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Unmanned Aerial Vehicle For Relief Operations

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Abstract: *In the event of a natural disaster, the military is used for rescue operations and is split into two teams, one for rescue and one for relief thereby increasing the demand for manpower resources. In this scenario the additional manpower can be used to focus more on rescue operations there by saving the lives of hundreds of people, by diverting the manpower used for relief to the rescue operations. This project intends to do so by using unmanned aerial vehicles for relief operations by air transport of supplies to disaster affected areas and airdropping them to the designated drop zones. It intends to use a fixed wing aircraft using brushless dc motors as propulsion and would be navigated by GPS and Galileo satellite-based navigation (Neo8M), with the computer of the aircraft will be an Arduino Based flight controller(APM 2.8), a 2.4 GHz Radio controller(CT6B), and the flight data will be transmitted to the operator by a 915 MHz Telemetry Module. The fixed wing design offers high speed and long range on a limited battery life. The supplies would be dropped mid air and would land on the ground using a parachute system.*

Index Terms **– Drones, Unmanned Aerial Vehicles, Fixed Wing Aircraft, Multi Rotor Aircraft, GPS Module .**

I. Introduction

Given the success of drones in the present world and their use cases in various applications, it is only valid that they be a reliable replacement for humans in operations that require the delicate touch of a machine. This Vehicle is designed in a way that allows it to fly longer distances at higher speeds and reach locations which primarily are the major advantages of fixed wing aircrafts. This also lets the drone deliver the payload via a parachute system and return to base thereby making a significant number of deliveries in a shorter span of time. Fixed wing drones have a multitude of advantages and disadvantages but in scenarios like this, it is safe to say that the advantages outweigh the disadvantages. The fact that drones have existed for a while and yet were only used as a play toy is infact surprising. But in present day scenarios when literally every aspect of aerial warfare is covered with weaponized drones, it is safe to assume that the days are not too far away when delivering supplies in combat zones and disaster effected regions.

With the given availability of sensors, we can make sure that flight data is transferred with minimal loss and responsiveness of the flight is maintained throughout. The systems advantages can be classified as follows,

ADVANTAGES:

1. Fast loading and unloading of payload
2. No requirement to land at the drop site or hover thereby enabling quick deployment.
3. Fixed wing design enables higher speeds at almost half the power of the multi rotor counterparts.
4. Autonomous flight makes it easy for the operator to take off and forget about the flight.
5. Light weight materials and readily available materials facilitate quicker replacement of parts.
6. Simple yet effective designs thereby making production simple.

DISADVANTAGES:

1. Cheap materials make it susceptible to damage.
2. Take off and landing sequences take a while of time.

1.1 EXISTING MODEL

Drones in relief and rescue are either still a work in progress, or used entirely for different purposes. At present, the closest that we came to delivering supplies through drones are the amazon drone delivery system that uses multi rotor drone for a door-to-door delivery service.

Fig. 1.1 Multi-Rotor drone delivery system

1.2 PROPOSED MODEL

The proposed model is a fixed-wing unmanned aircraft with autonomous capabilities designed to fly distances further at speeds faster than any similar operative multi rotor drones. The payload would be dropped at the designated drop zone using a parachute mechanism which would decrease the time taken for the recovery of the payload in disaster effected regions.
Also, the aircraft can return to the loading base in a faster span of time there by enabling it to indulge in multiple sorties there by increasing the efficiency of the mission.
The proposed aircraft would be autonomous and would enable the user to add on waypoints and required speeds prior to the mission or even change them mid-way. The usage of different flight controllers also determines the number of waypoints that can be input into the aircraft and that in turn determines the accuracy of the mission.
The GPS modules can be used in a blended configuration so as to improve the location accuracy. The aircraft design is done using simple easily available materials such as depron foam and plywood. The selected design has been inspired from three versatile aircraft C-130 Hercules, DHC Twin Otter, and a Cessna-152. The payload can be loaded into the drone from the top hatch and unloaded from the bottom hatch.
The entire model is powered by a 3S lithium polymer battery with a capacity of 2200 mAh. The aircraft is propelled by two 1400 KV brushless dc motors coupled with 8*4.5 inch propellers in pusher configuration. The control surfaces of the aircraft are controlled by SG-90 and MG-995 servo motors.
The design aspects of the aircraft are mentioned furthermore in the paper.

