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AUTONOMOUS UAV BASED DELIVERY SYSTEM FOR HOSPITALS

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Abstract - *Advancement in technology has revolutionized medical field. Unmanned aerial vehicles (UAVs) are the next wave of technological advancements that have immense potential in the medicine field. The utilization of UAVs has been piloted in various medical fields due to their great flexibility and price efficiency. The aim of this paper is to develop the prototype of UAV which may be controlled manually and also in autonomous mode using GPS module and Radio telemetry especially for Hospitals and Healthcare purpose. The system contains Hexacopter drone, Integrated GPS module and Radio telemetry for long distance controlling and data transmission, remote for manual flight operation and Pick and drop function to deliver the payload. It also includes the PC software for drone and controller interface and smartphone application to the controller through Bluetooth. In autonomous mode UAV is controlled by employing GPS module, Radio telemetry and Mission planer software. The presented prototype of the UAV is capable of intelligent remote waypoint navigation. Through the Interfacing software user can give waypoints for the UAV to navigate. UAV coordinates with the flight pattern given by the user to perform the delivery task. The aim is to be ready to efficiently deliver blood samples, medicines, vaccines, Automated external defibrillators (AEDs) and likewise during a short period* of time *compared to road transport, just in case of emergencies.*

Key Words*: *UAV, GPS, Radio telemetry, Waypoints Hospitals, Healthcare, Delivery

1. INTRODUCTION

The unmanned aerial vehicles (UAV) (commonly mentioned as a drones) are unmanned aircraft systems without a pilot on board and capable of carrying a payload. UAVs are a becoming a major part of an unmanned aircraft system. The system includes a UAV, a ground based controller, and a software for communications between the UAV and ground based controller. The flight of UAVs may operate with various degrees of autonomy: either manually (through remote by an operator at the ground station) or autonomously by onboard controllers and computers.

UAVs are originally developed for military uses and from last decade, they are making their way into the overall public and the personal sector. Nowadays, we are already using UAVs for disaster management, search and rescue operations, and crop; monitoring, weather tracking, aerial photography and much more. UAVs are often flown autonomously and can reach to almost any geographical location, therefore the importance of UAVs are rapidly increasing within the medical field.

In many countries, delivering medical supplies like vaccines and medicines by road transport is very time consuming and also use of air transport like a helicopter is extortionate therefore drones are a very affordable alternative to any transport just in case of medical emergencies. The facility of drones to accumulate real-time, high-resolution temporal, spatial information, Fast reaction time and thus the power to navigate at low cost makes them viable and attractive medical delivery platform.

Fig-1: Actual system

2. MANUAL FLIGHT OPERATION

The UAV can be controlled manually by using a transmitter and receiver. The components are connected to the Arducopter and the receiver which is the remote control of the UAV. This mode of flight has a range of 500m because of the range of the remote control. We can use the autonomous mode for longer ranges. Manual operation should include information about the specific mission, which will be completed with the help of UAV, to ensure a safe operation. Manual operation is used to perform checks and balances.

Fig -2: Block diagram of Manual flight operation

Fig-3: Interfacing with receiver

3. AUTONOMOUS FLIGHT OPERATION USING GPS

There are various software that are available in the market using which UAV can be controlled autonomously. We are using "Mission Planner" software to control our UAV from ground stations. The two important elements of this autonomous flight operation are Global Positioning System (GPS) and Radio telemetry. The radio telemetry kit which we are using is 3DR radio telemetry kit which allows users to establish telemetry connection between computer and drone. The serial board module of radio telemetry kit is mounted on a drone and the USB is connected to a computer on the ground station. The GPS module will be connected to the Arducopter and Arducopter will be connected to Mission Planner software so that flight path can be entered. By using GPS module the drone is able to locate itself in terms of latitude, longitude and altitude and Radio telemetry is used for long distance communication and data transfer. The GPS module is set up at the top of drone at some height from the Arducopter (which is our flight controller) so that there is no signal interference. The number of waypoints can be decided by the user and height of waypoints can be different at different positions. If drone in the autonomous flight mode faces latency or range issue, then it returns back to its home location.

