



QUADCOPTER FOR DELIVERY USING IoT

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Abstract: This project aims to infuse the IoT technology to build an autonomous quadcopter. Internet of Things is a wide area comprising of sensors, actuators and cloud platform. The devices that collect the data and exchanges them through the network is termed as IoT. The project is about developing a quadcopter with autonomous feature using IoT sensors mounted on the quadcopter. The term autonomous means that no human intervention is needed to control the quadcopter. The quadcopter can be controlled from both an RC transmitter and an android device. The quadcopter is designed in such a way to provide the users with little or no work in controlling the quadcopter.

Keywords: Bluetooth, Global Positioning System, and Unmanned autonomous vehicles, Raspberry pi

I. INTRODUCTION

Unmanned Aerial Vehicles (UAVs) have gone through a global boom in recent years due to their increasing accessibility. Quadcopters in particular, with four rotors, have favorable characteristics for many applications such as infrastructure inspection, asset monitoring and surveillance, due to their ability to hover and take-off and land vertically. Events such as the 2011 Christchurch earthquake have benefited from their use inside dangerous seismic locations. However, UAV localization remains a significant challenge, especially in confined or GPS denied locations. Positioning the aircraft relative to another object is a common task that is difficult to achieve.

Here, an autonomous quadcopter controller is presented that is able to track and maintain a desired relative location to a static object. This is achieved with a monocular vision system with the entire computational processing completed on board the UAV. As a consequence, the UAV is designed to operate in infrastructure free environments, providing increased efficiency, autonomy and safety.

Figure 1 shows the basic IoT functional diagram system intended to be an IoT server or system is comprised of a number of basic functional blocks to promote various functionalities of the system such as sensing, identification, automation, communication, and management like any other automated industrial robot

II. LITERATURE REVIEW

Prof. A.V. Javir, Ketan Pawar, Santosh Dhudum, et al. [2], this paper focuses on the aerodynamic effects of a quadcopter and addresses all the aspects of quadcopter ranging from mechanical design to the components used. It provides backup to the selection of different components with the help of various formulas from research papers. It also gives clear results with respect to weight of components and their corresponding costs.

Yiwen Luo, Meng Joo Er, et al. [3], presented an approach to develop an intelligent control and navigation system of an indoor quadcopter. It documents developing a stabilized flying control system with low cost components such as the budget friendly Raspberry Pi computer including traditional PID controller, and electronic speed controller developed to provide the basic platform for the quadcopter. PID tuning is utilized to optimize the overall performance. Also, RGB and depth cameras and other sensors are deployed to enable remote semi-autonomous control.

Gordon Ononiwu, Arinze Okoye, et al. [4], this paper presents the design and implementation of an aerial surveillance quadcopter for search and rescue applications. The first phase of the paper considered modelling of the

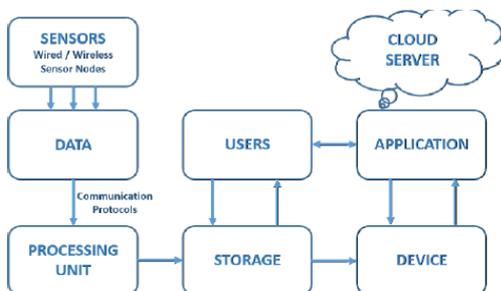


Figure 1 Basic IoT Functional Blocks



quadcopter while the second phase involved system implementation and simulation. It results in surveillance and reconnaissance quadcopter which can take the photographs from environment captured through the aid of the on board mounted camera while live streaming with the help of laptop during flight.

Prabhjot Singh Sandhu [5], presents a method for the development of low cost, reliable, accurate intelligence, surveillance and reconnaissance technology (ISR). The live video transmission can be utilized to generate a 2D map of the area using MATLAB, overlaying two maps made at different times which can be useful to trace changes that have taken place in the area. The developed platform can further be used as a low cost alternative to carry out explosive detonation of army targets with very high level of precision.

A. Samba Siva, B. Prudhviraaj kumar, et al. [6], this paper presents the research and development of a Mini Unmanned Aerial vehicle. Unmanned aerial vehicles offer advantages for many applications when comparing with their manned counter parts such as military and disaster and rescue operations, and survey and monitoring the weather conditions. They preserve human pilots of flying in dangerous conditions that can be encountered not limited to military applications but also in other scenarios involving operation in bad weather conditions, trees, or near to buildings, infrastructures and other obstacles.