II. Construction of the Aircraft.

- The aircraft is constructed using deprom foam board 5 mm in thickness. It is then reinforced with glass fibre.
- The wingspan of the aircraft is 1.5m.
- The length of the fuselage aircraft is 1m.
- The plans of the design are attached further.
- The hatch is an 18cm*11cm opening present at the bottom of the aircraft right behind the CG (Center of Gravity).
- The CG is located 7.7cm behind the leading edge of the wing.
- The wing displays a positive camber configuration housing the BLDC motors and the Electronic speed controllers.

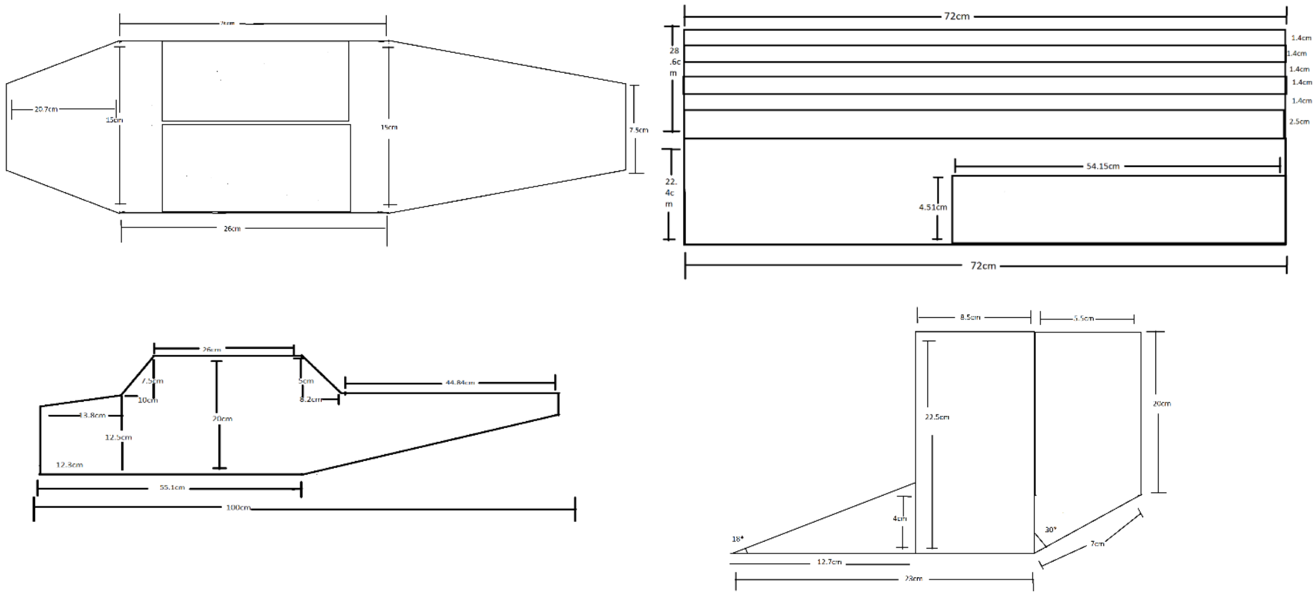


Fig. 2.1 Design Plans of the Aircraft

2.1 Wings

During the wing design process, eighteen parameters must be determined. They are as follows:

1. Wing reference (or planform) area (SW or S ref or S)
3 2. Number of the wings
4 3. Vertical position relative to the fuselage (high, mid, or low wing)
5 4. Horizontal position relative to the fuselage
6 5. Cross section (or air foil)
7 6. Aspect ratio (AR)
8 7. Taper ratio ()
9 8. Tip chord (Ct)
10 9. Root chord (Cr)
11 10. Mean Aerodynamic Chord (MAC or C)
12 11. Span (b)
13 12. Twist angle (or washout) (t)
14 13. Sweep angle ()
15 14. Dihedral angle ()
16 15. Incidence (I w) (or setting angle, set)
17 16. High lifting devices such as flap
18 17. Aileron
19 18. Other wing accessories

The aircraft designed has a zero camber.

