Automated Drone Transportation System Incorporating Medical Emergency Supplies

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Abstract. As the medical sector has seen a big advancement the awareness among people and government to have proper infrastructure and a supply chain has increased since Covid-19. The availability of drugs and transportation has a good supply chain but in the emergency, the delay in the availability of treatment is also a big concern. Once a big factor is the traffic congestion in the country and this leads to the delay in the transportation and causes several lives. Drone technological advancements may play a significant part in this system. As 30% of accident deaths and 50% of heart attack deaths are due to delays in treatment caused by traffic congestions and Ambulance cannot reach on time. The proposed drone in this project is designed in a way to carry the medicinal requirements for first aid treatment, can carry all types of blood components for blood transfusion, and is designed with a piece of special defibrillator equipment that can provide electric shocks and used to initially treat heart attack patients. The designed medical drone can provide the initial treatment by reaching them through airways as soon as possible and this initial treatment can prevent the patient from getting into critical conditions and get the valuable time to transport them to the hospital post the first aid treatment. The design and infrastructure of the model drone are made with advanced and lightweight components with a carrying capacity of 3-5kg so that the medical equipment can be carried. The system is automated using Mission Planner software to make the drone reach the precise location automatically. The GPS module determines the current position and travels to the desired location. They can be manually controlled with a remote controller and viewed by the camera fixed over the drone. They can trace back to the location automatically. The display over the drone instructs and demonstrates the video of the operation of the equipment. This simplifies equipment operation and eliminates the need for a trained professional.

Keywords: Medical Drone, Automated transportation, First aid treatment, Easy operation, Reduces the risk due to delay of the ambulance, Life-saving, Airway transportation.

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1. Introduction

In a country like India where the per capita of vehicles is very less compared to another country due to the high population and poor infrastructure, traffic congestion has been a big concern. This has a direct impact on the delay in the ambulance and first aid treatment in emergencies. 30% of the accident deaths in India occur due to delays in ambulances and 50% of the heart attack deaths in India occur due to the lack of first aid treatment in the initial hour known as Golden hour. To reach the patients in the initial golden hour and increase the survival rate additional medical drones can make up the delayed ambulance time. These medical drones can reach the desired locations with the necessary equipment and medicines according to the type of emergency. They provide essential medicines that are needed to be given initially to stop the patient from reaching the critical condition. Blood transfusion has a major role to play in treatment for critical conditions, these drones can carry the required blood and minimize the travel time and the risk of being delayed due to traffic. These initial treatments do not require a doctor any individual who can read and understand can treat the patient with the demonstration video played on the screen in the drone. Especially for heart attack cases, the drones carry injections and tablets for mind cases and when the patient is serious and not able to be paralyzed defibrillator machine that provides electric shocks to the patient will be also attached with the drone. These first aid activities save the patient from reaching critical condition and get some more valuable time to reach the hospital. The drones are built in such a way to carry 3-5 kg of weight which is more than sufficient to carry this equipment and medicines. The drones can be controlled both automatically and also manually to make the tit reach the precise destinations. It is based on the GPS module and provides a more exact route to the destination. They are also lightweight and tiny, allowing them to fit into tighter spaces. These advanced technologies while in implementation can turn out to be lifesaving.

Problem statement

The country is facing more traffic congestion due to the increased number of vehicles and also the poor infrastructure. This traffic congestion leads to delays in the ambulance and first aid services to the patient by roadways. 30% of the road accident deaths are caused due delays in ambulance service and 50% of heart attack deaths occur due to lack of treatment in the initial hour. Rural areas and Primary healthcare centers lack proper treatment facilities and the availability of medicines is also a big concern. Transporting the patients may cause therapy to be delayed. The transportation of blood from the nearest blood bank is also a major challenge. Roadway transportation is facing a huge setback due to the unexpected traffic congestions and the delay in the complete progress.

2. Literature review

[1] 1st Joseph Christopher Fancher Et. Al (2017) in Drones for Medical Supply

In the U.s, drone technologies have the ability to influence the environment, society,

and people's everyday life. After conferring with the FAA, standards were created, including a max drone altitude of 500 feet and an air traffic management network based on current cell information systems. The agents can be blasted, seedlings, powders, etc., using the unmanned aircraft's flying platform (fixed-wing, single rotor, multi-rotor) composition, GPS flight control, spray bodies of three sections, and remote control or GPS ground flight control. Oil-dropping plant protection agents and plant protection spraying drones are the two types of plant care drones sold in China.

