drones can be used for humanitarian causes, such as delivering food and aid to remote areas. Besides having military uses, they enable communication in inaccessible areas. Thus in every field, drones can be used, and therefore, it arouses a feeling in us to know more about its features and working. I have been assigned two components: spinner(or flange shaft) and pin header connector. In the following sections, I will briefly describe these components.

- ### Structure and Properties

Male Pin header connector: An electrical component is a crucial part of a drone. It is connected to a distribution board which itself gets connected to a spider base(a platform that can be considered as the main body of the drone). Connectors are primarily used in electronic or instrumentation of PCB (Print Circuit Board) function as a bridge between two PCBs that were blocked. It can be classified based on pitch spacing which is the space between two of its pins. It can also be classified on the number of row pins which further depends on PCB board's design. Standard pitch such as 2.54mm and 2.0mm has 2-40 pins, and smaller pitch like 1.27mm and 1.0mm has 2-50 pins per row. Brass or phosphor bronze is used for designing the pins, and then nickel plating is done over it. It helps in the high-speed digitization of signal transmission as signals must be transmitted independently without interference.

Spinner (FLANGE SHAFT): The spinner is made up of cast iron or cast steel because these materials give sheer permissible strength of approx. 50N/mm2. It is another crucial part of the drone as it is the component that connects the motor of the drone to the fans of the drone. It helps in spinning the fans as the spinner has High torque transmitting capacity. Each rotor produces both lift and torque about its center of rotation and drag opposite to the vehicle's direction of flight. The drone hovers or adjusts its altitude by applying equal thrust to all four fans or spinners precisely. Thus without spinners, we cannot think that a drone can fly.

- ### Challenges

I have no experience of making any drone in my life, and now I will design its model. It's full of excitement, and at the same time, this will allow me to learn something entirely new. Creating the model in auto desk inventor can be challenging as I am not habitual to

it, but I know that my team and I will face every model challenge with utmost dedication and sincerity.

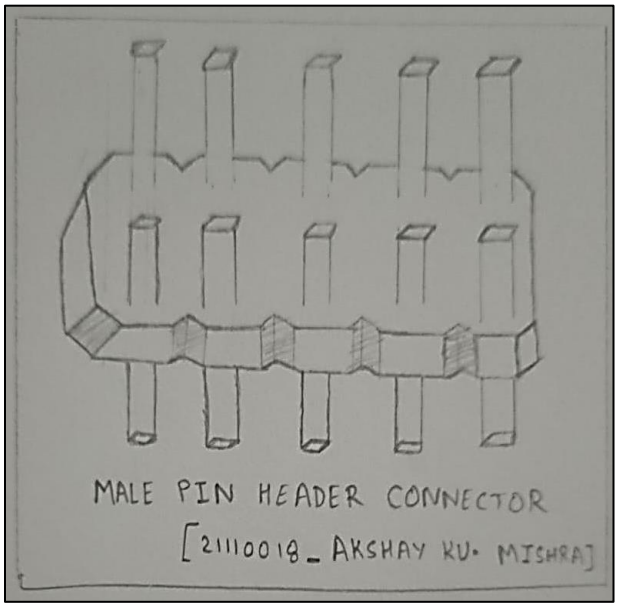


Fig 8.1(a) Male Pin Header Connector

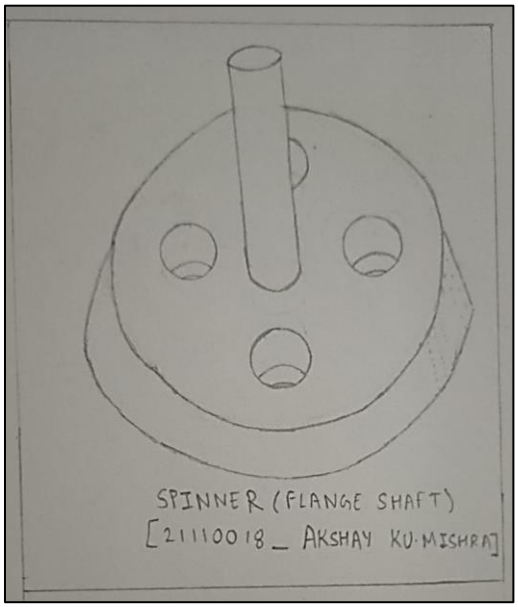


Fig 8.1(b) Spinner

Sources

1- https://learn.sparkfun.com/tutorials/connector-basics/pin-header-connectors#:~:text=Pin%20header%20connectors%20comprise%20several%20different%20means%20of%20connection.&text=These%20come%20in%20male%20and,on%20an%20Arduino%20Uno%20board
2- https://www.ismolex.com/beginners-guide-pin-header-connectors-2015/
3- https://en.m.wikipedia.org/wiki/Quadcopter

Part Name: - Spider Base

Aditya Gupte (21110014)

- ### Introduction

The spider base is the quadcopter part that acts as a support structure on which the other parts are fitted and adjusted. It is the drone's core as it will be the part that interconnects other components with one another. The main task is to have a solid and durable base that can hold the drone and its features together so that in case of collateral damage, it will be minimal to the parts on it. The base framework should be spacious enough so that the cameras, batteries, motor, rotors, etc., can fit comfortably and the internal wirings and circuits are not too crowded.

