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SELF-CHARGING SOLAR SURVEILLANCE DRONE

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1.ABSTRACT:

Drones are a common sight today and are being used in a wide range of applications. From selfies to pesticide spraying to military surveillance. Well, the problem with surveillance/monitoring is that many applications require long time surveillance. Drones do provide a good view for surveillance monitoring but have a huge drawback. This is the drone battery life. The major fear a drone pilot faces in surveillance is that the battery may run out and drone may land on a tree or building or some inaccessible area from where it cannot be retrieved and thus cannot be charged. This is also the case in military surveillance, the possibility of battery life running out and drone being inaccessible creates limitations for drone pilots during surveillance/monitoring. Well, we here develop a drone with solution to these problems using solar power to constantly charge the drone to increase its flight time as well as the ability to land the drone anywhere and automatically its battery remotely to take flight later. This will lead to improved flight time as well as automatic battery charging of drones in inaccessible areas so that it can take off from the same spot-on charging.

This solar powered drone provides the following advantages:

- Increased flight time
- Solar changing capability
- Anywhere daytime charging without chargers
- Easy to Use and no manual efforts
- No worries of battery run out over inaccessible areas.

The drone is a quad rotor drone that makes use of 4 x high powered drone motors with propellers to provide required lift to the drone. The drone body is integrated with solar panels for high efficiency charging during idle time as well as during flight time for improved flight times. The drone is integrated with a WIFI camera that can be monitored over an android smartphone using WIFI connection. It makes use of a rc remote controller to receive control commands for the user. The drone onboard rc receiver is used to receive control commands from the user and operate drone motors to achieve desired flight.

2. INTRODUCTION:

As a result of rapid technological progress, unmanned aerial vehicles (UAVs) have become more and more popular. UAVs have a variety of applications, ranging from military to commercial and civilian ones. They have multiple real-life applications like aerial photography, cartography and geodesy, precision farming, life rescue missions, infrastructure inspection and environmental protection. UAVs can be piloted remotely or fly autonomously along a planned path. They are used by the military to observe enemy controlled areas. The literature describes a drone as an unmanned aerial vehicle which does not require a pilot presence on board. This kind of vehicle is not allowed to transport passengers. It is piloted remotely or performs autonomous flights. Both taking-off and landing (or recovery) phases of the drone take place with automatic systems or are controlled by an external operator. Following the idea of electrically-powered UAV usage, there is a need to provide the necessary energy. A typical UAV movement scenario assumes that the drone flies from a ground site to the desired position, serves selected areas, returns to the ground site, and recharges its battery at the ground site. This forces one to schedule UAV missions in a way to preserve their battery power level as much as possible. The most common and the simplest solution is battery replacement by an operator and then charging them externally in a docking station or using a built-in drone charger with a connected power cable. In the case of the winged vehicles, it can be easily solved by covering the wings with solar panels. An unquestionable advantage of drones is the possibility to reach inaccessible places on Earth in a relatively short time. Using cams and sensors, they can monitor surroundings and the environment at such places with simultaneous transmission of data to a base station. The position of drones can be changed on demand with the use of suitable commands and protocols. The system is designed to operate in poorly accessible areas like glaciers, deserts, high mountains, conflict zones, etc. It is theoretically possible for people to get there, but it takes a lot of time and the journey may be dangerous to their health or life. The proposal is particularly useful in military applications where energy is not available and the area may be extremely dangerous. Other than that, many researchers have developed drones for other applications such as agriculture and forestry, firefighting, communications relay, remote sensing, aerial mapping, meteorology and so on. However, the power consumption for operating drones is considerably high and maintenance is very costly for applications like environmental monitoring purposes. So, one of the possible solutions to realize such application is using the green environment friendly energy namely solar energy.

3. LITERATURE SURVEY:

3.1 __Historical Background:__

There has been a rapid growth in drones with the advancement in the technology and their incorporation in consumer electronics. These are the aircrafts which were built for fulfilling limitary purposes originally. In the start, they were used as weapons such as missiles so that they could be controlled with the remote controls through radio waves. There are a lot of applications in which these drones can be used now as their functions now also include monitoring of the change in climate and delivering items for the search operations. The origin of these drones took place in the year 1894 when Venice was attacked by Austria using explosives. However, they were in the form of balloons which do not meet with the current standards of drones that work in the form of piloted aircraft for shooting missiles.