[2] 3rd Apurv Saha et al. (2017) in FPV Drone with GPS for Remote Region Imaging and surveillance

States Mostly in United States, drone deployments have the ability to influence the economic, community, and people's daily lives. Amazon, DHL, and Google are also the top three businesses looking into commercial drone applications. Google has just been looking into commercial drones and disaster aid. After conferring with the FAA, regulations were created, including a maximum drone altitude of 500 feet and an air traffic management system based on current cell communications infrastructure. The agent can be discharged, seeds, particles, etc., using the unmanned aircraft's flying platform (fixed-wing, single rotor, multi-rotor) composition, GPS flight control, spray bodies of three sections, and remote control or GPS ground flight control. Improved planting drones are sold in two forms in China: oil-dropping plant protection agents and plant protection.

Objective

To devise a system that will alleviate present traffic and infrastructure issues. To develop a prototype that can reach the required destination as soon as possible and carry necessary equipment and details. Gathering information and details, collecting literature review data and designing a system and model for them to execute the idea in real-time application. Develop a manual and automatic control drone to precisely reach the locations.

Components

The parts required to create the drone with the aforementioned standard are as follows::

A. S500 Multi-Rotor Air PCB Frame.
B. T-Motor 60A Flame ESC.
C. Propellers
D. Flight Controller.
E. GPS Module 4
F. Power Module.
G. Anti-Vibration Shock Absorber.
H. T Motor U Power U5 400KV

I. Digital Telemetry Drone Remote Control with Pro Receiver
J. 5200mah 4S 40C (14.8V) Lithium Polymer Battery Pack (Lipo)

A. S500 Multi-Rotor Air PCB Frame

The Multi-Rotor Air PCB Frames are the upgrades of the early Quadcopter F450 Frame. It is built on the succession of the F450 Frame and has all its merits. Its frames are upsweep slightly; this produces a dihedral effect that makes the quadcopter very stable especially when descending from a higher altitude. The carbon fiber rod makes the structure strong by running through the center making it equally balanced.

B. T-Motor 60A Flame ESC

These motor drivers have special core multirotor controllers they improvise greatly on the response provided by the throttle. Comprises customized tailored software for disc-type motor compatibility. They consist of all settings except timing which makes them more intelligent and adaptive. Optimized to work with a variety of flight-control systems that operate at a frequency of up to 600Hz.

C. Propellers

Orange HD Propellers Carbon Fiber Black is a specially designed high-quality propeller of multi-copter. These Propellers have a 15-degree angle and are lightweight with high strength designed at the end of the propeller to avoid whirlpool during the flying of the multi-copter. These would be found in multi-copters and drones alike. Thesepropellers have high flexibility and endurance and they help to improve air-powered efficiency and stability.

D. Flight controller

The latest upgrade of the flight controller is designed and developed to optimize the full drone code stack. It features a smaller form factor, computing more power, and with high ram feasibility. It is also equipped with sensors with higher temperature stability, integrated vibration isolation, and extra ports for better integration and expansion.

E. T MotorU Power U5 400KV

This U5 400KV T motor is waterproof and dustproof, making it excellent for multi-copters weighing 3 to 8 kg. Its unique side hole design provides swift airflow and cools 2.5 times faster than other motors. It is equipped with an oxygen-free copper coil that can withstand up to 180 degrees Celcius to enhance short circuit resistance. Siliconsteel sheet precision at 0.2mm standard height reduces heat and eddy and improves efficiency. The service life is over 1600 hours trouble-free.

3. Methodology

The methodology to build the drone which can be operated both automatically and manually is explained in this segment. The operation of the system is divided into two parts: the transmitter and the receiver. The transmitter section consists of a device for the signal transmission that controls and varies the operation of the drone according to the command given by the operator. The receiver section makes u the body of the drone where the flight controller act as the main component to which all the other components like GPS module, Motor Driver and Battery.To automate the system, the GPS module is linked to the application. The location chosen on the application directs the drone in which the flight controller commands the motor driver and motor to control its rotational direction. The rotation of the motor for uplift, left and right direction will be already programmed and the flight controller implements according to the command given. The manual control operation of the drone will be done using the remote controller with the view provided by the camera over the end of the drone.

