2016

SOLAR POWERED DRONE

One Step for Innovation

Combination of Photovoltaic Cell with Drone is like a fragrance blend in gold. That one a simple step for innovation and Regular Drone become high powered Solar Drone.

"SOLAR POWERED DRONE"

A PROJECT REPORT

Submitted in partial fulfillment of the requirement for the degree of

BACHELOR ENGINEERING

IN

[ELECTRICAL ENGINEERING]

(Department of Electrical Engineering)

ACKNOWLEDGEMENT

Table of Contents

ABSTARCT

Drones is an aerial vehicle operated to fly independently and is one of the representations of a UAV (Unmanned Aerial Vehicles). They are controlled by pilots on ground or simultaneously driven. They are called rotorcrafts because unlike a fixed wing aircraft, here lift is generated by a set of revolving narrow-chord aerofoils. Drones are actually very fascinating and in this project we are going to study about them, their components and about its widespread applications that determine its scope for the future. They are a mixture of streams of Electronics, Mechanical and especially Aviation.

Drones are of different types and have different configurations for example, bicopters, tricopters, quardcopter, hexacopters, octocopters, etc. They have different uses and accordingly respective configurations are used. Hexacopters and Octocopters have better stability and yaw configuration. Control of motion of vehicle is achieved by altering the rotation rate of one or motor discs, thereby changing its torque load and thrust/lift characteristics. The use of four rotors in a Drone allow the individual rotors to have a smaller diameter than the equivalent helicopter rotor, which allows them to possess less kinetic energy during flight.

Drones have different structures and designs according to the work needed to be done by it. Components like motors, batteries, electronic speed controllers (ESC‟s) also vary according to the power needed and work done by the Drone. Also enhancements like GPS trackers or cameras or infrared cameras are used so that they could add value to missions like disaster relief, search and rescue, agriculture and 3D mapping of the geography of an area.

These widespread applications outshine the disadvantages which are rectifiable and hence this makes it a very productive technology in today‟s world. It is supposed to appear into full time existence in the coming years. But every technology has merits as well as demerits. It is up to us to use technology productively to enhance the people as well as the planet instead of using them destructively. For instance, exploitation of drones by using them for spying and other lethal purposes that can harm people.

1.0 Introduction

A Drone or a quad rotor helicopter is a multi rotor copter that is lifted and propelled by four rotors. All the four arms have a motor and a propeller at their ends each. The lift is generated by a set of rotors and vertically oriented propellers, hence Drones are classified to rotorcrafts.

They are also referred to as pre-programmed missions.

Drone uses 2 sets of identical fixed pitched propellers; 2 clockwise (CW) or in one direction and 2 counter-clockwise (CCW) or opposite direction. This helps the machine to hover in a stable formation. This is unlike most helicopters. Control of vehicle motion is achieved by altering the rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics. These use variation of RPM unit (revolutions per minute) to control lift and torque.

Drones are known by different names, including: drone, quad rotor, quad- copter, UAV (Unmanned Aerial Vehicle), UAS, or drone. There are series of bicopters (two blades), tricopters (three blades), Drones (four blades), hexacopters (six blades), and octocopters (eight blades). The multi rotors with a high number of blades are designed to carry a heavier payload, for efficient yaw smoothness and for efficient lift capacity. According to the efficiency needed for a particular task, respective series may be used.

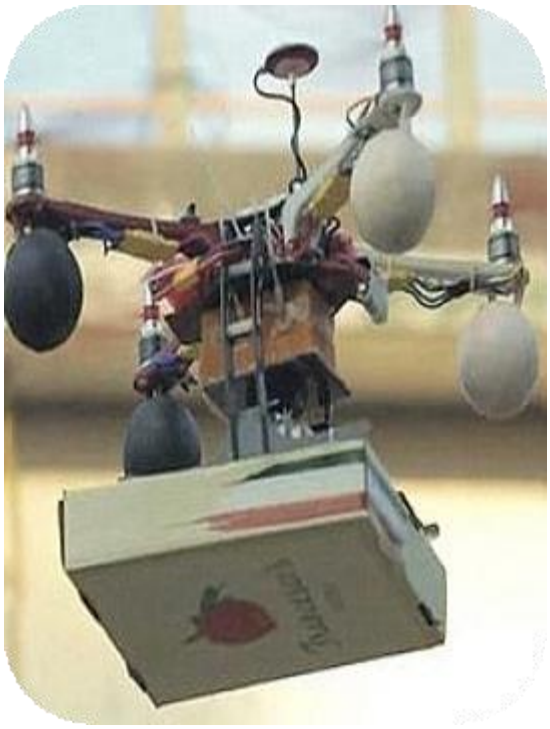
A helicopter has one big rotor to provide all the lifting power and a little tail rotor to offset the aerodynamic torque generated by the big rotor. Without it the helicopter would spin almost as fast as the propeller. But a quad rotor's all four rotors work together to produce upward thrust and only 1/4 of the weight is lifted by each rotor. So less powerful motors are used, making it cost efficient. The quad rotor's movements are controlled by varying the relative thrusts of each rotor. The Drone allows a more stable platform, making it ideal for tasks such as surveillance and aerial photography, attributing to its unique design.

2.0 Review of Literature

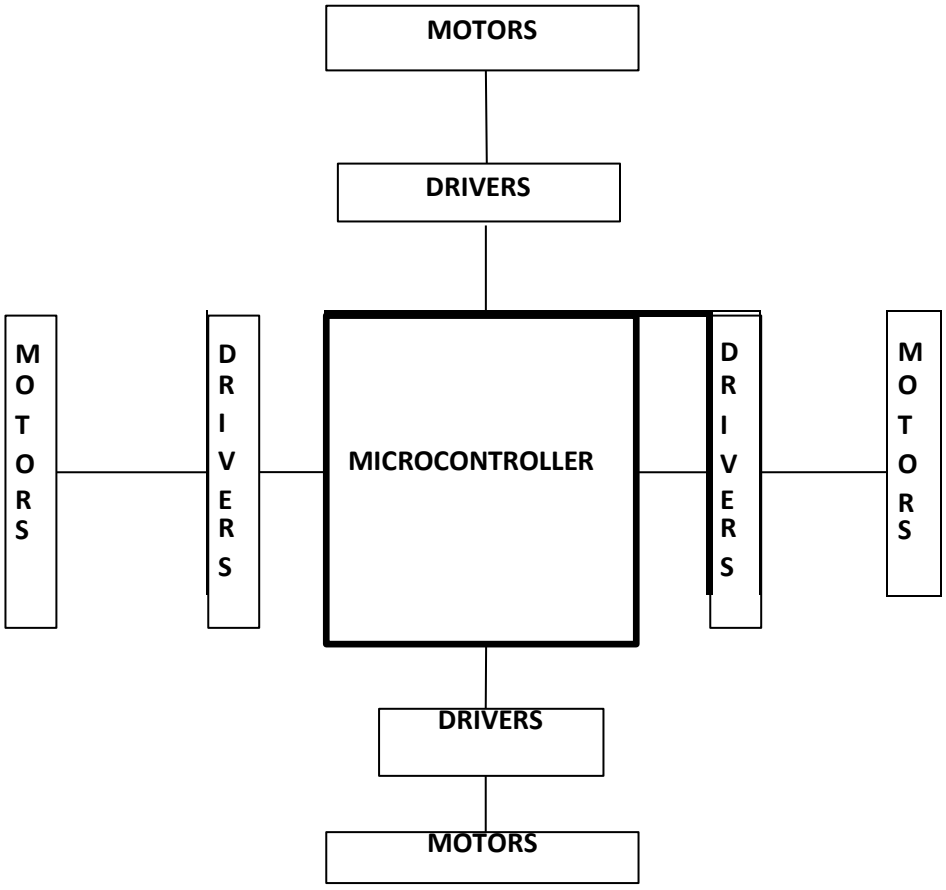
1) The website of ABC NEWS posted an article by Rheana Murray on 8th August 2014, headlined, "How Drones will Replace Humans in the Workplace" to which Mary Cummings, a drones expert who teaches at MIT and Duke University says, "Maybe if you're a cargo pilot for FedEx or UPS, drones will augment the delivery world and one could argue that they would be much more environmentally friendly since they could take cars off the road for last mile delivery and help reduce congestion." She further adds, "Jobs like delivery for which cargo planes are used currently and crop dusting should be turned over to drones immediately. Crop dusting is the most dangerous job in general aviation with a high accident rate. Drones can not only do that job better, but much safer. This will happen in the next 10 to 20 years. Ultimately, drones will create more jobs than they replace, they will save lives, and they will give us capabilities we only dream about – like everyone owning our own flying cars."

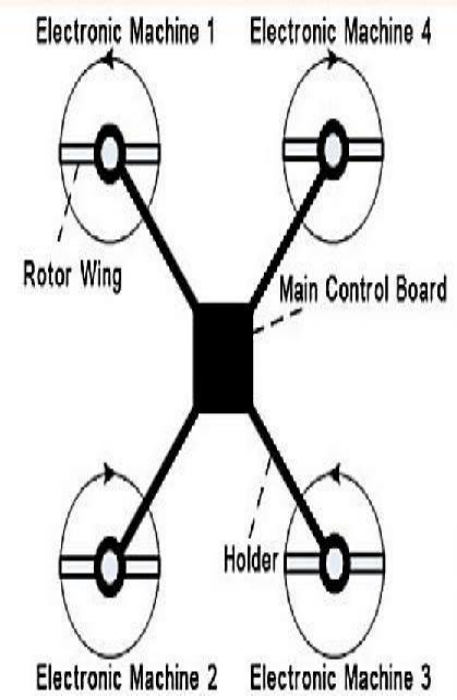
2) In a website known as www.farmingdrones.com, an article headlined "Farming Takes Flight Drones save IL Farmers Time and Money was posted. It explains how drones are used in agriculture to give a crystal clear view of their fields. Dennis Bowman, a crop sciences educator with the University of Illinois Extension, is using two drones to take aerial snapshots of crops in the research plots on the university's South Farms. He says, "It offers a quick and easy way to check on the plants" progress and determine if they need more attention. It does allow the opportunity to get an overall survey of the area and make a better use of your time, rather than just walking out blindly into a field of corn that's taller than your head, and hoping that you stumble across any of the problem areas that might be out there. People think about drones and a lot of times, the negative connotations come to mind, privacy issues and those kinds of things. But in the agricultural community, we're out in the middle of nowhere most of the time,