3.1 Motors

3.1.1 Brush less DC electric motors

A brushless DC electric motor (BLDC motor or BL motor), also known as an electronically commutated motor (ECM or EC motor) or synchronous DC motor, is a synchronous motor using a direct current (DC) electric power supply. It uses an electronic controller to switch DC currents to the motor windings producing magnetic fields which effectively rotate in space and which the permanent magnet rotor follows. The controller adjusts the phase and amplitude of the DC current pulses to control the speed and torque of the motor. This control system is an alternative to the mechanical commutator (brushes) used in many conventional electric motors.

The construction of a brushless motor system is typically similar to a permanent magnet synchronous motor (PMSM), but can also be a switched reluctance motor, or an induction (asynchronous) motor. They may also use neodymium magnets and be outrunners (the stator is surrounded by the rotor), in runners (the rotor is surrounded by the stator), or axial (the rotor and stator are flat and parallel).

Fig:3.1.1 Brushless dc motor

The advantages of a brushless motor over brushed motors are high power-to-weight ratio, high speed, nearly instantaneous control of speed (rpm) and torque, high efficiency, and low maintenance. Brushless motors find applications in such places as computer peripherals (disk drives, printers), hand-held power tools, and vehicles ranging from model aircraft to automobiles. In modern washing machines, brushless DC motors have allowed replacement of rubber belts and gearboxes by a direct-drive design.

3.2 Servo motors.

Servo motors (or servos) are self-contained electric devices that rotate or push parts of a machine with great precision. Servos are found in many places: from toys to home electronics to cars and airplanes. If you have a radio-controlled model car, airplane, or helicopter, you are using at least a few servos. In a model car or aircraft, servos move levers back and forth to control steering or adjust wing surfaces. By rotating a shaft connected to the engine throttle, a servo regulates the speed of a fuel-powered car or aircraft. Servos also appear behind the scenes in devices we use every day. Electronic devices such as DVD and Blu-ray DiscTM players use servos to extend or retract the disc trays.

Fig:3.2Servo motor sg90

3.3 Electronic Speed Controller

The term ESC stands for “electronic speed control is an electronic circuit used to change the speed of an electric motor, its route, and also to perform as a dynamic brake. These are frequently used on radio-controlled models which are electrically powered, with the change most frequently used for brushless motors providing an **electronically produced 3-phase electric power** low voltage source of energy for the motor. An ESC can be a separate unit that lumps into the throttle receiver control channel or united into the receiver itself, as is the situation in most toy-grade R/C vehicles. Some R/C producers that connect exclusive hobbyist electronics in their entry-level vehicles, containers, or aircraft use involved electronics that combine the two on a sole circuit board.

Fig 3.3 Electronic Speed Controller

4.1GPS module

The GPS module allows for the tracking of the aircraft while in air or in an event of a crash. The module used for the project is U-Blox Neo M8N. It can be used with many concurrent navigation satellite systems, like GPS+GLONASS, allowing better performance.