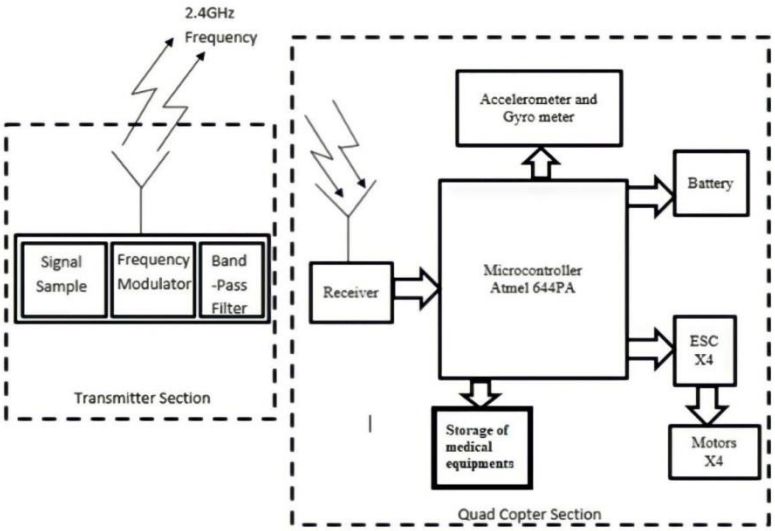

Fig. 1 Block Diagram

The storage unit for medical equipment has been attached to this drone. The storage unit can carry Red Blood Cells, Plasma, Platelets, Vaccines, and Injections that required a particular temperature storage unit. The other section of the storage unit contains emergency medicines according to the need. Medical equipment named Defibrillator is the main component attached to the drone which can be used as first aid treatment during heart

attacks.

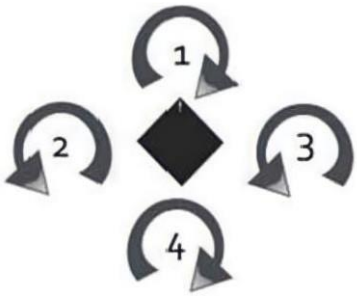

Fig. 2 Initial rotation of wings

Software used

The entire system is controlled both automatically and manually. The automated model needs to be connected to the GPS module and be programmed and connected to the application to make automation possible. Mission planner is the software used to program the flight controller and the location set on the application will be directed by the flight controller to reach the location. The change in location or destination can be controlled by the application and the operator will be able to terminate the application and also control it manually using the remote controller. It is also possible to trace the direction, time, and distance.

Modeling and Analysis

This is the prototype model in the above-mentioned specifications designed and executed in the way to lift 3kg of weight excluding the drones components weight. The model is complete with all structural and program modifications and is ready to carry and fly.

Fig. 3 Prototype Model

4. Result and Discussion

The result of the test analysis shows that the drone can fly both automatically and manually and can reach the precise location within a 2 km radius. The drone can fly approximately 70 - 100 meters high with a speed of 80- 100km/h at the maximum. The 4 motors of the quadcopter produce a torque of 6000 that can carry 6kg of weight. The drone weighs about 1.6kg and it is noted that the drone takes twice the amount of torque of its weight to lift itself. So out of the torque produced for 6kg 3.2ks is taken up by the drone itself and it can carry an external weight of 2.7 kg.

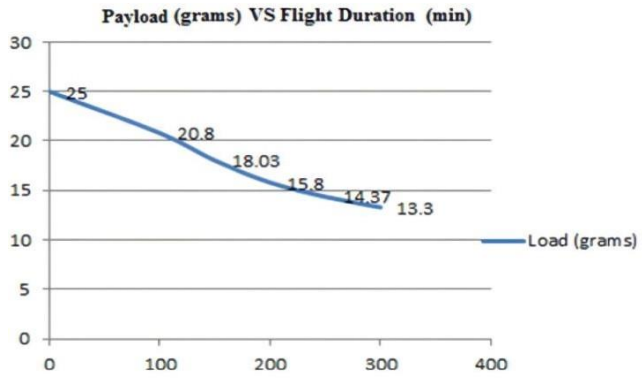

Fig. 4 Payload vs Duration graph

Future scope

Drones seem to be on the verge of revolutionizing the transportation and delivery systems. In 2025, it is expected to be a 45 billion USD business. The medical sector is set to see a huge transition as the not contact treatment and social distancing as becoming a part of life. The roadway delay and the quick availability of the system will be more favored and a proper systematic format for running these under control can revolutionize the future of delivery and transportation of lightweight objects.

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