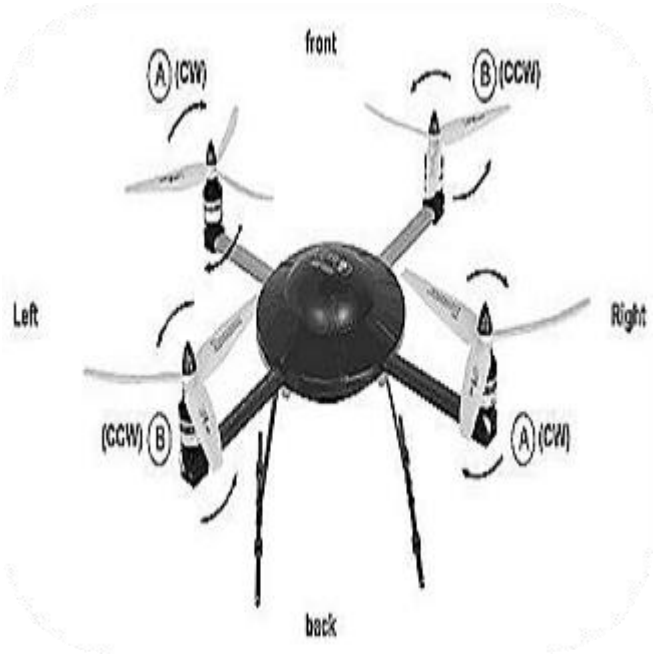
3.0 Drone



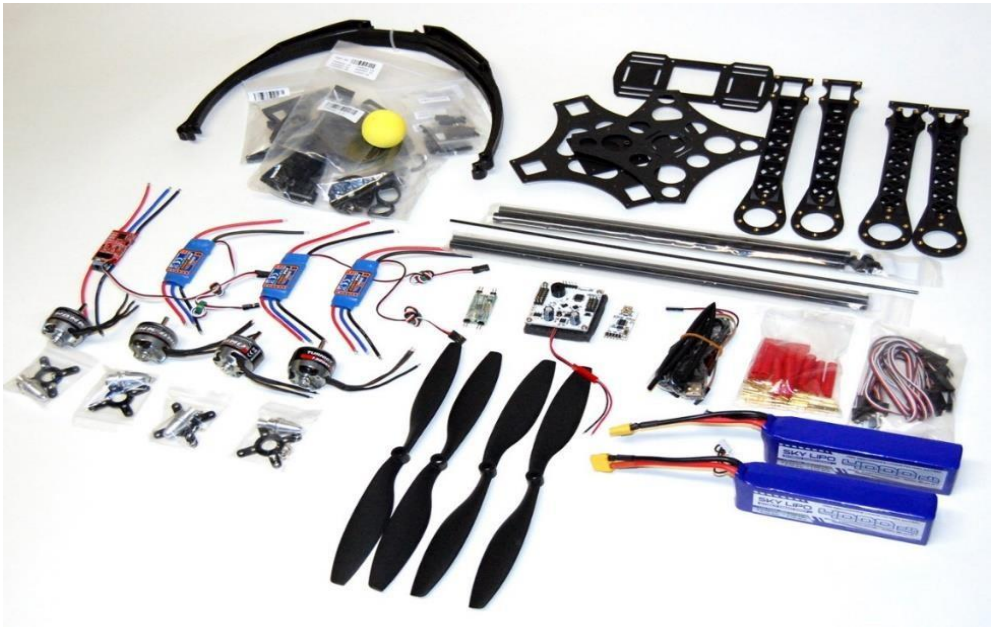
3.1 Block Diagram of a Drone




Electronic Machine 1
Electronic Machine 4
Rotor Wing
Main Control Board
Holder
Electronic Machine 2
Electronic Machine 3


front
A (CW)
B (CCW)
Left
Right
(CCW) B
A (CW)
back

3.2 Components of a drone



The main components used for construction of a Drone are the frame, propellers (either fixed-pitch or variable-pitch), and the electric motors. For best performance and simplest control algorithms, the motors and propellers should be placed equidistant. Recently, carbon fiber composites have become popular due to their light weight and structural stiffness. The electrical components needed to construct a working Drone are similar to those needed for a modern RC helicopter, which include the electronic speed control module, on-board computer or controller board, and battery.

The components are elaborately described as follows:

1) Frame:

It is the structure that holds or houses all the components together. They are designed to be strong and lightweight. To decide the appropriate frame for the copter 3 factors, i.e. weight, size and materials used are considered. The frame should be rigid and able to minimize the vibrations from the motors. It consists of 2-3 parts which are not necessarily of the same material:

- The center plate where the electronics are mounted
- Four arms mounted to the center plate
- Four motor brackets connecting the motors to the end of the arms

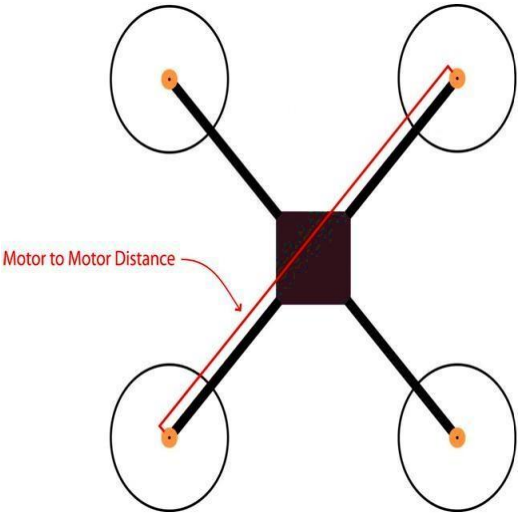
Strong, light and sensible configuration including a built-in power distribution board (PDB) that allows for a clean and easy build is highly recommended. Parts and accessories that are 100% compatible and interchangeable are always preferred.

Frames are usually made of:

- Carbon Fiber- Carbon fiber is the most rigid and vibration absorbent but it is the most expensive too.
- Aluminium- Hollow aluminium square rails are the most popular for the arms due to its light weight, rigidness and affordability. However aluminium can suffer from motor vibrations, as the damping effect is not as good as carbon fiber. In cases of severe vibration problem, it could mess up sensor readings.
- Wood/ Plywood /MDF (Medium-density fibreboard)- Wood boards like MDF plates could be used for the arms as they are better at absorbing the vibrations than aluminium. Unfortunately the wood is not a very rigid material and can break easily if the Drone crashes.

For the center plate, plywood is most commonly used because of its light weight, easy to work factor and good vibration absorbing features. As for arm length, "motor-to-motor distance" is sometimes used, meaning the distance between the

center of one motor to that of another motor of the same arm. The motor to motor distance usually depends on the diameter of the propellers in order to have enough space between the propellers.



Frame used in our Drone

2) Rotors or Motors :

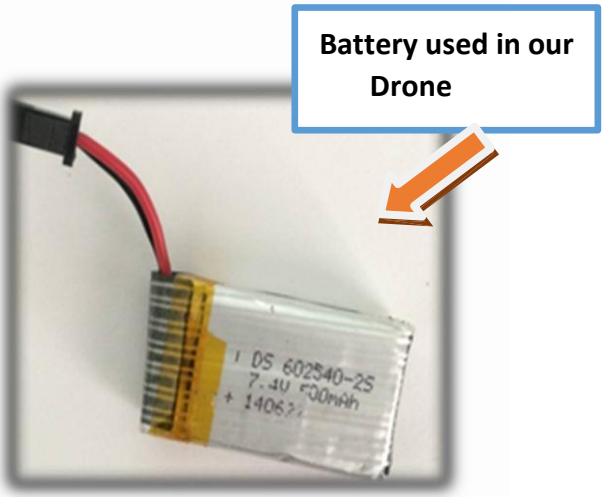
The purpose of motors is to spin the propellers. Brushless DC motors provide the necessary thrust to propel the craft. Each rotor needs to be controlled separately by a speed controller. They are a bit similar to normal DC motors in the way that coils and magnets are used to drive the shaft. Though the brushless motors do not have a brush on the shaft which takes care of switching the power direction in the coils, and that‟s why they are called brushless. Instead the brushless motors

have three coils on the inner (center) of the motor, which is fixed to the mounting. On the outer side, it contains a number of magnets mounted to a cylinder that is attached to the rotating shaft. So the coils are fixed which means wires can go directly to them and therefore there is no need for a brush. Brushless motors spin in much higher speed and use less power at the same speed than DC motors. Also they don‟t lose power in the brush-transition like the DC motors do, so it‟s more energy efficient. The Kv(kilovolts)-rating in a motor indicates how many RPMs (Revolutions per minute) the motor will do if provided with x-number of volts. The higher the kV rating is, faster the motor spins at a constant voltage. Usually outrunners are used – brushless motors used for model planes and copters.

Motor used in our Drone

3) Battery – Power Source:

LiPo (Lithium Polymer) batteries are used because it is light. NiMH(Nickel Metal Hydride) is also possible. They are cheaper, butt heavier than LiPo. LiPo batteries also have a C rating and a power rating in mAh (which stands for milliamps per hour). The C rating describes the rate at which power can be drawn from the battery, and the power rating describes how much power the battery can supply. Larger batteries weigh more so there is always a tradeoff between flight duration and total weight.



4) ESC- Electronic Speed Controller:

The electronic speed controller controls the speed of the motor or tells the motors how fast to spin at a given time. For a Drone, 4 ESCs are needed, one connected to each motor. The ESCs are then connected directly to the battery through either a wiring harness or power distribution board. Many ESCs come with a built in battery eliminator circuit (BEC), which allows to power things like the flight control board and radio receiver without connecting them directly to the battery. Because the motors on a Drone must all spin at

precise speeds to achieve accurate flight, the ESC is very important. This firmware in a ESC changes the refresh rate of the ESC so the motors get many more instructions per second from the ESC, thus have greater control over the Drone‟s behavior. The frequency of the signals also vary a lot, but for a Drone it is preferred if the controller supports high enough frequency signal,
so the motor speed can be adjusted quick enough for optimal stability.

5) Propellers:

A Drone has four propellers, two "normal" propellers that spin counter- clockwise, and two "pusher" propellers that spin clockwise to avoid body spinning. By making the propeller pairs spin in each direction, but also having opposite tilting, all of them will provide lifting thrust without spinning in the same direction. This makes it possible for the copter to stabilize the yaw rotation, which is the rotation around itself.

The propellers come in different diameters and pitches (tilting effect). The larger diameter and pitch is, the more thrust the propeller can generate.

It also requires more power to drive it, but it will be able to lift more weight. When using high RPM (Revolutions per minute) motors, the smaller or mid-sized propellers. When using low RPM motors the larger propellers can be used as there could be trouble with the small ones not being able to lift the Drone at low speed.

