IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727
PP 48-52
www.iosrjournals.org

Quadcopter for Rescue Missions and Surveillance

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Abstract: *The aim of this research paper is to design a light weight quadcopter system using budget friendly Raspberry pi. The quadcopter will be controlled from a laptop or a RC (Remote controller) from a certain distance wirelessly. This small and highly manageable system would acquire data such as video/images from a camera installed in the quadcopter and send them to the base station. The project would have an impact on carrying out future rescue missions and would provide visual and audio aid to the people in distress. It will have the ability to help assist, locate and save victims, faster with more efficiency than any other option. It could also be used as a measure for survey or surveillance.*

Keywords: *Raspberry-pi, Quadcopter, Remote Controller, rescue mission, surveillance.*

I. Introduction

Quadcopter is a drone which is the next form of helicopters having more dynamic stability than helicopters. It is a small type of Unmanned Aerial Vehicle (UAV). UAVs have most often been used in the field of military but they are also used for search and rescue, surveillance, traffic monitoring, weather monitoring, firefighting, research applications in scientific community, fire sensing and some important areas.

Quadcopters are unmanned aerial vehicles with ability of vertical take offs, landings and hovering at a desired location. Quadcopter consist of four rotors which are attached at the end of the frame structure. A pair of rotors in one arm facing each other rotates in clockwise direction while the adjacent pair of rotors rotates in anticlockwise direction. Therefore, the resultant torque acting on the air frame structure is zero.

Quadcopter is a device with an intense mixture of electronics, mechanical and mainly on the principle of aviation. The Quadcopter can be customized and sized according to our own convenience. It can be designed as much small as we want by using the small sized components we need to make it.

II. Review of Literature

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 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. Prudhviraj 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 definition

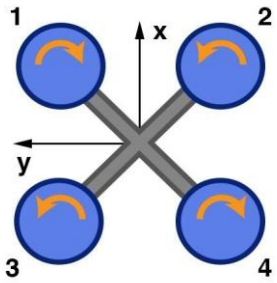
There are several problems faced in while carrying out rescue operations. It is costly to carry out a rescue operation as it requires many resources and expenditure. Large number of skilled manpower is required for operating rescue missions. Topographical aspects may vary from place to place thus putting 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

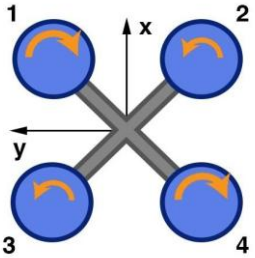
The initial step would be to create a chassis (frame) where raspberry pi, the main component would be mounted. Lithium battery will be used as they have the best ratio of weight to power. Motors would be used to spin the propellers. Using accelerometer and gyroscope, Electronic Speed Controller (ESC)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

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.



Hover



Yaw

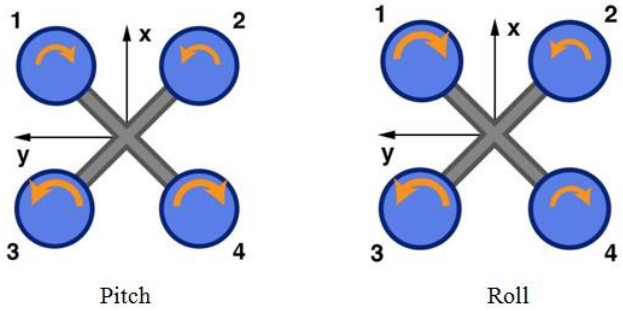


Figure 1: Quadcopter flight control

Hover Yaw Pitch Roll The two pair of propeller as shown in figure1, (1,3) and (2,4) rotates in opposite direction .The pair (1,3) rotates clockwise and remaining pair (2,4) rotates anticlockwise. This combination of rotation produces apposite torque. These results propellers generate vertical lifting force upward which raises quadrotor body in the air and it can moves in hover, yaw, pitch, roll, landing and take-off. Pitch and Roll movement can be achieved by altering the speed of any one pair of motor. While other motor pair speeds remain constant. Yaw movement can be achieved by altering the speed of both motor pairs in quadrotor.

a. Roll: Rotation around the front-to-back axis is called roll. Roll is controlled with the aileron stick, making it move left of right, if the aileron stick is moved to the left, the quadcopter will fly left, if moved the aileron stick to right, the quadcopter will fly right.

b. Yaw: Rotation around the vertical axis is called yaw. Yaw rotates the head of the quadcopter either to left or right, yaw can be controlled through the throttle stick making it to rotate either to the right or left.

c. Pitch: Rotation around the side-to-side axis is called pitch. Pitch is the movement of quadcopter either forward or backward. Forward Pitch is achieved by pushing the aileron stick forward, which makes the quadcopter tilt and move forward. Backward pitch is achieved by moving the aileron stick backwards, making the quadcopter, come closer.