Fig -4: Block diagram of Autonomous flight operation using GPS

Fig -5: Waypoint selection of Autonomous flight

4. CONTROLLING UAV THOUGH BLUETOOTH

To control drone through Bluetooth by using smartphones, we have developed an Application named as 'Medic Drone' for smartphones using MIT app inventor. It's a open-source and free software originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It uses block coding method which allows users to drag and drop visual objects to make an application which will run on mobile devices. Through this app user can control flight operation of drone through Bluetooth. The each button in the app is programmed for UAV to move on up, down, left, right, forward and in backward directions using block coding programming method.

Fig -6: Layout of Medic Drone Application

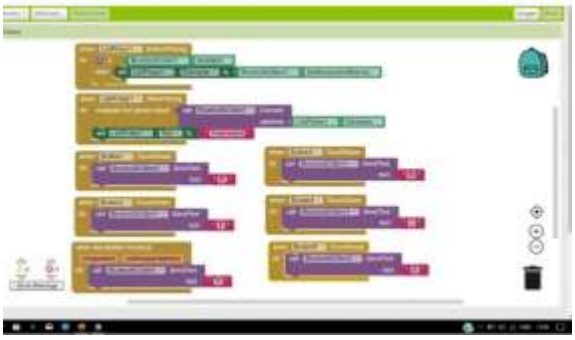

Fig -7: Block coding of Medic Drone Application

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5. PICK AND DROP FUNCTION

UAVs can be used for medicine, vaccine, blood package delivery and medical emergencies, etc. In this system we are adding a new function pick and drop which can be used for Hospital delivery, to carry small emergency medical equipment and medical to deliver medical supply in remote areas. In this system we are using two separate modules, one for pick and drop and another for less than drop function. This function can pick any medical equipment such as defibrillator, blood samples or any other object of maximum load of 1.5kg and can drop it wherever it is desired. In emergency conditions where ambulances can't reach due to traffic this function can be used for drop facilities by using separate modules which can lift any payload such as medical equipment, blood samples up to 1.5kg.

Fig –8: Module for Pick and Drop function

6. 3D PRINTED DESIGNS

In this system we use 3D printed design for various purposes such as a GPS module stand to reduce the signal interference of Arducopter and GPS module and UAVs stands to reduce the weight of UAV because it can use minimum battery and helps motors to produce maximum thrust. To make 3D design we use "Investors" software, and after designing to 3D printing those models we have used "Flashprint" software which is designed for 3D printers. After models are ready they're printed in 3D printer. Such objects help to minimize weight and helps UAVs for maximum thrust**.**

Fig-9: 3D printed designs

7. CONCLUSIONS

The implementation of the medical delivery system using drones would be helpful to an enormous amount of people in remote areas and also to hospitals. The UAVs can be used to deliver healthcare things in rural areas and to the nearby Hospitals and also they have the ability to reach victims who require immediate medical attention within minutes which in could mean the difference between life and death. They can transfer medicine within Hospital walls and can couriers blood packages between Hospital buildings. UAVs offer a variety of exciting possibilities to the healthcare industry that will help us to save money as well as the lives of people.

The aim of our project was to apply engineering principles and design a drone to improve medical accessibility. The proposed prototype of the drone will be very beneficial for delivery of various medical products in Medical field. Because of the drone's Hexacopter design, payload capacity and Pickup-drop mechanism, the transportation of medical and biological components is easily possible. The project provides insights on the drone based delivery system. The team successfully designed and built a drone with a Pickup-drop mechanism for transportation of medical supplies. The design and testing of the UAV, hence, has successfully demonstrated the feasibility of using medical delivery drones in healthcare and hospitals.

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