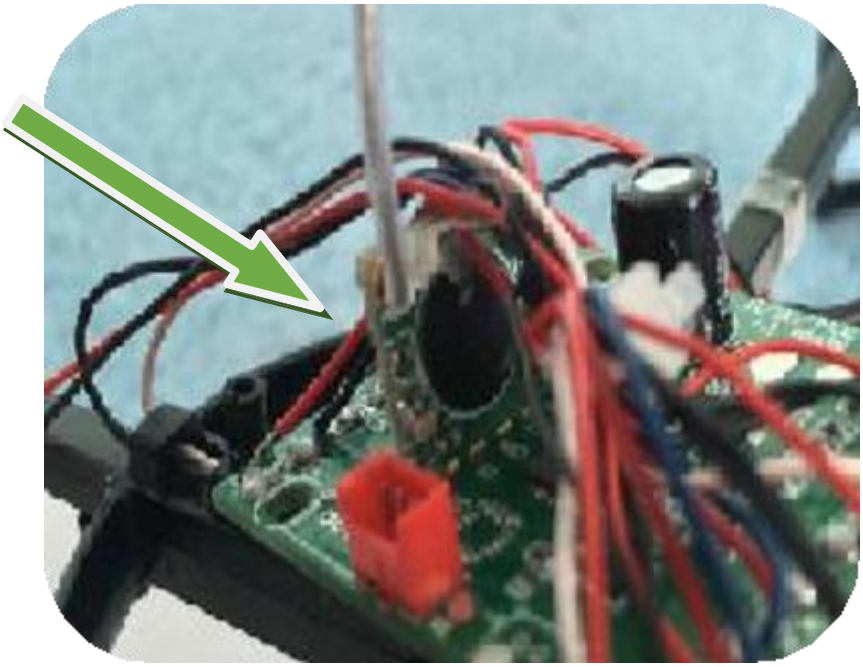
Propellers used in our Drone

6) Radio Transmitter and Receiver :

The radio transmitter and receiver allows to control the Drone. Four channels for a basic Drone is required .Using a radio with 8 channels, so there is more flexibility is recommended. Drones can be programmed and controlled in many different ways but the most common ones are by RC transmitter in either Rate (acrobatic) or Stable mode. The difference is the way the controller board interprets the orientations feedback together with the RC transmitter joysticks. In Rate mode only the Gyroscope values are used to control the Drone. The joysticks on the RC transmitter are then used to control and set the desired rotation speed of the 3 axes, though if the joysticks are released, it does not automatically balance again. This is useful when the Drone is required to do stunts like tilting it a bit to the right. The speed of the 4 motors will be adjusted automatically and constantly to keep the Drone balanced.

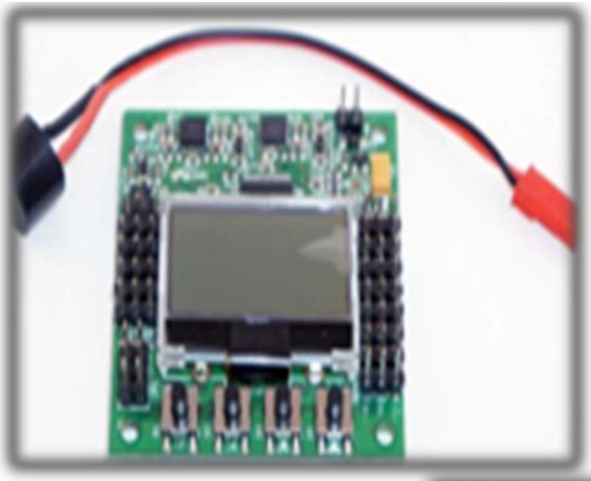
Transmitter used in our Drone

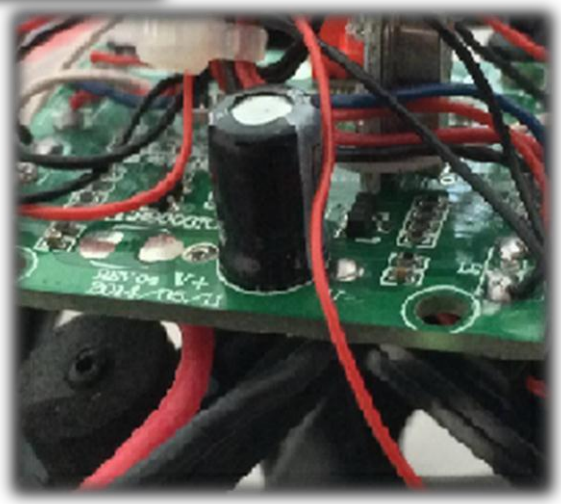
Receiver used in our Drone



7) Flight Controller:

The flight control board is regarded as the „brain" of the Drone. It houses the sensors such as the gyroscopes and accelerometers that determine how fast each of the Drone's motors spin. Flight control boards range from simple to highly complex. An affordable, easy to set up, having a strong functionality controller is always recommended. Such controllers can handle about any type of multi rotor aircraft so if even we want to upgrade to a hexacopter or experiment with a tricopter, we need not purchase another board.



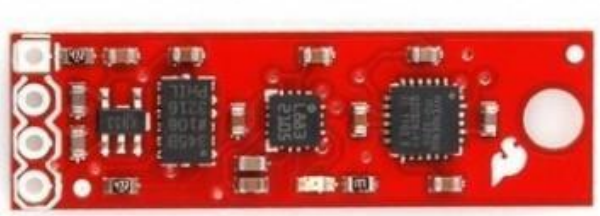


Flight controller used in our Drone

8) Microcontroller and Inertial Measuring Unit:

Sensors connected to a microcontroller to decide on how to control the motors. Depending on the level of autonomous a Drone should be, one or more such sensors can be used in combination. The Inertial Measurement Unit or IMU is the electronic sensor system of the Drone which measures velocity, orientation and gravitational forces of the Drone. It calculates the orientation of the Drone – the three orientation angles, Roll, Pitch and Yaw. These angles are then fed into some controlling electronics that uses those angles to calculate the required changes in the motor speeds. The IMU contains at least 6 sensors, referred to as 6DOF. These sensors should be a
3-axis accelerometer and a 3-axis gyroscope. Sometimes another sensor, a 3-axis magnetometer, is added for better Yaw stability(totally 9DOF).

The accelerometer measures acceleration and force, so downward gravity can be measured too. It has 3 axis sensors, so the orientation can be worked upon also.

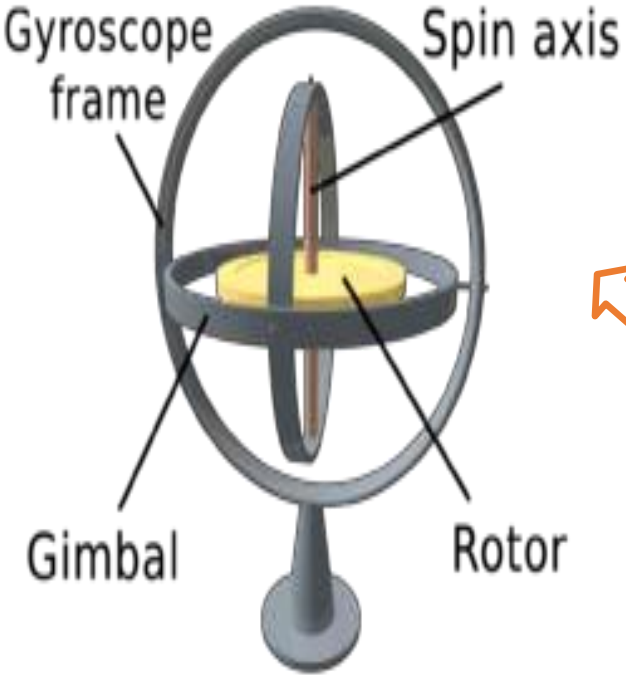


A gyroscope measures angular velocity or rotational speed around the three axis.

If accelerometer only is used then we can measure the orientation with reference to the surface of earth. Sometimes the accelerometer can be very sensitive and unstable because when the motor vibration is bad, the orientation is messed up. Therefore a gyroscope is used as a solution to this problem.

The gyroscope too drifts a lot. When the sensor rotates, the gyroscope will give the angular velocity. But when it stops rotating, it doesn‟t necessarily go back to 0 deg/s. The gyroscope readings will provide an orientation that continues to move slowly (drifts) even when the sensor stops rotating. Hence both the accelerator and the gyroscope sensors have to be used together to obtain a productive orientation.

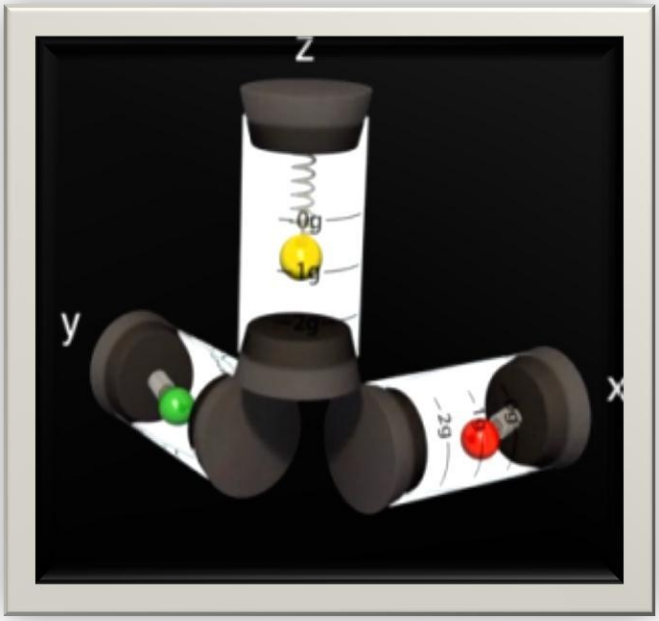
Unfortunately, the accelerometer cannot sense yaw rotation. Hence a magnetometer is used for this purpose. A magnetometer is a device that measures the directions and strength of the magnetic field. It determines which way is south and north. The pole locations are then used as a reference together with the Yaw angular velocity around from the gyroscope, to calculate a stable Yaw angle.



Gyroscope

Magnetometer (circa 1832)

Magnetometer

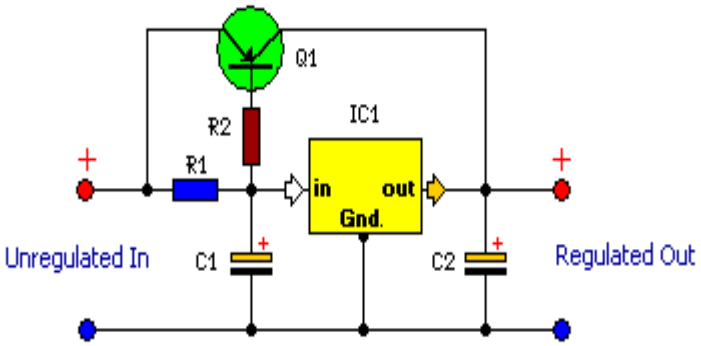


Accelerometer

9) Solar Cells

Assemblies of solar cells are used to make solar modules which generate electrical power from sunlight. A solar array generates solar power using solar energy.