Fig:4.1.1 GPS module N8M

4.2 Telemetry module

4.2.1 UAV Telemetry Module

The telemetry module mainly transmits various data and real-time videos of UAVs to realize the communication between the aircraft and ground pilot. The telemetry module can be divided into four types: data transmission module, image transmission module and data & image integrate transmission

module, and data & image remote controller. Data transmission module can only transmit UAV data, image transmission module can transmit real-time video of UAV, and data & image integrate transmission module can transmit UAV data and real-time video together. Figure and number integrated remote control has more remote control functions. Data & image remote controller integrates image and data transmission function in the remote control.There are two types of telemetry modes: point-to-point telemetry module and 4G telemetry module. Point-to-point telemetry refers to the direct paired communication between Sky terminal and ground terminal. 4G telemetry module uses Telecom operator network for UAV communication

Communications satellites are composed of a complex array of electronic devices that facilitate the receiving or sending of signals (known as the payload) with ground stations on the Earth, or support the operation of the satellite.

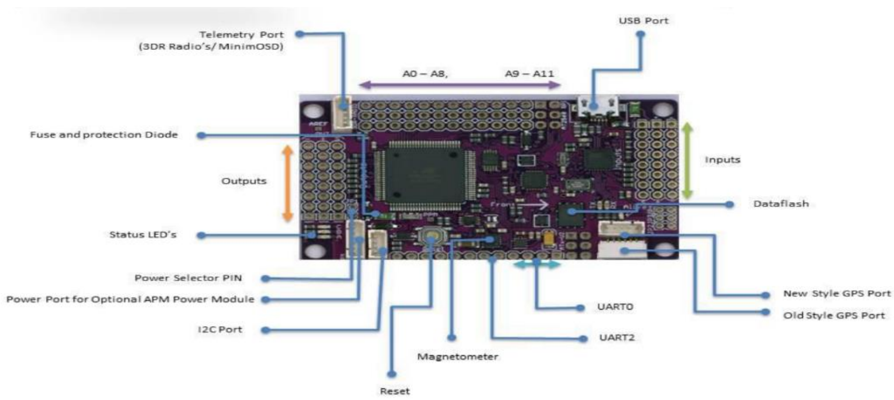
Fig:4.2 Telemetry module

5.1 Flight Controller

Physically, a flight controller is nothing more than a circuit board with electronic chips on them. You can compare them to the motherboard and processor in your laptop. The flight controller is the brain of a drone. A small box filled with intelligent electronics and software, which monitors and controls everything the drone does. And just like the brains of different organisms, flight controllers also vary in sizes and complexity. (picture of different flight controllers)

The ArduPilot Mega 2.8 is a complete open source autopilot system, it allows the user to turn any MultiRotor capable of performing programmed GPS missions with waypoints. The OS / Firmware for the APM 2.8 for Fixed wing aircraft's is Arduplane.

Fig:5.1 Flight Controller



5.2 Ardupilot Mission Planner:

Mission Planner is used to upload new firmware, for calibrating your APM 2.8 and checking and calibrating your radio. The Planner can also be used for following:

- Updating firmware
- Calibrating radio
- Calibrating horizontal and magnetic settings
- Setting up Attopilot Voltage and Current monitor
- Setting up Ultrasonic sensor
- Tuning PIDs
- Setting flight modes
- Mission Planning
- Ground Station

Most of the settings are explanatory, but the Planner is quite powerful and can be used for full ground station work or setting up full autonomous flight.

Fig:5.2 Mission Planner Software

6.1 Power Supply

LIPO stands for lithium-ion polymer battery or Lithium polymer battery. The abbreviation for this battery is Lipo, LIP, Li-poly etc. This battery is a rechargeable battery. It is a lithium-ion technology using a polymer electrolyte instead of a liquid one. These batteries provide higher specific energy as compared to other lithium battery types. They are used in applications where weight is a critical feature, like mobile devices and radio-controlled drones and aircraft. They have been gaining in popularity in the radio control industry over the last few years. Now, It is the most popular choice for anyone looking for long run times and high power.

6.2 Cell configuration and Battery voltage

Lithium polymer battery is constructed from the rectangular cells. You can increase the voltage of the battery using a series connection of the cells. Also, by making the parallel connection of the cells, the battery current will be increased. The nominal voltage of a Lithium polymer cell is 3.7V. The three cell (3S) pack is 11.1V, a four-cell (4S) pack is 14.8V.