3.2 __University of Connecticut's autonomous battery charging of Quadcopter:__

The quadcopter is identical to a drone. However, the flight timing of a quadcopter is restricted because of the drawbacks of the new battery supply. Including additional batteries is not a permanent solution to the issue. Because adding batteries will utilize extra power, resulting in a decrease in battery timing and flying duration. In this project, the design team of the University of Connecticut decided to build a UAV structure that can charge autonomously without requiring human involvement. The design team developed an autonomous structure which can navigate the unmanned aerial vehicle to the charging location, thus, charging the quadcopter's battery without needing a human engagement. The design team of the University of Connecticut used an image processing mechanism to search the charging station. The design team believed that it is the most suitable option because the drone is designed for flying indoors. Moreover, the team will experiment on the inside. Therefore, there will be no need for GPS. This image processing method involves pointing out towards a tag or a colour close to the charging station. The drone will fly near to the colour or tag till the time it reaches the charging station. When the drone identifies the charging station, it should rest on the top of the charging station to charge itself. To dock at the charging station, the camera that is installed under the drone will persistently monitor for colour or tag. As soon as the bottom camera identifies a tag, the drone will dock in the charging station and initiates charging. The other function of the drone will monitor the battery persistently until it is complete. After complete charging, the drone will take off.

3.3 __Solar UAV Design:__

The unmanned aerial vehicle (UAV) developed in this project was founded on the Green Falcon UAV that was built at the Australian Research Centre for Aerospace and Automation (ARCAA) and QUT. The main sub-systems include navigation structure. The elements of this navigation structure are a gyro sensor, accelerometer, GPS, airspeed sensor, autopilot, barometer pressure, and fail-safe structure. The autopilot utilized in the development of the UAV was the ArduPilot Mega 2.5. It is a comprehensive autopilot structure with a higher proportion of benefit to cost and lower weight. The autopilot structure functions in three ways, i.e., self-governing 11 way, to ultimately execute the mission that does not need crew by pre-programming the computer checked coordinates of each phase of a flight from the ground control stations (GCS). The second component is stabilization mode. It helps the earthly captain in regulating and maintaining the flight of the aerial vehicle. However, in this manner, the captain has incomplete command on the aerial vehicle, and when the input is absent, autopilot becomes able to manage the smooth flying of the aerial vehicle. The third component is manual mode. This mode is helpful in executing a pre-flight check. Through this mode, the pilot can independently execute manual take-offs and landings operations when the autopilot is not pre-programmed.

All these modes allow the autopilot to convey significant flying details like pitch, roll, yaw, GPS position, battery position and airspeed to ground control station by employing a telemetry module. The airframe of the UAV is smooth to transfer quick deployment and manually take off. The wingspan of the airframe is 2.52m; length is 960mm and wing aspect proportion is 13. The original weight was 960g however, after including the SSC panels, the weight elevated to 1610g. So, the ultimate weight of the unmanned aerial vehicle was 3285g.

3.4 __Eagle Eye Drone by Francois Baptista and Stephane Pietroiusti:__

One of the critical problems with drones is that they need to charge the batteries after a brief flight duration. However, the Eagle Eye Drone designed by Baptista and Pietroiusti is created with a different aim. It is structured with solar panels at the top surface. Thus, it recharges itself while flying in the air and does not require to land. This drone is structured for the areas with hidden dangers in distant places. These drones offer information about the way the land has changed and the trees that might have perished. This drone was developed by French engineers and they aimed to keep people secured during wild experiences. Because of its super characteristics, it has become a mandatory device for the rescuers.

