A TELE-OPERATED QUADCOPTER WITH COLLISION AVOIDANCE SYSTEM

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ABSTRACT

A quadcopter is an Unmanned Aerial Vehicle used in several applications like search and rescue, military surveillance etc., A human operator is required to navigate the quadcopter in domestic applications but, in some danger prone areas and GPS denied areas, where human cannot enter the area, the navigation may be difficult to the operator as it should not collide with the obstacles in its path. To overcome this limitation, we present an approach called automatic collision avoidance system so that the operator can rely on it to avoid collisions and can simply concentrate on the navigation of the quadcopter which we also can call as Tele-Operated. This can be achieved by installing sensors on all directions and an FPV camera system to provide a video information to the operator.

Keywords: Arduino Uno, Automatic Collision Avoidance, FPV (First Person View), Sharp IR sensor, UAV (Unmanned Aerial Vehicle).

I. INTRODUCTION

The UAV's are advancing with their various applications. The main advantage of drone is that it is unmanned vehicle. It can be operated from a remote location and also can be used either with GPS and also without GPS in GPS denied areas such as in military operations. An UAV plays a major role assisting in surveillance, search and rescue operations etc., By adjusting the thrust of particular rotors the direction of the quadrotor can be changed. The Pitch, Roll, Yaw axes are principle axes for movement of the quadrotor. The motors speed will be controlled by the Electronic Speed Controllers by the principle of Pulse Width Modulation. A microcontroller will control all the signals from the radio transmitter to receiver. Thus by providing a best flight.

II. EXISTING PROJECT

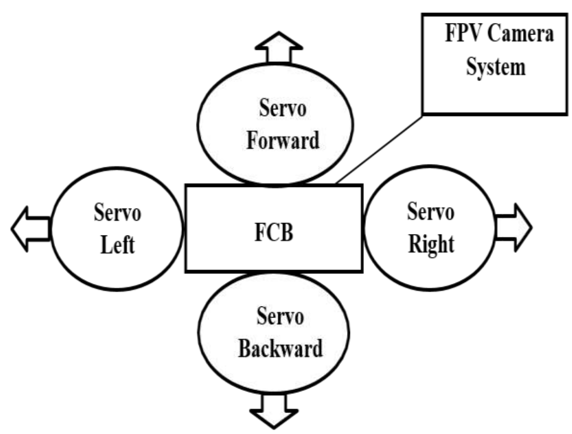

Fig 1. Block Diagram of Existing Project

In the existing system quad copter was used to capture the videos and images. Fig 1 shows the block diagram of existing project. The user can view the video or pictures and understand the situation in the area. Thus making the quad copter useful during the time of disasters and military operations for infiltration. The simplicity of this design makes the quad copter as an aerial vehicle without any application. The microcontroller helps to control the motor which receives the command from the transmitter to switch the motor speed as per the configuration setup by the software.

III. PROPOSED PROJECT

The drawback of existing projects is that there is no self-protection system which in return always requires the UAV to be in operator sight. It is not effective in some danger prone areas and GPS denied areas. This drawback can be overcome by adding an automatic collision avoidance system with the installation of Sharp distance measuring sensors and a microcontroller board to make the process effective. As a result, the operator can concentrate more on the navigation than the obstacles in path which leads to collision, thus making the navigation simple. Fig 2 shows the block diagram of proposed project.

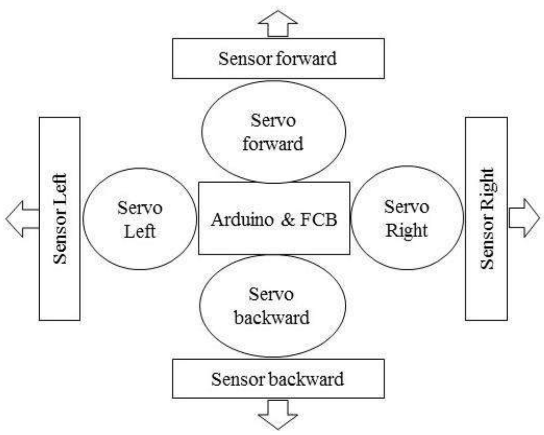

Fig 2. Block Diagram of Proposed Project

This makes the complete utilization of the available technology of our period to help the survivors of the natural disasters and further enhances the quality of UAV on the basis of its applications. This model has wide range of applications from surveillance to the rescue operations during the natural disaster. This enhances the application of the quad copter.

IV. ARDUINO UNO R3

The Arduino Uno features an Atmega328 microcontroller with 6 analog input pins and 14 digital pins out of which 6 are pulse width modulation pins. Here the Arduino acts a decision maker by reading values from both IR sensors and the Radio receiver and writes values to the flight control board. On detection of any object through sensor, the signal from receiver to Flight control board is given a correcting value to avoid collision, the same signal is passed when no obstacle is detected.

The Sensor readings are read through the analog pins of Arduino. The signals from first two channels of Radio Receiver, Aileron (CH1) and Elevator (CH2) are read through Pulse Width Modulation pins and writes the modified signals to the Flight Control Board. The Arduino is programmed in such a way to modify the signals when an obstacle is detected the signal of particular channel is corrected and no modification in no obstacle case. The signals from other two channels Throttle (CH3) and Rudder (CH4) are not required to change as there is no chance of collision. Hence these two channels are directly connected from Radio Receiver to Flight Control Board. The power supply for the Arduino and the Radio Receiver is from the Flight Control Board's first channel and the supply for the Flight Control Board is from the first ESC pin. The schematic diagram is as shown in Fig 3.