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.

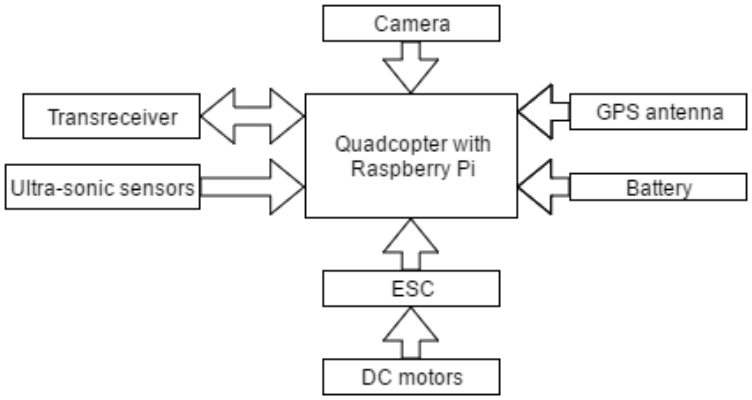


Figure 2: Block diagram (Quadcopter Side)

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 & 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. They

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.

Research for future study

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 operations

Acknowledgements

The authors P. Srivastava, T. Ninawe and C. Puthran would like to thank their guide Asst. Prof Ms. Vaishali Nirgude, Department of Computer Engineering, Mumbai University for her guidance and constant support. The authors would also acknowledge the HOD, Dr. Sheetal Rathi, Dean Academic Dr. R.R Sedamkar, the Principal, Dr. B. K. Mishra and the college management for their support.

References

[1] Dhriti Raj Borah et al., "A review on Quadcopter Surveillance and Control", *ADBU-Journal of Engineering Technology*, 4(1), 2016, 116-119

[2] Prof.A.V.Javir, Ketan Pawar, Santosh Dhudum, et al., "Design, Analysis and Fabrication of Quadcopter", *Journal of The International Association of Advanced Technology and Science*, vol. 16, 2015

[3] Yiwen Luo, Meng Joo Er, et al., "Intelligent Control and Navigation of an Indoor Quad-copter", *IEEE*, 2014, 1700-1705.

[4] Gordon Ononiwu, Arinze Okoye, et al., "Design and Implementation of a Real Time Wireless Quadcopter for Rescue Operations", *American Journal of Engineering Research*, 5(9), 2016, 130-138.

[5] Prabhjot Singh Sandhu, "DEVELOPMENT OF ISR FOR QUADCOPTER", *International Journal of Research in Engineering and Technology*, 03(4), 2014, 181-189

[6] A. Samba Siva, B. Prudhviraj kumar, et al., "Development of Mini Unmanned Aerial Vehicle*", IOSR Journal of Mechanical and Civil Engineering*, 12(2), 2015, 16-19

[7] Vimal Raj , Sriram, Ram Mohan , Manoj Austin , "Design and fabrication of inclined arm miniature sized quadcopter UAV", *IOSR Journal of Mechanical and Civil Engineering*,13(5), 2016, 73-76

[8] It Nun Thiang, Dr.LuMaw, Hla Myo Tun, "Vision-Based Object Tracking Algorithm With AR. Drone", *INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH*, 5(6), 2016, 135-139

[9] Ramamoorthy Luxman, Xiao Liu, "Implementation of back-stepping integral controller for a gesture driven quad-copter with human detection and auto follow feature", *IEEE*, 2015, 134-138

[10] Mr. B. Vinoth Kumar, S. Kalaiyarasan, et al., "Quadcopter Based Gas Detection System", *IOSR Journal of Electronics and Communication Engineering*, 11(1), 2016, 64-68

[11] Alex G. Kendall, Nishaad N. Salvapantula, Karl A. Stol, "On-Board Object Tracking Control of a Quadcopter with Monocular Vision", *International Conference on Unmanned Aircraft Systems*, 2014, 404-411