4. STATEMENT OF PROBLEM:

Problem:

Drones are commonly used in medicine and observation. The most frequent uses of drones in medicine include the supply of crisis evaluations in the unavailability of other sources of reach; distributing medicines, help packages, blood, vaccines and other kinds of clinical stuff. In addition, drones offer many advantages concerning surveillance, for example, offense prosecutions, traffic monitoring, and border monitoring, etc. Nevertheless, in the current times, even the most developed drones have a flight duration ranging from 20 to 25 minutes. The short battery life of drones creates problems during surveillance and make the usage of these drones as impracticable in all fields. Due to the 3 extensive usages of drones in surveillance and medicine, it is essential to look for a way by which the flight duration of these drones can be increased without interrupting the flights. Usually, drones operate through onboard batteries which have restricted capacities. Nonetheless, these drones are anticipated to accomplish vital and longer missions. Therefore, there is a need for an autonomous mechanism by which the flight time of drones can be enhanced, and the missions can be completed without any effect. It aids in extending the working duration of drones.

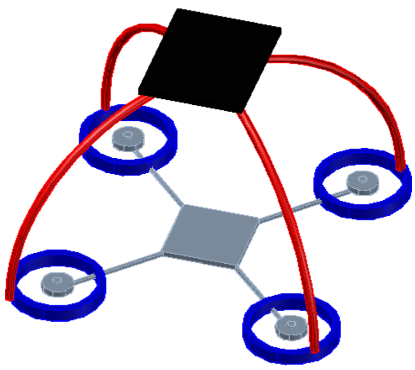
Solution:

Self –charging drones are the solution to the short battery timing of drones. A self-charging solar surveillance drone. A drone using solar power to constantly charge the drone to increase its flight time as well as the ability to land the drone anywhere and automatically its battery remotely to take flight later. Solar-powered UAV, using solar cells installed onboard, captures solar energy reaching the aircraft surface during daylight. Such generated power is supplied to the motor to propel the aircraft and other electronics or to recharge the battery on board. The battery supplies power when in darkness or under clouds.

5. METHODOLOGY:

5.1 Structural modification of quadcopter:

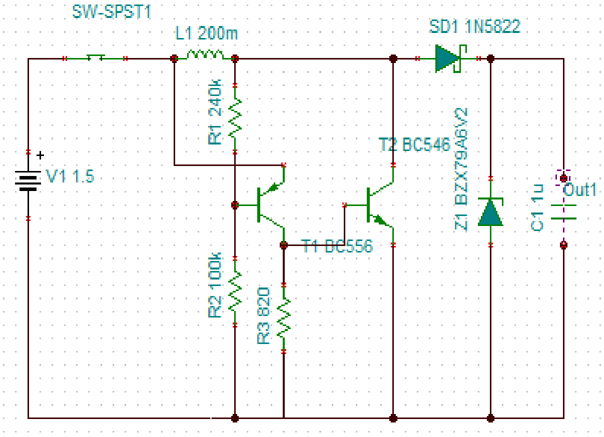
The design and modification of the structure of mini quadcopter. The black shape on top represented the solar panel. The placement of the solar panel was located at the best position in body to get most radiation energy from the sunlight without affecting the aerodynamics of the quadcopter since it was located at the center of the body. The blue frame which covers around each motor was the typical frame work provided by mini drone in the market for outdoor protection.

