Design and Development of Autonomous Delivery Drone

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Abstract - Drone is an Unmanned Aerial Vehicle which can be controlled manually, or it can fly autonomously. During pandemic the delivery of products became very tough because contactless delivery is very difficult. In this paper we propose a drone which can fly autonomously and can deliver the items without making any person-to-person contact. The proposed drone can fly around 100 meters and carry weight of 500 grams. An Ultrasonic sensor which is interfaced to the drone helps in avoiding the obstacle in range of 50 cm.

Keywords - Autonomous, Contactless Delivery, Drone, Obstacle Avoidance

I. INTRODUCTION

Drone is an Unmanned Aerial Vehicle (UAV) which is a flying object without a human pilot. It can be controlled by the remote control which is operated by the pilot who is on the ground or in another vehicle. It can fly autonomously also. The drone technology has seen an increase in consumer popularity, growing in market size from 2 billion USD in 2016 to 22.5 billion USD in 2020 [7].

In recent times Drone has been used for many applications like military, security, surveillance, and delivery services. The Drone executes the mission autonomously or by remote control with the command with a companion Personal Computer. Autonomous drones are deployed in variety of applications including sanitizing entire towns, which we have seen during the COVID-19 pandemic. Based on the input received from the user, the flight controller controls the operations of a conventional drone.

The drone can locate and navigate to destination through google map. Without human help drone can navigate automatically by on board computers. It helps in faster transport of goods, reduce the fuel cost of vehicles. Drones are used to carry medicine in covid 19 pandemic. It is very useful in covid pandemic where it is useful to carry medicine in Emergency purpose. Drone delivery system will track live location of consumer and help to deliver the products. Global Positioning System (GPS) helps to find the consumer present location. Nowadays online delivery has become more trend in E-commerce like Amazon, Flipkart etc. But with the help of drone, it is easy to deliver the products.

II. LITERATURE SURVEY

There are few literatures in which applications of drones were discussed. In [1] Md R Haque, M Muhammad, D Swarnaker, M Arifuzzaman designed a drone as a low weight and low-cost. This UAV is capable of autonomous flight to deliver parcel which are ordered through online. This UAV uses an android device as its core. To locate and navigate destination, this drone used the Google maps. Raspberry pi is used as a control board for the drone and GPS was Allocated, as well as Android device is used. No Algorithm is used and it is managed with only Hardware. This drone can able to carry 1kg payload and power of 360rps and range is up to 5km.

In [2] Anand Met al., implemented to interface a companion PC (Raspberry Pi) with an autopilot system. Authors established short range telemetry communication between the two using Bluetooth modules. Here, control board is Raspberry pi with an autopilot system. HC-05 modules are used to transmit and receive data and use mobile application of Q Ground Control to perform remote operations such as arming and changing of modes. Authors conducted a test flight that performs autonomous navigation and landing.

In [3] Aurello Patrik et al., proposed the development of navigation systems of autonomous drone for delivering items that uses a GNSS (Global Navigation Satellite System) and a compass which are used in drone. The drone was controlled by the GNSS, Navigation systems. A relatively small positional deviation was observed.

In [4] Arme Devos, Emad Ebeid, Poramate Manoonpong aimed at protection of the drone. The drones may enter into deadlocks and corners which are considered as the complex situations. This method protects the drone from entering in complex situations. The developed algorithm has been validated through simulation and for infrastructure inspection, the algorithm which is newly developed is used. They used Pixhawk 2 as the flight controller for control board to the drone,

along with Computer vision techniques for obstacle avoidance. Two neuron recurrent network(LADAR Sensors) for obstacle detection and to avoid them. Eventually, the duration of this drone is 30 min.

In [5] Jeevan G Murthy et al., built drone to deliver products to required destination. The one-time password is used for security Enhancement. It has run time of 30 mins, with payload of 1kg and power of 360rps and range is up to 5km. Use of this will enables faster transport and goods which will enable timely delivery and also reduce fuel cost of vehicles.

In [6] Inkyu Sa et al., built a cost-effective and research-grade quadrotor. Control board is Intel NUC 5i7RYH [i7-5557U, 3.1-GHz dual cores, 16-GB random-access memory (RAM)]. Algorithms used is visual-inertial (VI) odometry-aided vertical takeoff and landing (VTOL) platform root-mean-square (rms) pose errors, drift error of the total flight distance, total system mass is 3.62 kg, and 1.27-kg payload Flight time 12 mins can fly up 15m the state estimation and control performance of the drone.

In [7] Thomas lee, Susan Mckeever, and Jane courtneyz developed drone with the Deep Learning approaches using computer vision applications. Significant strides have been made towards vehicular autonomy. Autonomous Navigation and obstacle avoidance were used to navigate the drone. One drawback of this work is lack of uniformity of metrics in the domain.