Vimal Raj, Sriram, et al. [7], this paper addresses the design and development of an inclined arm quadcopter for mini payload and long-time endurance. In the inclined arm UAV the arms are inclined with respect to motors. For this design the thrust, maneuverability, forces acting etc. are evaluating

It Nun Thiang, et al. [8], this paper presents a simple and effective vision algorithm designed by using color object tracking method to track the moving objects based on an on-board cameras. The vision tracker also supports the position error between the drone and the object in real time in order to control the drone. The information obtained from vision algorithm is used to control roll angle and pitch angle of the drone in the case using bottom camera, and to control altitude and the yaw angle of the drone when the front camera is used as vision sensor.

Ramamoorthy Luxman, et al. [9], the proposed work demonstrates building a quadcopter driven by human gestures. This paper also demonstrates a MATLAB framework, to simulate and analyze the performance of a

quadcopter designed with back-stepping integral controller. It gives a synopsis of the controller used in ETH OS4 quadcopter and presents an easy to use GUI to tune the controller while designing the quad-rotor.

Mr. B. Vinoth Kumar, et al. [10], this paper presents a design for quadcopter that can automatically detect and take initial steps to stop gas leakage in vulnerable premises by alerting them. In particular gas sensor has been used which has high sensitivity for methane (CH₄) and LPG. The system consists of Gas leakage detection module which warns by sending information and by alarm.

Alex G. Kendall, Nishaad N. Salvapantula, et al. [11], in this paper, the development of an object tracking controller for a quadcopter using an on-board vision system is presented. A low-frequency monocular computer vision algorithm is applied in closed-loop control to track an object of known color. It could be used to locate a target object efficiently.

III. PROBLEM DESCRIPTION

There are several problems faced in while carrying out rescue operations. It is costly to carry out a rescue operation as it requires many resources and expenditure. Large number of skilled manpower is required for operating rescue missions and it is hard to provide food for peoples. Topographical aspects may vary from place to place thus putting additional human efforts. Emotions such as fear, nervousness and tension can lead to wrong judgement which may lead to fatal accidents. Unfavorable conditions such as bad weather, land sliding, earth quakes could pose as a threat while trying to save people.

IV. METHODOLOGY

The initial step would be to create a chassis (frame) where raspberry pi, the main component would be mounted. Lithium-Polymer battery will be used as they have the best ratio of weight to power. Motors would be used to spin the propellers. Using accelerometer and gyroscope, Electronic Speed Controller (ESC) unit will control the four motors and provide stability to the quadcopter. Remote Controller (RC) will provide input to the Quadcopter.

A. Quadcopter flight dynamics

For controlling the altitude a remote controller (RC) is used. When the controller of the quadcopter is moved up or down the propeller speed is adjusted causing the quadcopter to gain or lose altitude. Thrust is a type of force. When a system accelerates mass in one direction, the accelerated mass will cause a force of equal magnitude but



opposite direction on that system. The force applied on a surface in a perpendicular direction or normal to the surface is called thrust.

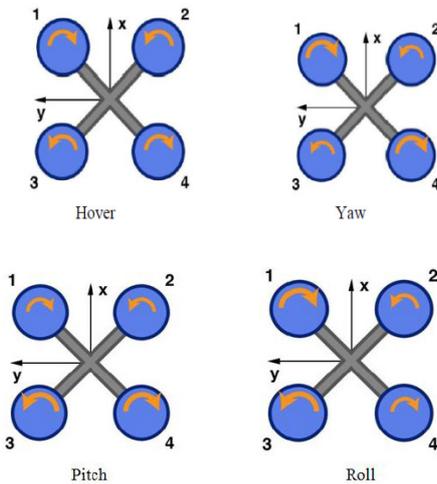


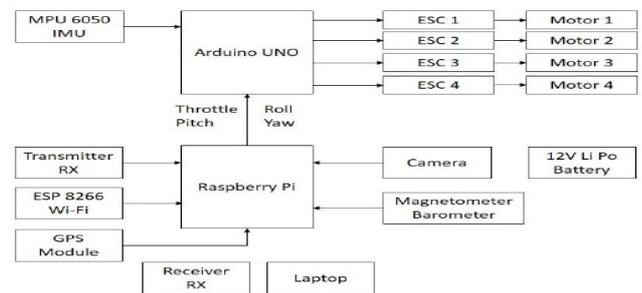
Figure 1: Quadcopter flight control

V. PROPOSED WORK

When it comes to take on rescue operations, it becomes difficult for the rescue team to go to a specific place to reach out for help. To provide a solution to this problem drones can be used. Drones are of many types which are used for various kinds of purpose. Drones have an advantage as they require limited space. As the technology is getting advanced it is possible to construct a small scale quadcopter. The aim is to construct a very compact size drone which will go to places having unfavorable conditions where a human cannot go in person and provide audio as well as visual aid. This will further facilitate rescue missions held in hostile territories.