10) Current Booster Circuit



R1 = 1R-2W
R2 = 10R-2W
C1 = 35v-470uF
C2 = 35v-470uF
Q1 = TIP2955
IC1 = 78xx Regulator

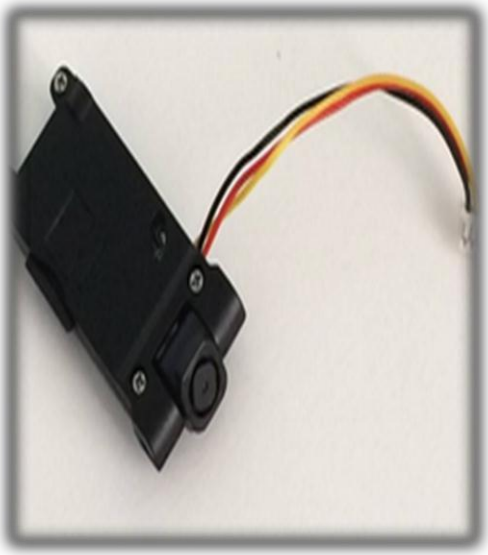
Volt regulators such as the LM708, and LM317 series (and others) sometimes need to provide a little bit more current then they actually can handle. If that is the case, this little circuit can help out. A power transistor such as the 2N3772 or similar can be used. The power transistor is used to boost the extra needed current above the maximum allowable current provided via the regulator. Current up to 1500mA(1.5amp) will flow through the regulator, anything above that makes the regulator conduct and adding the extra needed current to the output load. It is no problem stacking power transistors for even more current. (see diagram). Both regulator and power transistor must be mounted on an adequate heat sink.

3.2.1 Extended Options

Optional components such as GPS (Global Positioning System) modules, cameras, ultrasonic sensors, barometers (barometric pressure sensors) etc can be considered. They enhance the performance of the Drone, and add value to its uses. GPS modules communicate to satellites and retrieve accurate relevant information. This information can be used to calculate speed and path. It is very useful for autonomous Drones that need to know its exact position and which direction to fly.

An ultrasonic sensor measures the distance to the ground or the altitude. It is of great use if the Drone has to maintain a certain distance from the ground without adjusting the height. Most of these sensors have a range of between 20cm to 7m.It needs to be mounted at the bottom of the Drone. The barometer measures humidity and pressure and works best at high altitudes. The best altitude combination will be to use both an Ultrasonic sensor and a Barometric pressure sensor at the same time.

A Drone with an attachment of GPS and a high definition camera

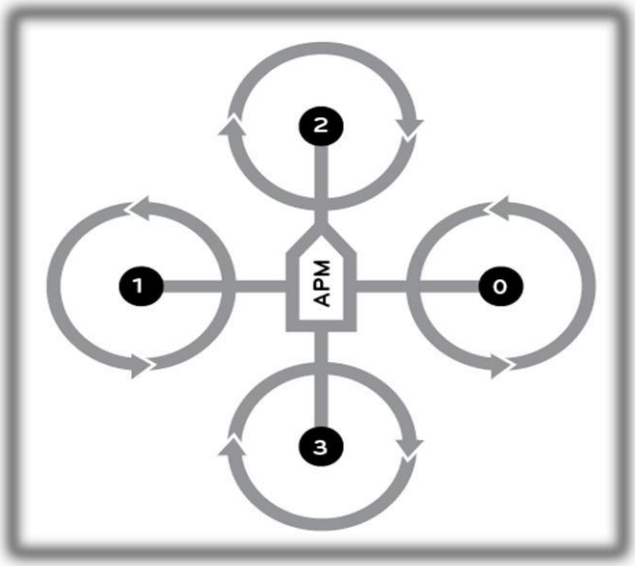


Camera used as an attachment in our Drone with a USB to view the images

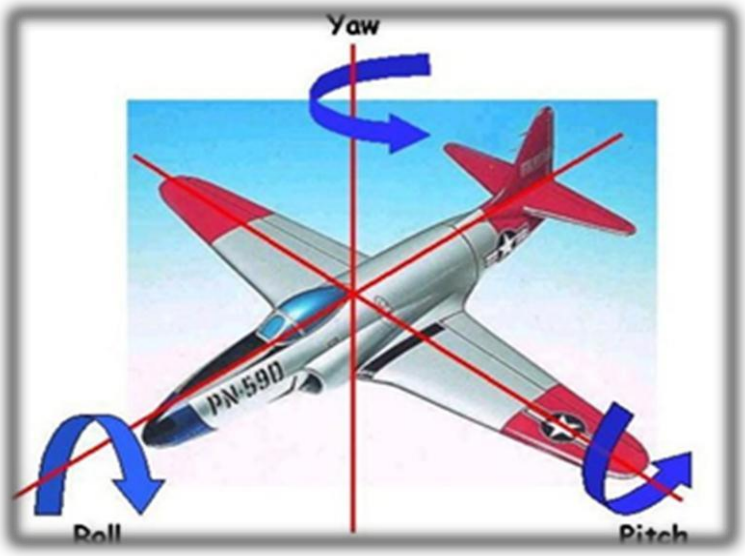
3.3 Flight Control

The flight control in Drones work is based on the principle that each rotor produces thrust and torque about its center of rotation, as well as a drag opposite to the vehicle's direction of flight. If all rotors spin at the same angular velocity, with rotors marked 1 and 3 rotating clockwise and rotors marked 2 and 4 counterclockwise, the net aerodynamic torque, and subsequently the angular acceleration about the yaw axis, is exactly zero, which implies that the yaw stabilizing rotor of conventional helicopters is not needed. Yaw is induced by mismatching the balance in aerodynamic torques (i.e. by Offsetting the cumulative thrust commands between the counter-rotating blade pairs)

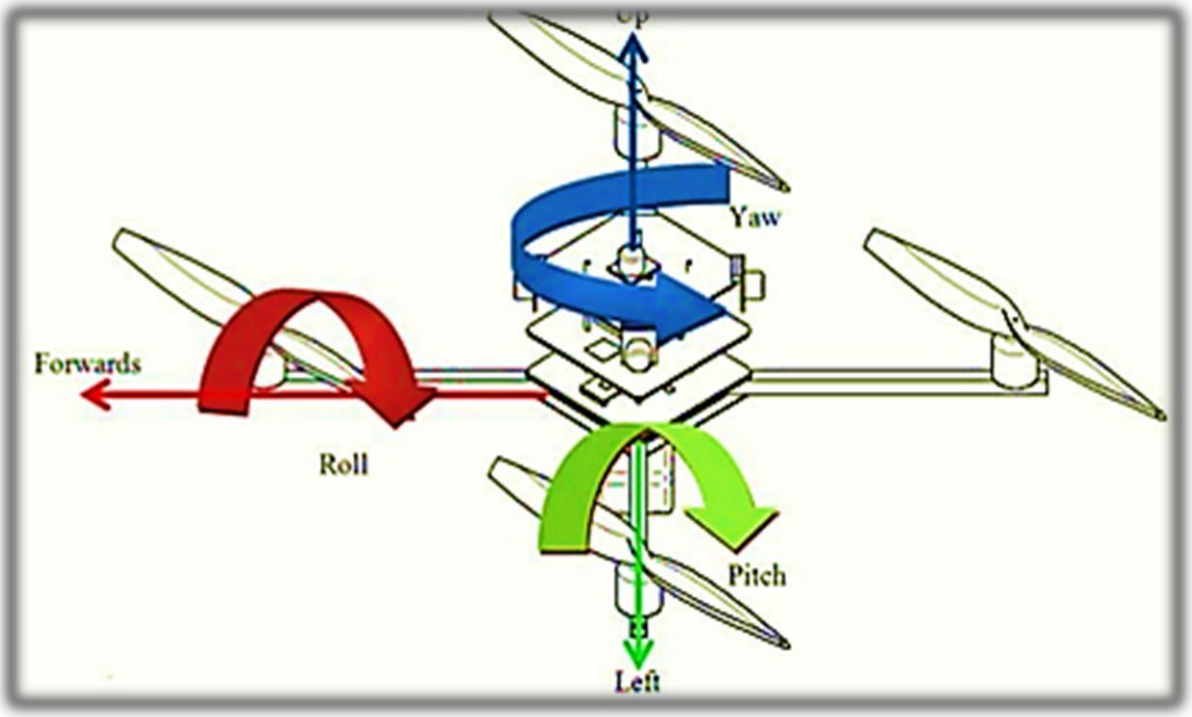
The 4 rotors aligned take the shape of a square, two on opposite sides of the square rotate in clockwise direction and the other two rotate in the opposite direction. If all rotors turn in the same direction, the craft would spin just like the regular helicopter without the tail rotor. Yaw is induced by unbalanced aerodynamic torques. The aerodynamic torque of the first rotors‟ pair cancelled out with the torque created by the second pair which rotates in the opposite direction. Hence if all four rotors apply equal thrust the Drone will stay in the same direction.



For balance, the Drone should continuously take the required measurements from the sensors, and make alterations to the speed of each rotor to maintain the body level. These adjustments usually are done automatically by a sophisticated control system on the Drone in order to stay perfectly balanced. A Drone has four controllable degrees of freedom, namely: Yaw, Roll, Pitch, and Altitude. Each degree of freedom can be controlled by adjusting the thrusts of each rotor. In an aeroplane, it is given by:

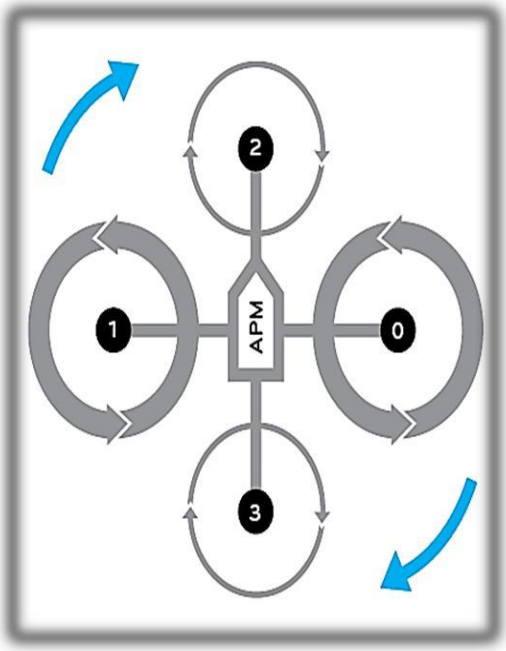


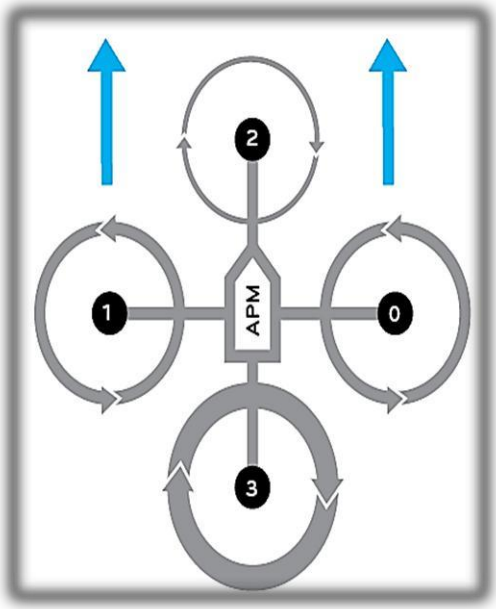
Primary Control Surface	Airplane Movement	Axes of Rotation	Type of Stability
Aileron	Roll	Longitudinal	Lateral
Elevator/ Stabilator	Pitch	Lateral	Longitudinal
Rudder	Yaw	Vertical	Directional



Similar to an aeroplane, the movements of a Drone also contain- roll, yaw and pitch.