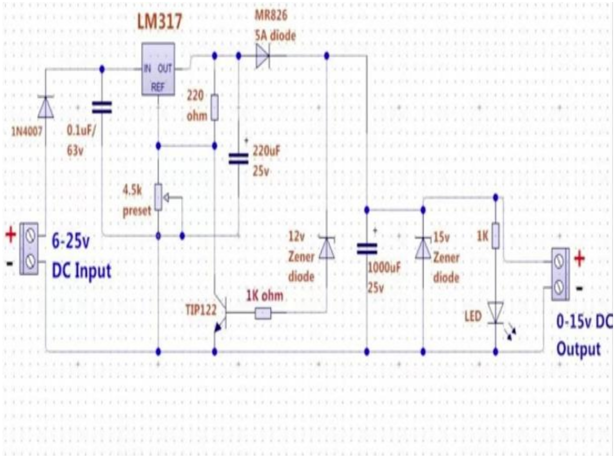


CAD Design of structural modification of the quadcopter

5.2 Design of the Solar boost Convertor Circuit:

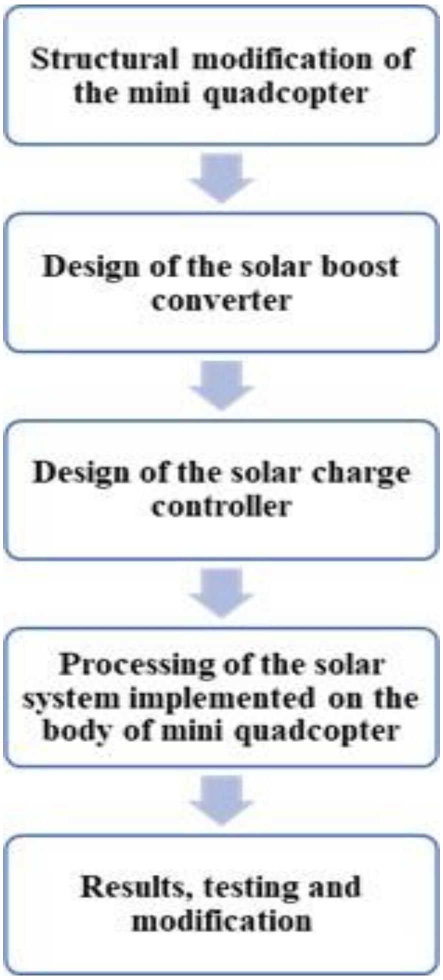
A solar boost converter boosts low input voltage to higher output voltage. The current will surely be stepped down in the process of stepping up the voltage input. To design the solar boost converter for mini quadcopter, the circuit must be as simple as possible so that the circuit board is light weight and can be easily installed to the body of the mini quadcopter. The solar boost converter needs to be designed and added into the whole system so that the potential difference produced by the solar panel can be boosted to a higher voltage.





5.3 Design of the solar charge controller circuit:

To transmit and distribute the generated voltage as well as boost voltage to the whole circuit, a charge controller was designed. A charge controller is a voltage or current controller that controls the power that supply into or draw from the battery storage. It helps to protect the battery and prevents it from overcharging, overvoltage that will later influence the performance of the battery, reduce its life span or evengiving the risk of damaging the battery at the same time pose a potential threat to health and safety. The ultimategoal of a charge controller in standalone PV systems is to maintain the highest possible state-of-charge while preventing battery over-charge during high solar insolation and avoid over-discharging during low insolation and excessive loading. A 555 timer was used as a switching device that can control the connections between the solar panel and the battery. This timer circuit helped to set the threshold voltage levels of the solar as well as the battery to automatically switch back and forth between charging modeand cut off mode. The timer used a relay to switch the modes.



6. PROPOSED SYSTEM:

Solar power is the conversion of sunlight into electricity, either directly using photovoltaic (PV) technology, or indirectly using concentrated solar power. Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect. Hundreds of photovoltaic cells (also called solar cells) make up a Solar Photovoltaic (PV) Array. Solar cells contain materials with semiconducting properties in which their electrons become excited and turned into an electrical current when struck by sunlight.

The project is the design of a quadcopter used for surveillance. The video feed or image content captured via an on-board camera is transmitted to the receiver. In the aspect of energy, the best-case scenario for the implementation of this quadcopter involves the quadcopter being self-sustaining. However, for the purpose of implementation, the project focuses on the extension of flight time. This is due to the cost constraints in the aspect of the materials to be used and the limited efficiency of the solar cells available. Extension of flight time by harvesting energy in this project is to be a stepping-stone towards a self-sustaining power system for a quadcopter. This may lead to the capability of being able to survey distances that are farther away from the take-off point of the quadcopter or the capability of being able to survey a particular location for a longer period or combining these two capabilities.

7. FABRICATION AND TESTING:

The design is converted into real life product with the help of engineering drawings and testing is done on the product. The test results are verified with the design and analysis data obtained during the designing phase of the product.

8. CONCLUSION:

In conclusion, we decide to build self-charging drone's system as a solution for the short battery timing of drone problem. After deep research by team members, we found that such an issue is serious problem for drones because it results to the possibility of failing the mission that the drone would do and also affects the utilization of drones for various missions. The idea of our Project to solve this issue resulted from brainstorming and deep research. This project entails extensive research about how this solution can be executed successfully and what are the costs involved and the resulting advantages.

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4. Dr S Sathees Kumar, IARE10907, Associate professor of mechanical department.

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