A. System Architecture

The purpose of the work is to control a quadcopter from a distance by using a computer or RC. The quadcopter movement and control will be carried out by the raspberry pi. The model consists of two blocks which is mentioned below. The quadcopter is command through the raspberry pi from the computer side block. The command signal will be transmitted wirelessly from the trans-receiver of computer/remote controller side block to the trans-receiver of the quadcopter side and the quadcopter will move accordingly. The quadcopter also includes some features like camera, navigation, etc. All these features are also controlled by the raspberry pi.



B. Technology

The main components used for construction of a quadcopter are the frame, propellers (either fixed-pitch or variable-pitch), and the electric motors. For best performance and simplest control algorithms, the motors and propellers should be placed equidistant. Recently, carbon fiber composites have become popular due to their light weight and structural stiffness. The electrical components needed to construct a working quadcopter are similar to those needed for a modern RC helicopter, which include the electronic speed control module, on-board computer or controller board, and battery. The components are described as follows:

- a. **Frame:** Every quadcopter needs a frame to integrate all the components together. Things to consider here are weight, size, and materials.
- b. **ESC:** The electronic speed control or ESC tells the motors how fast to spin at any given time.
- c. **Motors:** These are rotary mechanisms that consist of a stator and rotor part used to spin propellers. In drones a stationary core and a rotating out runner is used.
- d. **Propellers:** Propellers are blades which when rotated generate thrust by pushing the air downwards. These are specified based on diameter and pitch. A quadcopter has four propellers, two propellers that spin counter-clockwise, and two propellers that spin clockwise.
- e. **Camera:** The Raspberry Pi camera module is used to capture high-definition video, as well as still photographs. It is easy to integrate the camera module to the Raspberry Pi.
- f. **Flight Control:** It is regarded as the brain of the quadcopter. It controls the motors in a synchronized way.
- g. **Receiver-Transmitter:** These are used to control the drones by giving a command signal. The receiver placed on drone receives the signal and transmitter transmits the signal.
- h. **Battery:** These are portable power units which store electric energy and provide them when load is applied



lithium polymer battery is favorable due to its light weight characteristics.

C. Setting up Raspberry Pi

To use Raspberry Pi, an Operating System (OS) needs to be installed onto an SD card. The Raspbian OS offers Wi-Fi configuration utility. A shortcut exists for Wi-Fi Configuration on the desktop of Raspberry Pi. Since the router provides dynamic IP address via DHCP, it is important to configure it to assign a static IP address on the Raspberry Pi. This automatically assigned IP address is absolutely fine if the connection is not used often. But since the Raspberry Pi will be accessed more often, it is better to configure a static IP for the Raspberry Pi.

VI. RESULTS

According to the proposed plan the final outcome of this paper leads to the development of a quadcopter that has a stable flight. This project is implemented using Raspberry-pi, a frame where everything is mounted, motors and propellers for the movement of the quadcopter, ESC to control the motors. The result is a very stable flight platform. The complete system helps in various applications such as surveillance and rescue missions. Longer flight time can be achieved by adjusting trade-off between two variables, the battery capacity (weight) the efficiency of the thrust developed by the motors. The efficiency of the thrust has two factors which are the efficiency of the motor itself and the propeller design.

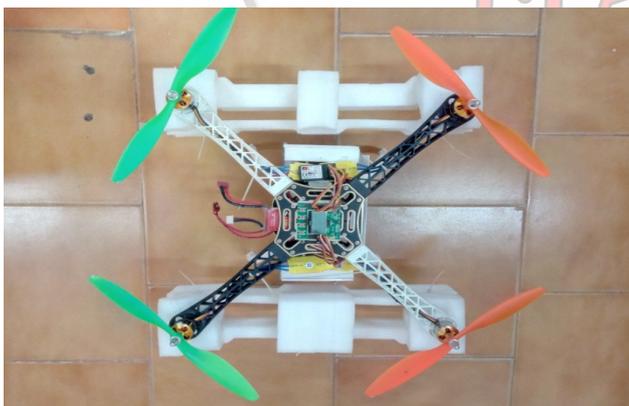


Figure 3: Quadcopter prototype

VII. CONCLUSION AND FUTURE SCOPE

This paper presents an approach which could be used for developing a small and compact sized quadcopter which can be used to carry out rescue operations and

provide audio/video aid to the people in distress. It could also be used as a surveillance system to increase the security strength especially in the area where human interference is strictly prohibited. It could also be used for performing live video streaming. Quadcopters offer advantages for many applications when comparing with their manned counter parts. Save human pilots from flying in dangerous conditions that can be encountered not only in military applications but also in other scenarios involving operation in bad weather conditions, or near to buildings, trees, civil infrastructures and other obstacles.

The future research can be carried out to implement and design SWARM technology so that a fleet of quadcopter drones can be sent that communicate with each other and perform various operation.

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