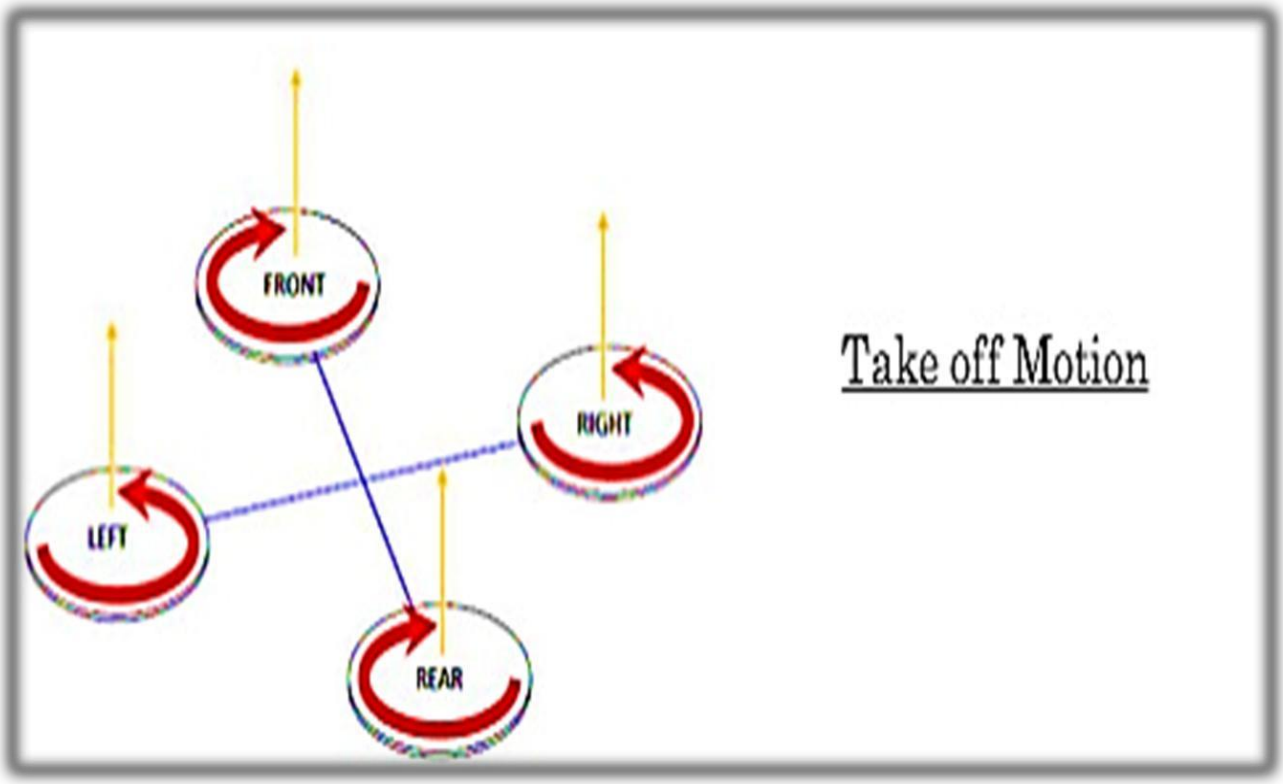
- Roll (tilting left and right) - Controlled by increasing speed of one motor and lowering the opposite one.
- Pitch (moving up and down) - Same way as roll, but second pair of motors are used
- Yaw (turning left and right) - Controlled by turning up the speed of the regular rotating motors and taking away power from the counter rotating.

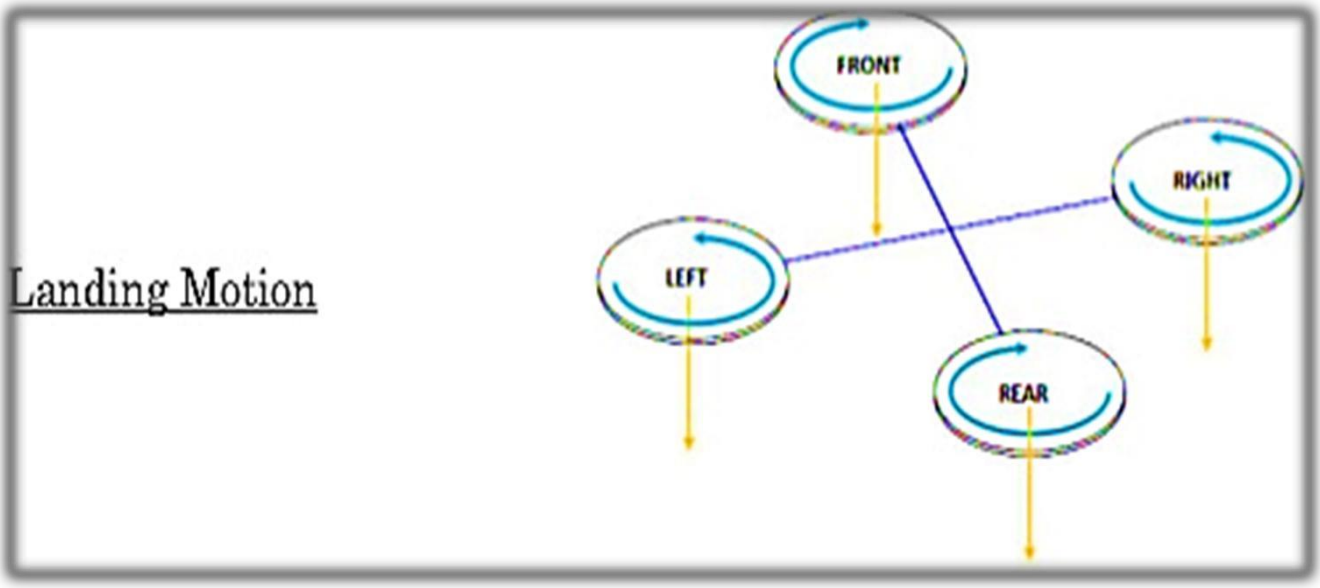


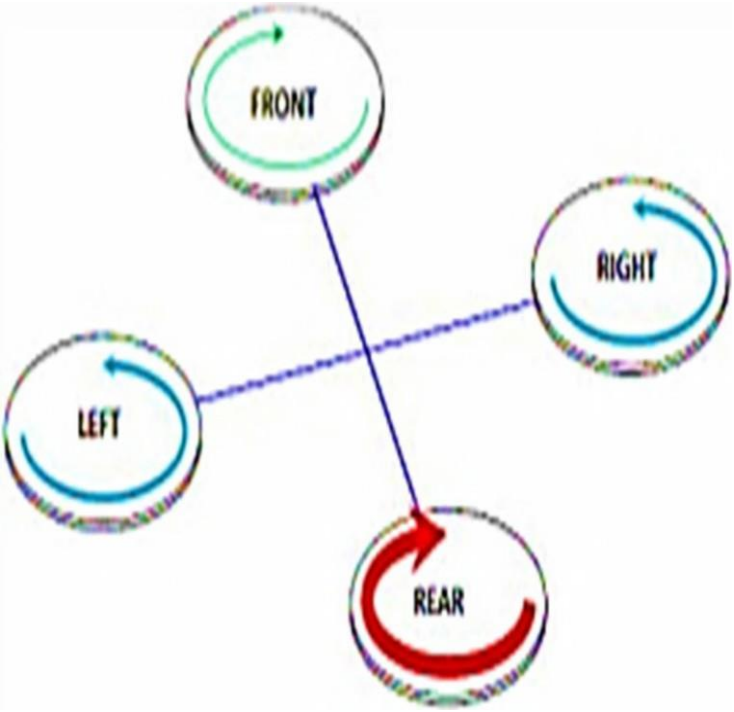


For rolling or pitching, one rotor's thrust should decrease and the opposite rotor's thrust should increase by the same amount, which causes the Drone to tilt. When it tilts, the force vector is split into the horizontal and the vertical component. Due to this, firstly, the Drone begins to travel opposite to the direction of the newly created horizontal component. Secondly, because the force vector has been split, the vertical component

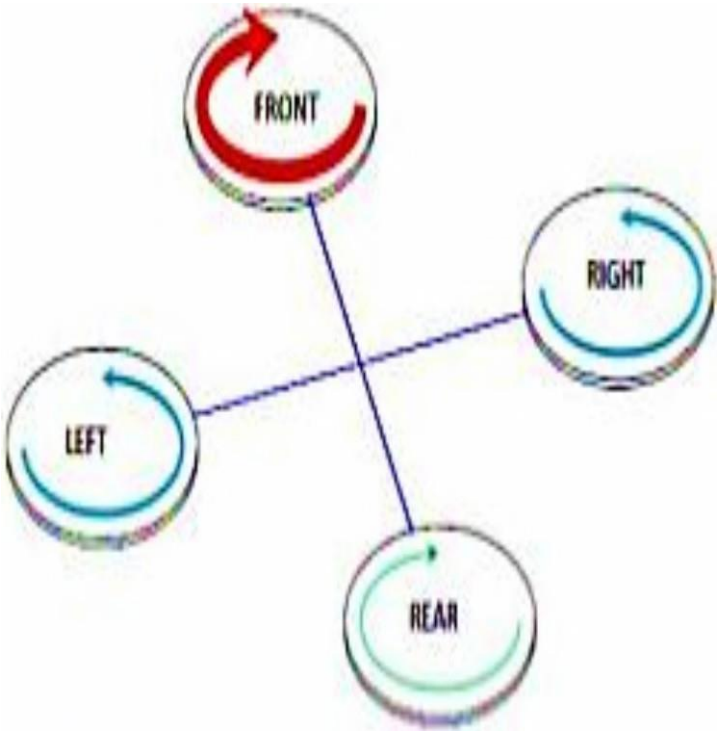
will be smaller, causing the Drone beginning to fall. In order to keep the Drone stable, the thrust of each rotor should then be increased in order for compensation.