Number of cells	Cut off voltage	Nominal voltage	Maximum voltage
1S	3.0V	3.7V	4.2V
2S	6.0V	7.4V	8.4V
3S	9.0V	11.1V	12.6V
4S	12.0V	14.8V	16.8V
5S	15.0V	18.5V	21.0V
6S	18.0V	22.2V	25.2V

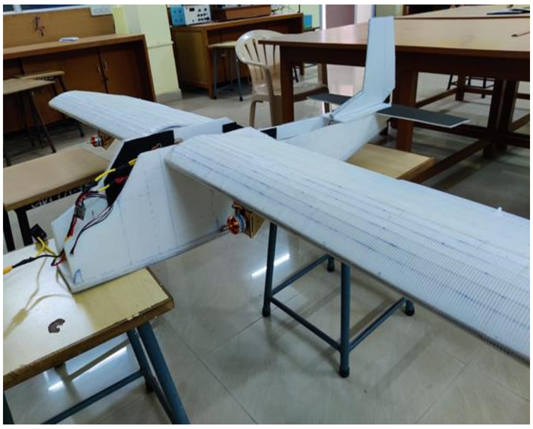
6.2 Cell configuration and Battery voltage

7.1 RESULT OF THE PROJECT

The project Aim's that **"UNMANNED AERIAL VEHICLE FOR RELIEF OPERATION"**

Wings:
The wing consisting of three types of camber
1.Positive camber
2. Negative camber

3. Zero Camber
In this drone we used Zero camber wing



An airfoil that helps lift a heavier-than-air craft. When positioned above the fuselage (high wings), wings provide an unrestricted view below and good lateral stability. Parasol wings, placed on struts high above the fuselage of seaplanes, help keep the engine from water spray.

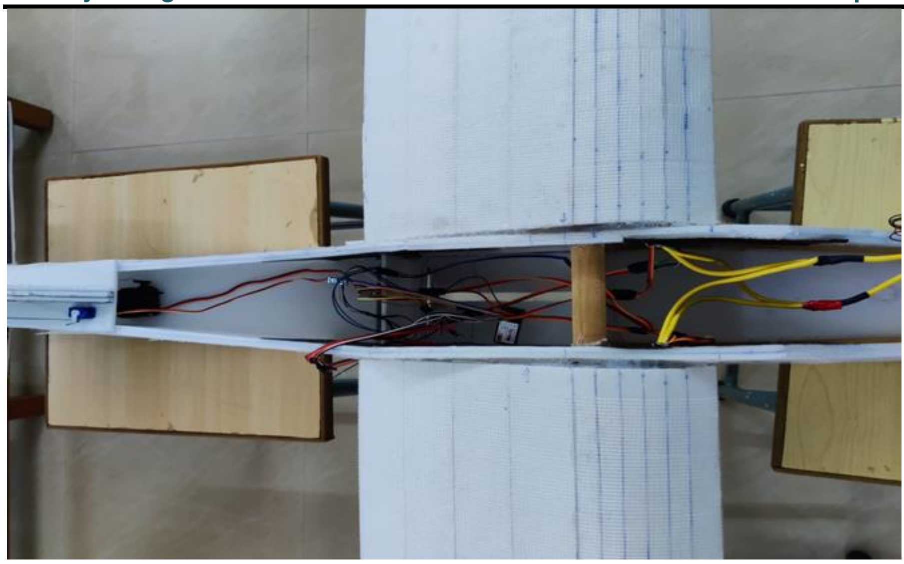
Elevator and Tail:

The elevator is for takeoff of drone in a runway.

The tail (or) empennage, also known as the tail or tail assembly, is a structure at the rear of an aircraft that provides stability during flight, in a way similar to the feathers on an arrow.