In [8] Victor R. F et al., developed a model which mainly aim at reproducible safe landings in urban areas which is a critical challenge. In that respect, an Extended Kalman Filter (EKF) algorithm was proposed that fuses planar visual marker and ultrawideband (UWB) localization strategies with the drone's software pose estimation to improve landing accuracy. First, confirm that you have the correct template for your paper size.

III. PROPOSED METHOD

In this paper, a Delivery Drone is proposed which can automatically fly from source to destination based on the geographic co-ordinates system of the source and destination. This drone can carry the goods which has to be delivered to the people at the destination.

The circuit diagram of the proposed method is given in Fig.1. This drone consists of four motors connected to the frame body at the same distance from each other. Two motors rotate in clockwise direction and the other two motors in anti-clockwise direction to provide thrust to lift the drone in the air. Due to the differences in motor technology, different Electronic Speed Controllers (ESC) are required for drones with brushed motors and those with brushless motors. Drone has an ESC for each rotor which handles the rotor with one system.

The drone was calibrated using the Mission Planner. For the calibration the Arducopter flight controller Mission Planner is used. The mission instructions is programmed by providing the destination co-ordinates to the Raspberry Pi. Then the controller sends location details to the Global Positioning System (GPS). The GPS location is referred as a waypoint.

As per the commands, the Drone behaves i.e., how to takeoff, landing and fly to specific location automatically according to the programmed instructions. The ultrasonic sensors are used for the obstacle detection and precision landing.

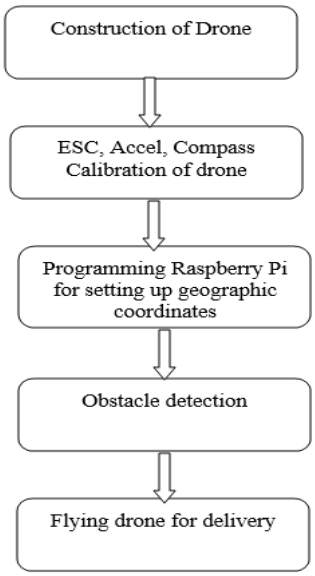

Fig 1. Flow Diagram of the Proposed Method

Fig.1 shows the flow diagram of the proposed work. As per the flow diagram, the drone is built first as per the Fig.2. The block diagram of the drone is shown in Fig.2. The built drone is shown in Fig.3. The drone is built by four arms like X shape. The motors with Propellers are used for Flight operation. The Motors speed is controlled by the Electronic Speed Controller (ESC). The ESC calibration is done using the mission planner software. Accelerometer calibration is to initialize the axis parameters of the drone. Using compass calibration, the coordinates of the drone are initialized GPS

module. Radio calibration is used to bind our remote to the drone and give the parameters about the remote-control levels. Radio calibration can be done if drone is controlled by remote controller. The main brain of this System is Arducopter Flight Controller. After Building of the drone, the Ultrasonic Sensor is interfaced for obstacle detection. Raspberry pi is the Heart for this system and it controls the Arducopter with programmed instruction along with it. The destination for the delivery drone is set using GPS module.

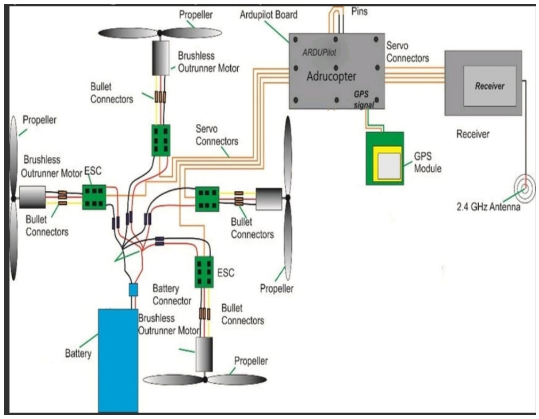

Fig 2. Block diagram of the built drone

Fig 3. Built Drone

Fig 4. Drone with Carrier

IV. EXPERIMENTAL RESULTS

The drone is designed and developed. A carrier is attached to the drone as shown in Fig. 4. The proposed drone could carry the payload of 500 grams. The built drone could fly around 100 meters. As per the geographic coordinates given, Drone reaches the required destination and delivers the package. The ultrasonic sensors are interfaced to the drone as the primary purpose is to measure distance of any object with in 50cm range. The ultrasonic sensors are responsible to measure how close the obstacles are from the drone.

V. CONCLUSION AND FUTURE WORK

In this paper an autonomous Drone which can be used for delivery of objects is proposed. The drone can carry a weight of 500 grams and it can fly around 100 meters from source to destination as per the geographic coordinates given. The proposed drone can reduce delivery time. The drones can be used to carry medical supplies and other products to remote areas with less time. In future the drone can be made to fly more distance. The autonomous flying can be done by artificial intelligence.

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