- ### Challenges to be faced

The base should be designed with caution so that the drone is not imbalanced after fitting the parts. The T shape structure and the gap beside it will help reduce aerodynamic resistance when the quadcopter attains high speed at a high altitude. The edge of the framework is a bit curved, which allows the drone to achieve a significant rate during its flight. The holes at the edges of the structure will be used to fit the spider arms, including the rotors at their ends. The motor and the battery are essential parts placed in the center. The distribution board should be placed carefully inside so that electrical units have enough space for the wirings and stay connected to the battery. Once the other parts are adjusted inside, they can be enclosed from above to prevent rain. This also helps in protecting the internal components. The spider cap is fitted above this structure.

Since the base holds together many essential internal components of the drone, it is crucial that The base frame can have that much weight. The base frame should be durable but not too heavy as it will compromise the speed. The holes at the corner edges of the frame should be of accurate dimensions so that the spider arms would fit perfectly and not stay loose. The frame should have proper curves to reduce the impact of air resistance. The main challenge is to design the base to hold the weight of other components without compromising the speed. The inside of the base should be adequately insulated to prevent any fire in case it happens if any part heats up too much beyond the limit. Proper care should be taken of the components inside so that any dysfunction of the drone is prevented. The inside details should be accessible for repairing purposes if required.

The selection of material for constructing a drone is essential. We need materials so that drone has low weight and better speed. Mainly, materials of carbon fiber composites are preferred. Thermoplastics like nylon, polystyrene, polyester, etc., are also used because they are inexpensive, and it is easy to mold them in complex parts of the drone. Lithium-ion batteries are mainly preferred for uncrewed aerial vehicles. We can use any of the above materials for the spider base framework and insulate them properly. Carbon fiber composites have excellent thermal insulation performance at high temperatures.

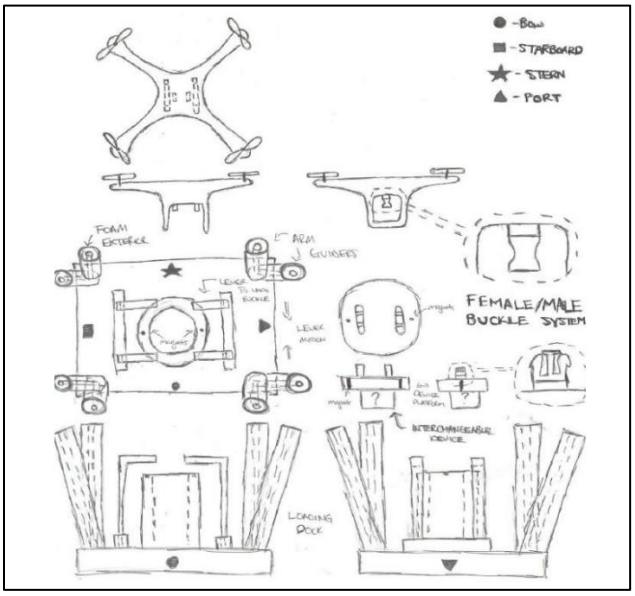


Fig 9.1(a) Sketch of Concepts of Drone

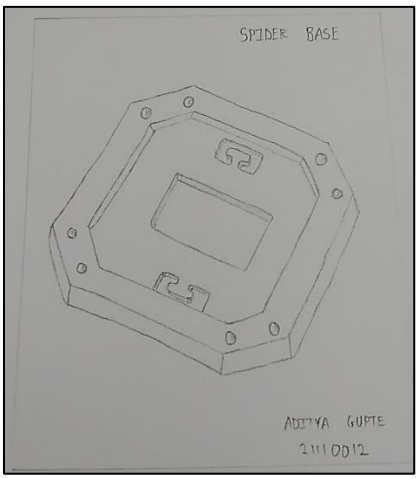


Fig 9.1(b) Sketch Spider Base

- ## Conclusion

The base frame is a crucial component of the quadcopter which connects many structures, protects them from external damage, and its shape gives the drone the ability to fly faster.