Fuselage

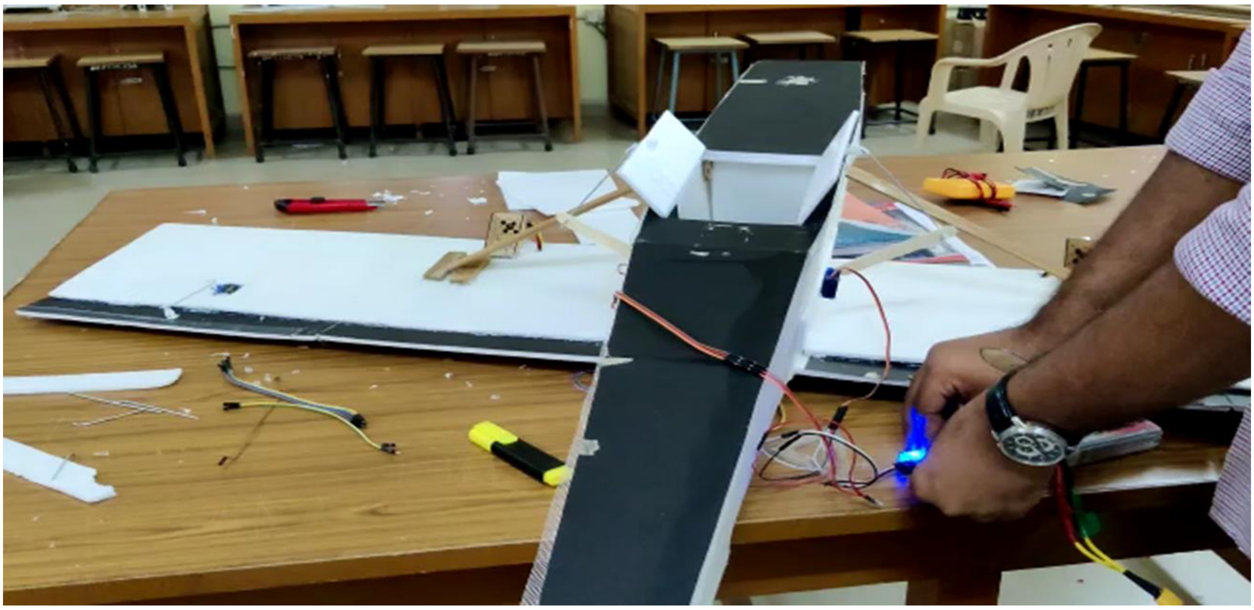
Fuselage, central portion of the body of an airplane, designed to accommodate the crew, passengers, and cargo. It varies greatly in design and size according to the function of the aircraft.



In a jet fighter the fuselage consists of a cockpit large enough only for the controls and pilot, but in a jet airliner it includes a much larger cockpit as well as a cabin that has separate decks for passengers and cargo. The predominant types of fuselage structures are the monocoque (*i.e.,* kind of construction in which the outer skin bears a major part or all of the stresses) and semimonocoque.

Hatch

Have you ever noticed a hatch on the roof of some aircraft? This looks a bit like an openable sunroof, but of course, it serves a much more important function. It is an emergency exit for the cockpit crew, as we explain here.



In our project the hatch is for dropping of food, medicines and hopefully organs etc,
The hatch is controlled by servo motors which is present underbelly of the aircraft.

III. CONCLUSION

The project aim's that "**UNNMANED AERIAL VEHCILE FOR REIEF OPERATION**" In the event of a natural disaster, the military is used for rescue operations and is split into two teams, one for rescue and one for relief thereby increasing the demand for manpower resources. In this scenario the additional manpower can be used to focus more on rescue operations there by saving the lives of hundreds of people, by diverting the manpower used for relief to the rescue operations. This project intends to do so by using unmanned aerial vehicles for relief operations by air transport of supplies to disaster affected areas and airdropping them to the designated drop zones. This would enable the delivery of ration food, medicines and hopefully organs.

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