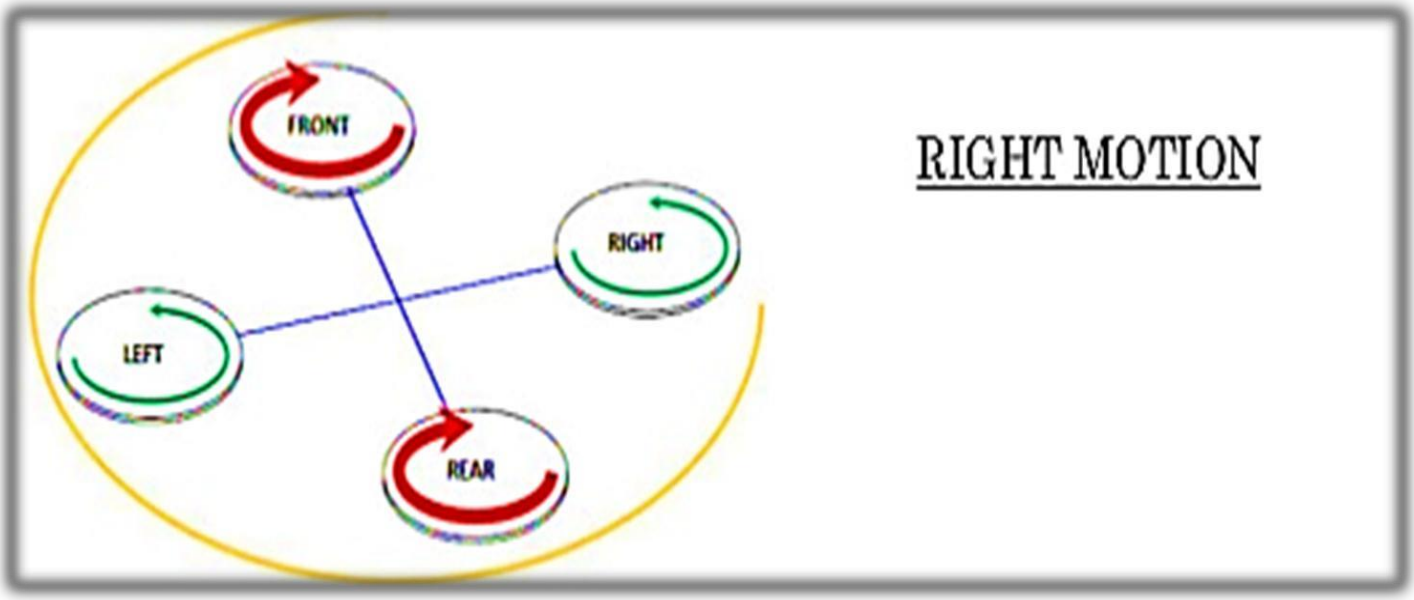


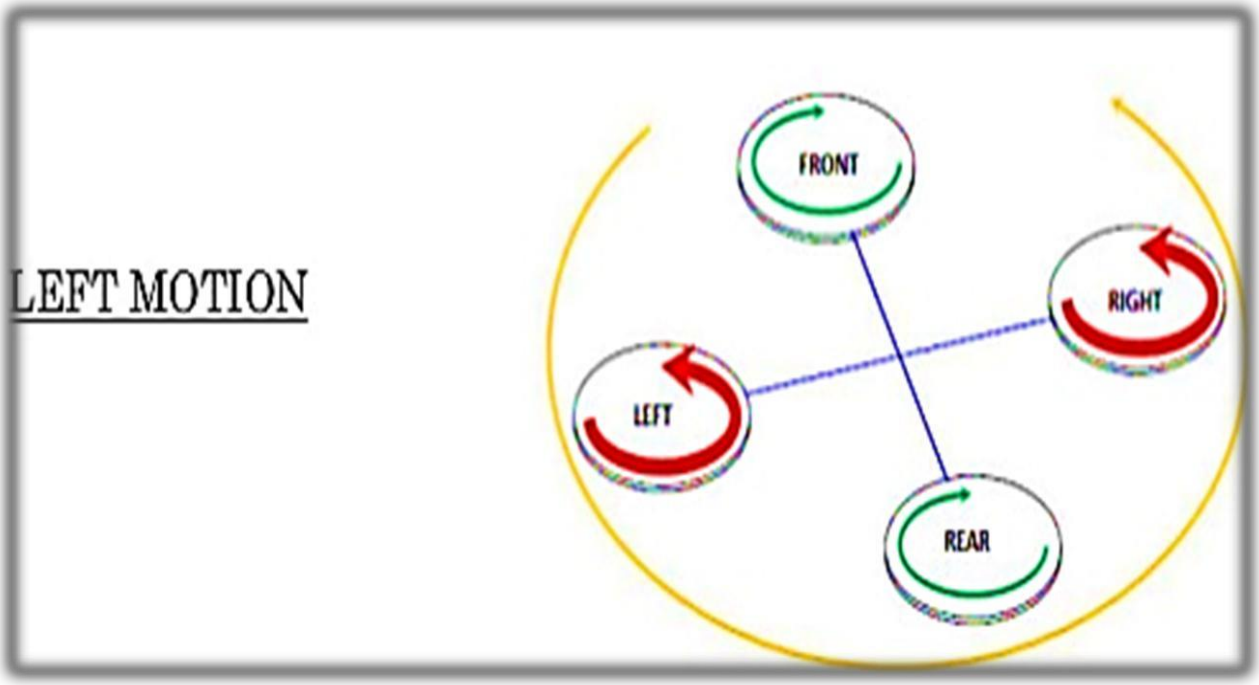


FORWARD MOTION



BACKWARD MOTION


FRONT
RIGHT
LEFT
REAR
RIGHT MOTION


LEFT MOTION
FRONT
RIGHT
LEFT
REAR

3.4 Applications of Drones

Drones have variety of applications in the field of research, military and many more. Drone designs have become a cynosure as to most research fields as they are an important concept of unmanned aerial vehicle (UAV). They use an electronic control system and electronic sensors to stabilize the aircraft. Their small size and agile maneuverability prove a great strength to these Drones and they can be flown indoors as well as outdoors.

Some of their applications include:

1) 3-D Mapping- Small and lightweight drones help in surveying large landscapes with thousands of digital images that can be stitched together into a string of 3-D maps. Though military and other government satellites produce similar maps, but the stupendous outcomes of UAV technology outshines them repeatedly.

2) Search and Rescue- Drones are a widespread application to rescue patients during injury or any calamity, manmade or natural. Drones have the ability to help assist, locate and save victims, faster with more efficiency than any other option. There are campaign missions to provide a string product line of Search and Rescue (SAR) Drones. Advanced technology is used to create drones that can reach people in small spaces and supply food, water and medicine to trapped victims. Many advances like water-resistance, high definition GPS tracker and cameras in Drones prove a great benefactor especially in the search and rescue aim.

3) Farming- In agriculture technology helps in great precision to monitor fields, increase yields and also save money. Moreover, drones also help precise applications of pesticides, water, or fertilizers by identifying exactly where such resources are needed and delivering them there too. Cameras in drones are able to spot nitrogen levels (low or high) or watch the growth of a particular section. Infrared light cameras inform about plant health by measuring the efficiency of photosynthesis in various plants. These infrared cameras also detect which land is suitable for appropriate growth of which plant.

3.5 Advantages of Drones

The main merit of Drones and similar unmanned aerial vehicles is their small size, due to which they could traverse in narrow conditions.

The use of drones has tremendously grown in a short span of time owing to the long flying time in contrast to the manned aircrafts. Without a human pilot, drones can operate for significantly longer without fatigue than airplanes. Moreover, drone operators can easily hand off controls of a drone without any operational downtime. They are remote controlled, so no danger will be there to the crew.

They contain a whole lot of widespread applications, in day to day lives, domestic purposes and national to international purposes.

Some more of their advantages include:

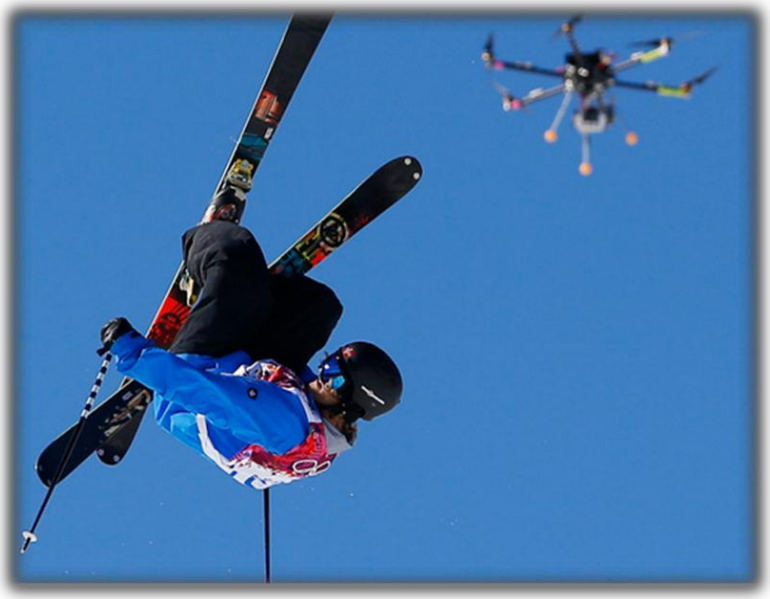
- Does not require mechanical linkages to change the pitch angle at the blade as it spins.
- Four small rotors have smaller diameter than one large helicopter rotor.
- Takes less damage to rotors.
- No need for a tail rotor which generates no lift.
- Easier to build four small blades compared to large one.
- Due to ease in construction and control, they are used in amateur model aircrafts project.
- They can traverse through difficult terrains because of their small size and there is less risk of damage too.
- They can save lives. They greatly reduce putting military manpower in combat (in harm).
- They are significantly cheaper and the cost in fuel and maintenance is way lower than regular airplanes.
- Drones are smaller and are able to fly lower than traditional airplanes and the risk level to military hardware is comparatively low.
- Drones increase surveillance, reconnaissance, and general military intelligence.

- Drones contain more pinpoint precision and accuracy from larger distances, which in turn reduce the collateral damage to civilians and infrastructure.
- Drones are easier and faster to deploy than most alternatives.

Drones in agricultural use for detecting lands for appropriate plant growth

Drones used in search and rescue applications.

One application is to rescue people from drowning in huge seas and oceans.



Drones used in filming high level adventure sports where filming by normal cameras is not feasible and does not give the desired outcome.

3.6 Disadvantages of Drones

Though drones possess a lot of advantages there are some concerns which should be thought about. They include:

1) Drones also contain limitations. For instance, they cannot communicate with civilians for more detailed intelligence. Drones cannot capture surrendering military personnel, abandoned hardware, or military bases. They cannot go from door to door (at least till now this facility is not yet available). Drone warfare causes collateral damages in civilian lives and property, as well as traditional warfare too.
2) According to civilians drones are viewed as an invasion force. The mere presence of drones has been known to convert civilians into military combats. Furthermore, when drones cause collateral damage, such as killing civilians and damaging civilian property, the opinions of civilians decrease even more so. Additionally, some cultures believe the use of drones as not brave and cold hearted. As a result, drones are sometimes counterproductive by more destabilizing some region.
3) Some drone pilots or operators have difficulty switching between combat mode at work and civilian mode while not working. This is especially difficulty when drone pilots have minimal transition periods between work and personal.
4) The worst scenario is when drones or a fleet of drones have been commandeered or taken control by the enemy. While security measures help make this possibility more difficult, it will never be impossible.
5) Exploitation of usage of drones could be done, for instance, spying (to the extent of harming someone) that infringes privacy and confidentiality.
6) Battery power may be restricted and may require frequent charging.
7) Very limited funds coupled with ambitious design schedule. Greater ambition leads to more complex calculation and design but nevertheless, the advantages of Drones outweigh the disadvantages, and they are worked upon so that optimum use of drones could be implied.