Sources

1- https://journals.sagepub.com/doi/full/10.1177/1558925019884691#:~:text=The%20results%20show%20that%20the,insulation%20performance%20at%20high%20temperature
2- https://matmatch.com/resources/blog/what-are-drones-made-of/

Part Name: - Arm

Aditya Deshmukh (21110014)

- ### Introduction

Drones are a growing modern age of technology that anyone can easily control and use for daily tasks. Currently, drones are being used in different sectors of the economy like surveillance, home delivery of goods in the e-commerce industry, etc. It has reduced the cost of transportation. The most significant advantage of drones is that it reduces the cost and save a lot of time, as it does not usually have to face traffic bottlenecks, and the labor cost of the companies decreases. The drone can be easily reached even in places where it is relatively complex or entirely impossible for humans to go, so this drone feature also makes it an excellent option to use in disaster management. The part which I got is making the arm of the drone. It is perhaps the main part because it acts as the bridge between the drone's wings and the main body. In our model, we decided to make four arms that will be symmetrically placed around the main body. There are various types of arms that can be made, but we decided to keep it simple and make it a rectangular type arm.

- ### Structure

The arm is the passive element of the drone since it is not a moving part. It can be made an active element by making it a foldable arm, but it would be tough to make it, and it would be of no use, so we decided to keep its rectangular shape and with a simple design. Also, the drone must be lightweight since it has to lift itself. So we have made a design on the side of the drone arm that will help to reduce a lot of its weight. We had made an up and down triangle(please refer to figure) pattern on the sideways of the arm, which will take a lot of material and make it lightweight, which will make the drone lighter. We decided to make this pattern stronger than any other structure.

The arm contains a pattern of holes at both ends. With the help of a spot on one side, it will be connected with the main body with a nut, and with the use of a hole on the other side, it will be associated with wings or rotating fans. The arm's length is kept medium so that neither it increases the weight nor causes hindrance to the movement of wings.

- ### Challenges to be faced

The major challenge I will face is taking the dimensions at which different holes have to be placed and the part that will be connected with the main body of the drone. I have to be very careful while taking dimensions and ensure that the same design is present on the main body of the drone. Also, the arm design has lots of sideways patterns. The pattern will help to reduce weight but making them is time-consuming. Overall, the part I got that is the drone's arm is on the somewhat tricky side and also time-consuming.

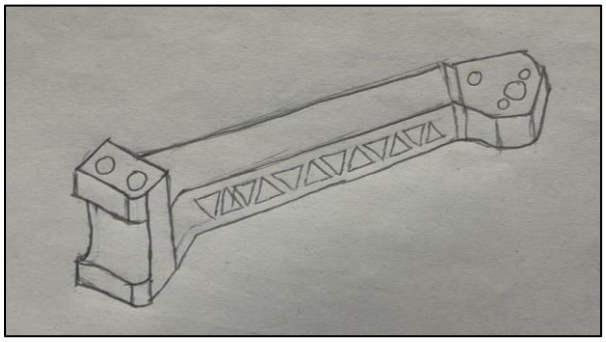


Fig 10.1(a) Sketch of Arm

Bar Code Scanner

- ### Introduction

A bar code scanner is attached to the delivery drone so that it ensures delivery to a specific person who is having a bar code. To keep the drone lightweight usually, it is made of plastic.

- ### Basic Structure

The bar code scanner has a very basic structure. It has a rectangular base on which the bar code scanner stands. It consists of a rectangular neck on which a scanning system is placed which also includes the head of the bar code scanner. Scanning will take place through a scanning system placed inside the top of the bar code scanner.

- ### Challenges to be faced

Since it is a basic structure it does have lots of challenges. I have to face challenges that include: dimensions have to match with other parts of the drone structure and also size of it has to be small since making it large will increase the weight of the drone.

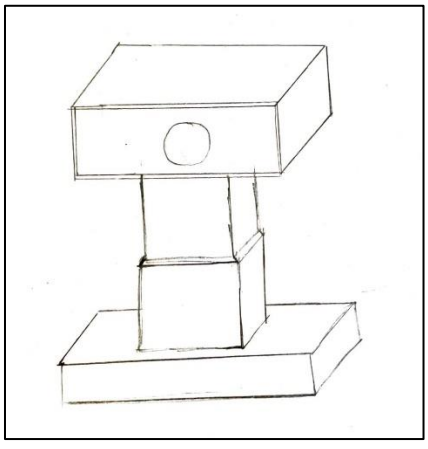


Fig 10.1(b) Bar code scanner

Sources

1. https://youtu.be/8BchvQPJsL0