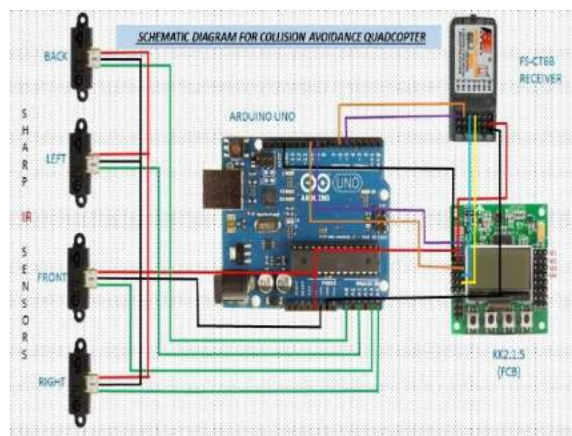

Fig 3. Schematic Diagram

V. SHARP IR SENSOR

Fig 4. Sharp IR Sensor

The Sharp IR Sensor (GP2Y0A21YK) is a wide angle distance measuring sensor. It will have an optical transmitter and an optical receiver through which the light signal is transmitted and received back on reflection from any object. The sensor has three pins in which the first two is +5V and Ground, the third pin is used to read the signal in either analog or digital format. The Fig 4 represents the sharp IR sensors.

Here the sharp IR sensors are used for detecting any obstacles in its path which leads to collision. The Range of the sensor used is 10-80 cm. The exact distance of the obstacle is not considered as its presence is enough to make a decision. The obstacles at different positions are identified by reception of reflected rays for corresponding positions through a Charge Coupled Device array.

VI. MOVEMENT CONTROL

Fig 5. Color Indication

A Drone's motion will be controlled by varying the speed of the motors. These variations in speeds will be controlled by the electronic speed controller according to the input from the operator. A Drone will start uplifting when the thrust generated by all the motors should be twice to that of the total weight. So, for vertical uplift and landing, the thrust of all the motors should be same, high for uplift and low for landing and constant for hovering. The speed variations are indicated by the color as shown in Fig 5. And, Fig 6 shows the thrust variations for takeoff and landing.

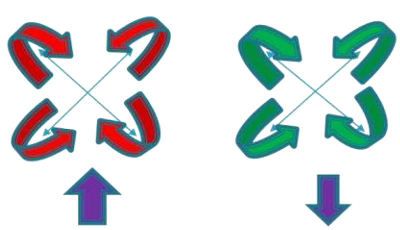

Fig 6. Vertical take-off and Landing

To Roll in desired direction the thrust of motors on opposite directions will be varied. To Roll Left side the Right side motors thrust should be greater than the left one's, vice versa. A conservation of angular momentum causes the Drone to roll as desired. Fig 7 shows the thrust variations for roll axis.

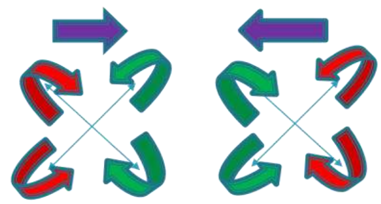

Fig 7. Side Way Movements

Similarly, A Drone pitches forward when the rear motors thrust is greater than the front motors, vice versa. Fig 8 shows the thrust variations for Pitch axis.

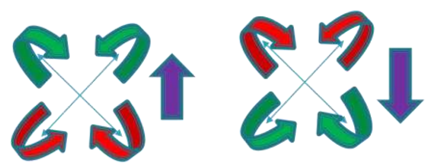

Fig 8. Forward and Backward Control

A Drone rotates in the anticlockwise direction when thrust applied to the two clockwise motors is greater than the two anticlockwise rotors, vice versa. Fig 9 shows the thrust variations for rotation or Yaw axis.

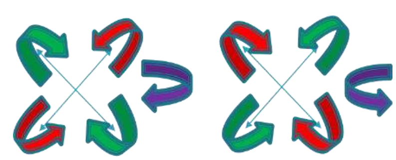

Fig 9. Rotation Control

VII. RESULT AND ANALYSIS

Quad copter was designed, fabricated and analyzed successfully. It was able to fly to a distance of 500m. The take-off took very smoothly. It was difficult to understand and handle the radio control. It was able to run continuously for half an hour as it runs on lithium polymer battery. It can patrol and so surveillance in any area. UAV cannot be used more than 10 minutes in cloudy areas. Fig 10 shows the working model of the project. It can go up to 20m/s. Thus we understood the various processes involved in the design, fabrication and analysis of UAV and clearly understood the mechanisms involved in it. The vehicle is best suited for defense and disaster management.

Fig 10. Working model

VIII. CONCLUSION AND FUTURE SCOPE

This project satisfies the needs of the current generation that requires surveillance of people showing up for help during the time of disaster. The important feature of this project is that the man power used for surveillance is reduced and the positioning of the people are estimated with perfection. The Automatic collision avoidance system helps the operator by avoiding accidents due to the obstacles in between. So that the human operator can concentrate on the UAV's navigation. This proves the efficiency of the usage of current technology. The advantage of this project is that it provides the situation of the victims of the natural disaster like flood and also to provide food and medicines for their needs.

The operation of the quadcopter is limited to human control in this project. This limitation will be overcome with the help of future development which makes the quad copter that can be navigated with help of setting autonomous flight. Thus providing a strong base for spying when the size of the quad copter can be quantified to few centimeters. Many quad copters can be synced to form a spawn under the command of a single quad copter which makes it easy to connect and coordinate to perform a specific task. Thus these advancements in our project is possible in the mere future.

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