4.0 Discussions

Drones or drones first came to application as small toys, or school/university projects and then no sooner began to garner widespread attention- used in big-budget movies, photography of high profile sports, agricultural use to rectify lands and detect levels of pesticides as well as other components like nitrogen in plants, search and rescue, land mapping, military.etc. The commercial as well as private use of drones is enlarging.

The main point is that with growing progress in technology, drones too are coming in different shapes, sizes and configuration (Drones, hexacopters, etc.) for better load and yaw stability. Moreover, extended components like camera, water- resistant components or GPS tracker make it easy in missions of combating, surveillance and especially search and rescue.

After 10 years, the market for commercial drones will reach $1.7 billion. Each year, $6.4 billion is being spent developing drone technology. The drones are even providing new job opportunities. 70,000 new drone-related jobs are projected within the next three years in USA alone. 100,000 new jobs are expected till 10 years. Moreover, schools are offering drone degrees & programs in order to provide a trained workforce capable of meeting this demand. This may also prove that there is no need for people to fear about losing their jobs because of replacement by robots or drones.

But there are also some concerns like all the new leading technologies. It is important to plan appropriately to achieve a productive outcome. Privacy among being the major concern in warfare's, could be used as a means of spying which is mere exploitation and negative use of Drone technology.

Since the advantages of Drone technology are more than its demerits (are very well rectifiable), then according to drone experts, drones will be "in trend" within next 10 to 20 years.

There is a wide scope that with its extending use in almost every field and with greater powerful components, drones will surely come into full time existence.

Hence Drones will very soon start taking over larger roles in a variety of jobs.

5.0 Conclusion

Drones will soon take on be an imperative existence in the coming future. They will be seen taking up larger roles for a variety of jobs including business in the immediate future They could become a part of our daily lives, from smallest details like delivering groceries to changing the way farmers manage their crops to revolutionizing private security, or maybe even aerial advertising. Today, Drones are capturing news video, recording vacation travel logs, filming movies, providing disaster relief, surveying real estate and delivering packages.

They are categorized according to their corresponding uses. Some are for military purposes provided with missiles and bombs, some for surveillance and reconnaissance purposes.

Agriculture is predicted to be the dominant market for UAV operations. In Japan drones are flown for the past 20 years. Lot of the farmlands over there are on steep hillsides, and those vehicles can treat an acre in five minutes which is very difficult or even impossible to do so with a tractor.

The innumerable advantages of drones lead to their growth in a short span of time. They have a few demerits but those can be rectified. Today most drones are controlled by either softwares or other computer programs. The components of a drone also vary based on what type of work needs to be done and how much payload needs to be carried. Outrunners, batteries, electronic speed controllers all come in different ranges according to the type of work needed to be done by the Drone.

Drones are a great provisional craft that could get in between airplanes and helicopters and are hence easier to fly all the time. Beside realtime 3Dflight, such as inverted flight, Drones give a more acrobatic feel to its flyers. Drones offers to be a great balance between cost , capability, and performance. The only problem is when funds are coupled with highly ambitious projects. A solution for this could be to gradually improvise on inventing Drones with new enhancements and new designs. Hence Drones have an exemplarily bright future.

The onus lies upon us whether we productively use it or destructively use it.

6.0 Websites Referred:

- www.robotshop.com
- www.google.in
- www.electrical4u.com
- www.eng-tips.com
- www.aerostudents.com
- www.gensace.de
- www.ecvv.com
- www.mikrokopter.altigator.com
- www.tomsguide.com
- www.dronetrest.com
- www.hobbyparthttp.com

PRINT BACK

Enrollment No :	130343109012	College :	Narnarayan Shastri Institute Of Technology, Jetalpur
Student Name :	Shah Hardip Yogitaben	Department :	Electrical Engineering
Mobile No :		Discipline :	BE
Email :		Semester :	Semester 8

PPR Details

Time Interval : -

Periodic Progess Report : First PPR

Project : Solar Power Drone

Status : Reviewed (Freeze)

1. What Progress you have made in the Project ?

Searching for material in hobby king us ware house & other sites.

2. What challenge you have faced ?

There are two many different models are available on site so,little confuse to select power item.

3. What support you need ?

Internet connection & confidence to search and compare to item.

4. Which literature you have referred?

Referred some site which sales material.

Comments

Comment by Internal Guide :

find proper site way to collect material

PRINT BACK

Enrollment No :	130343109012	College :	Narnarayan Shastri Institute Of Technology, Jetalpur
Student Name :	Shah Hardip Yogitaben	Department :	Electrical Engineering
Mobile No :		Discipline :	BE
Email :		Semester :	Semester 8

PPR Details

Time Interval : 0 days, 0 hours, 5 minutes, 52 seconds

Periodic Progess Report : Second PPR

Project : Solar Power Drone

Status : Reviewed (Freeze)

1. What Progress you have made in the Project ?

Checking different circuit compatibility with other one.which RF signal is used for controlling purpose is dissed.

2. What challenge you have faced ?

As we searched about parts,too much different model available so according that its complete with other is big problem we faced.

3. What support you need ?

Internal guide & Friends to discuss about RF controlling.

4. Which literature you have referred ?

Knowledge of RF control signal and its range know from Wikipedia.

Comments

Comment by Internal Guide :

ok

PRINT BACK

Enrollment No :	130343109012	College :	Narnarayan Shastri Institute Of Technology, Jetalpur
Student Name :	Shah Hardip Yogitaben	Department :	Electrical Engineering
Mobile No :		Discipline :	BE
Email :		Semester :	Semester 8

PPR Details

Time Interval : 0 days, 0 hours, 3 minutes, 51 seconds

Periodic Progess Report : Third PPR

Project : Solar Power Drone

Status : Reviewed (Freeze)

1. What Progress you have made in the Project ?

Getting advice from my friends, internal guide and head of department regarding arduino controller.

2. What challenge you have faced ?

We have low knowledge about controller and circuits. so we faced the problem regarding it.

3. What support you need ?

Internal guide & friends for information regarding arduous.

4. Which literature you have referred ?

Principle of arduino is got from hobbyking youtube and from some books also.

Comments

Comment by Internal Guide :

refer more for this

PRINT BACK

Enrollment No :	130343109012	College :	Narnarayan Shastri Institute Of Technology, Jetalpur
Student Name :	Shah Hardip Yogitaben	Department :	Electrical Engineering
Mobile No :		Discipline :	BE
Email :		Semester :	Semester 8

PPR Details

Time Interval : 0 days, 0 hours, 9 minutes, 23 seconds

Periodic Progess Report : Forth PPR

Project : Solar Power Drone

Status : Reviewed (Freeze)

1. What Progress you have made in the Project ?

Order items from hobby king,robotics uswarehouse,amazon Wiimote assemble this item is started.

2. What challenge you have faced ?

No problem faced.

3. What support you need ?

Funding related support got from my parents.

4. Which literature you have referred ?

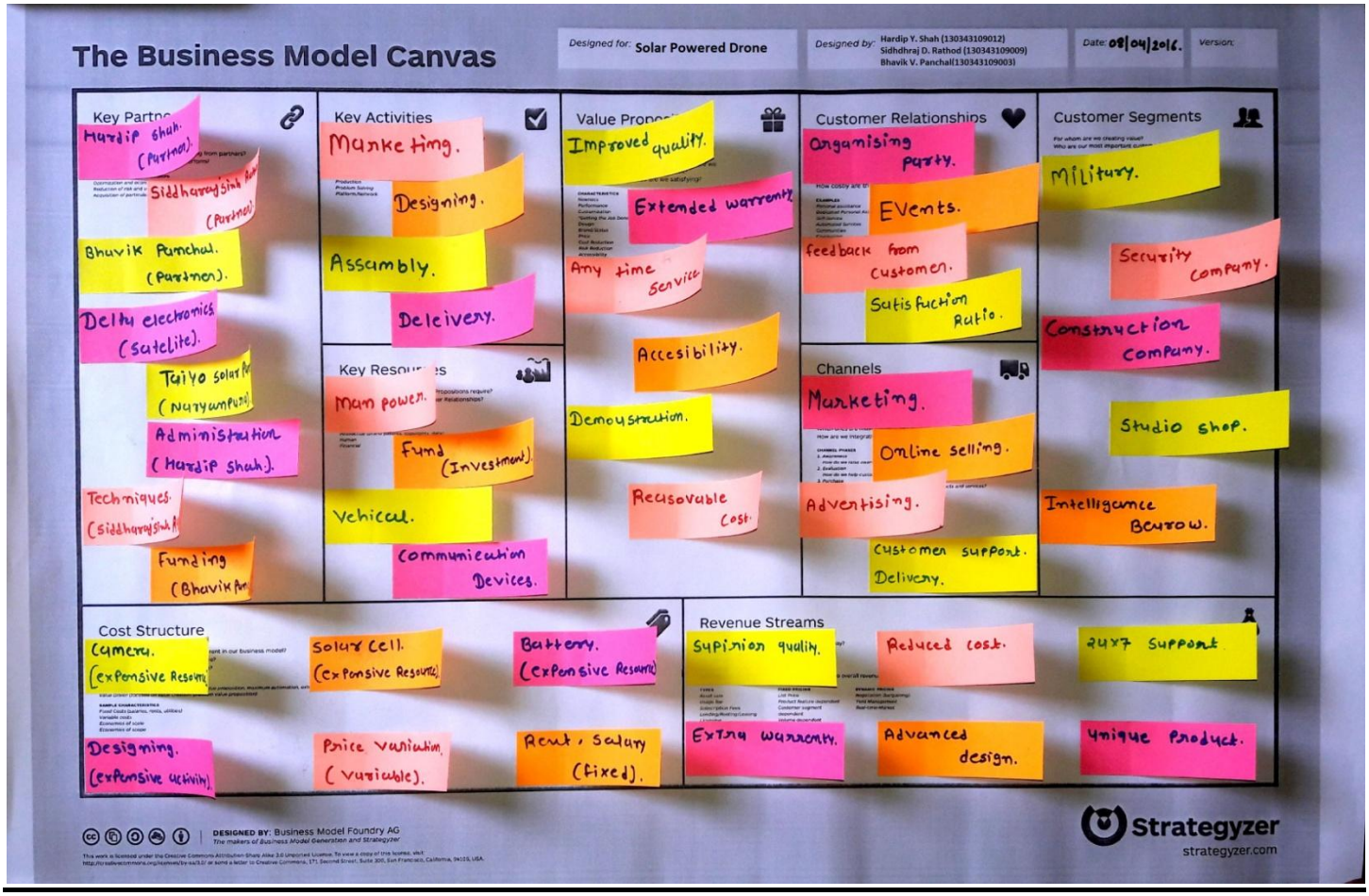
No literature referred.

Comments

Comment by Internal Guide :

ok

Business Model Canvas



Business Model Canvas Report

❖ KEY PARTNERS

- HARDIP SHAH (PARTNER)
  - Manage administration and management department
- SIDDHARAJSINH RATHOD (PARTNER)
  - Man-power management and production department
- BHAVIK PANCHAL (PARTNER)
  - Manage funding and account of company
- DELTA ELECTRONICS (SUPPLIER)
  - Supplier of Controller and motor
- TAIYO SOLAR PANEL (SUPPLIER)
  - Supplier of solar panel and booster circuit
- ADMINISTRATION (HARDIP SHAH)
  - Hardip Shah manage this department
- TECHNIQUES (SIDDHARAJSINH RATHOD)
  - Production department are under Siddharaj Rathod
- FUNDING (BHAVIK PANCHAL)
  - Account department manage by Bhavik Panchal

❖ KEY ACTIVITIES

- Marketing
  - Market analyzing and finding a customer according to our product is comes in this section
- Designing
  - Design according to customer requirement and its specification.
  - Best design and unique product is our motto
- Assembly
  - Assemble the supplied material by supplier
- Testing
  - Test the assembled product to remove the error like balancing, tuning, programming etc.
- Delivery
  - Deliver the goods by particular channel like trains, by air etc.

❖ KEY RESOURCES

- Man Power
  - Man power are require to assemble goods, communicate with customer, pack the product and at many more places
- Fund (Investment)
  - Investment are require to meet some fixed and variable expenses
  - Fixed Expenses like salary, rental etc
  - Variable Expenses are depends on market. i.e. some goods are ordered out of country whose price in foreign currency so price may be varied by changes in foreign currency.
  -
- Transportation
  - Man power needs transportation like bus services
- Communication Devices
  - To communicate and build relationship with customer communication are the first need between company executive and customer.

❖ VALUE PROPOSITIONS

- Improved Quality
  - To make competition in market some extra work or design or quality are require
- Extra warranty
  - Give extra warranty to customer to make in competition and attract the customer
- Any Time Service
  - Security does not premises, any time service is provided to customer to make good customer relationship
- Accessibility
  - Our product is accessible for convenient and easy use
- Demonstration
  - Our executives demonstrate our product in front of Clint.
- Reasonable Cost
  - Cost of our product is reasonable to attract clients and make competition between other competitor

❖ CUSTOMER RELATIONSHIPS

- Organizing Party
  - By giving invitation of party to our most valuable clients
- Events
  - To describe our product and its function event is organized
- Feedback from Customer
  - Feedback gives idea about "what they need?" and "what's are the problem in our product?" and many more
- Satisfaction Ratio
  - We are focused on the particular products which are most satisfied to our customers and identify the customer by knowing "who are they needs?"

❖ CHANNELS

- Marketing
  - Market analyzing and finding a customer according to our product and customer requirements.
- Online Selling
  - By online selling we can find customer and sell our products
- Advertising
  - To share and increment our cell advertising being done
- Customer Support
  - 24*7 customer care to support clients
- Delivery
  - Deliver our product on client 's timing

❖ CUSTOMER SEGMENTS

- Military
  - For make watch on border
- Security Company
  - For surveillance and security on terrorism activity
- Construction Company
  - For make watch on work from ground
- Studio Shop
  - Shooting and photography purpose

❖ COST STRUCTURE

- Camera (Expensive Resource)
  - According to polite and its sophistication behavior this is the expensive resourse
- Designing (Expensive Activity)
  - Different design on different specification and variable requirements become more expensive work
- Solar Cell (Expensive Resource)
  - Solar cell is expensive because of its uniqueness and manufacturing techniques
- Price Variation (Variable)
  - Price variation depends on market. I.e. some goods are ordered out of country whose price in foreign currency so price may be varied by changes in foreign currency.
- Battery (Expensive Resource)
  - Type of battery which we use in our product is quite expensive because of its high cost of manufacturing process and expensive material use on it.
- Rent, Salary (Fixed)
  - Salary and rest are fixed costs which are considered every month in our expenses

❖ REVENUE STREAMS

- Superior Quality
  - To make competition in market some extra work or design or quality are require
- Extra Warranty
  - Give extra warranty to customer to make in competition and attract the customer
- Reduced Cost
  - Cost of our product is reasonable to attract clients and make competition between other competitor
- Advanced Design
  - Design according to customer requirement and its specification
- 24x7 Support
  - Security does not premises, any time service is provided to customer to make good customer relationship
- Unique Product
  - Best design and unique product is our motto

GTU Innovation Council

Patent Drafting Exercise (PDE)

FORM 1 **THE PATENTS ACT 1970** **(39 OF 1970)** **&** **THE PATENTS RULES, 2003** **APPLICATION FOR GRANT OF PATENT**	**(FOR OFFICE USE ONLY)** **Application No:** **Filing Date:** **Amount of Fee paid:** **CBR No:_____**

1. Applicant(s) :

ID	Name	Nationality	Address	Mobile No.	Email
1		Indian			
2		Indian			
3		Indian			

2. Inventor(s):

ID	Name	Nationality	Address	Mobile No.	Email
1		Indian			
2		Indian			
3		Indian			

3. Title of Invention/Project:

4. Address for correspondence of applicant/authorized patent agent in india

Name:
Address:

Mobile:
Email ID:

5. Priority particulars of the application(S) field in convention country

Country	Application No.	Filing Date	Name of the Applicant	Title of the Invention
N/A	***N/A***	***N/A***	***N/A***	***N/A***

6. Particulars for filing patent co-operation treaty (pct) national phase Application

International application number	International filing date as alloted by the receiving office
N/A	**N/A**

7. Particulars for filing divisional application

Original(First) Application Number	Date of filing of Original (first) application
N/A	**N/A**

8. Particulars for filing patent of addition

Original(First) Application Number	Date of filing of Original (first) application
N/A	**N/A**

9. DECLARATIONS:

(i) Declaration by the inventor(s)

I/We, the above named inventor(s) is/are true & first inventor(s) for this invention and declare that the applicant(s). herein is/are my/our assignee or legal representative.

Date : 12 - April - 2016

	Name	Signature & Date
1	Shah Hardip Yogitaben	_____
2	Panchal Bhavik Vishnubhai	_____
3	Rathod Siddharajsinh Dilipsinh	_____

(ii) Declaration by the applicant(s) in the convention country

I/We, the applicant (s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.applicant(s)

(iii) Declaration by the applicant(s)

I/We, the applicant(s) hereby declare(s) that:-

- ☑ I am/We in possession of the above mentioned invention.
- ☑ The provisional/complete specification relating to the invention is filed with this aplication.
- ☑ The invention as disclosed in the spcification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.
- ☑ There is no lawful ground of objection to the grant of the patent to me/us.
- ☑ I am/we are the assignee or the legal representative of true & first inventors.
- ☑ The application or each of the application,particulars of each are given in the para 5 was the first applicatin in the convention country/countries in respect of my/our invention.
- ☑ I/we claim the priority from the above mentioned applications(s) filed in the convention country/countries & state that no application for protection in respect of invention had been made in a convention country before that date by me/us or by any person
- ☑ My/Our application in india is based on international application under Patent Cooperation Treaty (PCT) as mentioned in para 6
- ☑ The application is divided out of my/our application(s) particulars of which are given in para 7 and pray that this application may be treated as deemed to have been filed on _____under section 16 of the Act.
- ☑ The said invention is an improvement in or modification of the invention particulars of ehivh are given in para 8.

10. Following are the attachments with the application:

- ☑ (a) Provisional specification/Complete specification
- ☑ (b) Complete specification(In confirmation with the international application) / as amended before the international Preliminary Examination Authority (IPEA),as applicable(2 copies),No.of pages.....No.of claims.....
- ☑ (c) Drawings (In confirmation with the international application)/as amended before the international Preliminary Examination Authority(IPEA),as applicable(2 copies),No.of sheets....
- ☑ (d) Priority documents
- ☑ (e) Translations of priority documents/specification/international search reports
- ☑ (f) Statement and undertaking on Form 3
- ☑ (g) Power of Authority
- ☑ (h) Declaration of inventorship on Form 5
- ☑ (i) Sequence listing in electronic Form
- ☑ (j) ..... Fees Rs.XXX in Cash /Cheque/Bank Draft bearin No.XXX Date: XXX on XXX Bank.

I/We hereby declare that to the best of my /our knowledge, information and belief the fact and mtters stated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this **12** day of **April** , **2016**

Name Signature & Date

समुचित
ज्ञान
समन्वय

FORM 2
THE PATENTS ACT, 1970
(39 OF 1970)
&
THE PATENTS RULES, 2003
PROVISIONAL SPECIFICATION

1. Title of the project/invention :

Solar Power Drone

2. Applicant(s) :

3. Preamble to the description :

The following specification describes the invention.

4. Description :

a. Field of Application / Project / Invention :

Solar Drone

b. Prior Art / Background of the Invention / References :

Photovoltaic cell used in normal drone to improve its flying capacity

c. Summary of the Invention/Project :

We are used photovoltaic cell in regular drone which is store power in battery and increase the using time of it. So directly we are improve flying capacity by making "Solar powerd drone"

d. Objects of the Invention/Project :

Objects is to improve our security system by implanting PV cell into drone

e. Drawing(s) :

f. Description of the Invention :

Our aim is to improve our security system by implanting PV cell into drone. We are used photovoltaic cell in regular drone which is store power in battery and increase the using time of it. So directly we are improve flying capacity by making "Solar powerd drone"

g. Examples :

h. Unique Features of the Project :

Uniqueness in our projects is simple idea for big innovation.

5. Date & Signature :

Date :12 - April - 2016

6. Abstract of the project / invention :

Surveillance is most important work for military, law enforcement, and search and rescue operations.In past old techniques was used for surveillance. But now smart tricks and techniques is use like CCTV, Aerial Surveillance etc. But now days, Unmanned Arial Vehicles (UAVs) / Drones have grown in popularity for surveillance missions. The UAVs are perfect candidates for tasks that are tedious or dangerous for human, for example, patrolling along boarder lines, wild fire control, aerial surveillance and etc. The applications of UAV, as described above, generally require long flight time and reliable power supply. However, current UAV designs utilizing traditional battery or fuel cells usually struggle to meet such requirement. This project aims to provide an innovative solution to this problem by introducing the current popular photovoltaic system into the UAV power system design.

Drawing Attachments :

FORM 3
THE PATENTS ACT, 1970
(39 OF 1970)
&
THE PATENTS RULES, 2003
STATEMENT AND UNDERTAKING UNDER SECTION 8

1. Declaration :

I/We,

2. Name, Address and Nationality of the joint Applicant :

Here by declare :

(i) that I/We have not made any application for the same/substantially the same invention outside India.

(ii) that the right in the application(s) has/have been assigned to,

Name of the Country	*Date of Application*	*Application Number*	*Status of the Application*	*Date of Publication*	*Date of Grant*
N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

(iii) that I/We undertake that up to the date of grant of patent by the Controller , I/We would keep him inform in writing the details regarding corresponding application(s) for patents filed outside India within 3 months from the date of filing of such application.

Dated this **12** day of **April** , **2016**

3. Signature of Applicants :

To
The Controller of Patent
The Patent Office, at **Mumbai.**