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Design and Analysis of Hand Gesture Controlled Quadcopter

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Abstract—Hand control quadcopter, which is control of the motion of the hand. The user needs to wear a glove, which incorporates the sensors. The sensors will record the development of the movement in a particular direction, which will result in the development of the quad copter in that individual direction. The quad copter and hand motion glove are associated wirelessly by means of RF waves. The wireless correspondence empowers the user to cooperate with the quad copter in a friendlier manner. This project structured a quadcopter framework utilizing an ardupiolt mega2.8 chip with an RF transmitter with a few live control shapes accessible just as a mission organizer for autopilot control.

Keywords—Quad copter, Hand Gesture based controller, Ardupiolt control, Flight Controller, RF

I. INTRODUCTION

Most of the human being is inspired by levitation. In the world, we are living in three-dimensional, that is the reason. Nevertheless, individuals live and move for the most part in two dimensions. It creates the impression that individuals have an incredibly strong drive to overcome their natural limits. This prompts building machines that engage them to move in three-dimensional space, for instance, planes, helicopter and unmanned aeronautical vehicle (UAV) quad copter and so on [1]. From above of them UAV quad copter has only able to operate in dangerous locations and does not require an onboard pilot. So it can easily operate in a wide range of severe regions while keeping their activity at a safe displacement.

The fame of UAV quad copter has been just among military applications until 1996 [2]. In any case, with the advancement of unpredictable and complex and a skilled hardware running from an exceptionally incredible, light-weight, microcontroller to significantly smaller sensors with better exactness and precision [3]. It is conceivable to construct a quad copter with an assortment of sizes for various applications. The quad copter venture required broad investigation into a comparative framework. By evaluating other's work, This knowledge is utilized to build up our framework. To this end, investigate papers from different quad copter are utilized as aides in the early advancement of the elements and control hypothesis. Quad copter stages utilized in research remain to some degree the equivalent, having four electric engines pointed vertically upwards and

similarly square style. Be that as it may, some gathering structured their very own platforms [4-6].

A quad copter is an aircraft that comprises of four – fixed engines put toward the end of a cross-moulded casing. Fig. 1 demonstrates a schematic of a quad copter seeing how it functions. The two motors 1 and 3 (front and back) move in a clockwise (CW) direction, delivering torque, while motors 2 and 4 (right and left) rotates in a counterclockwise (CCW) direction creating a contrary torque bringing about a balanced torque over the aircraft. The four motors would deliver equivalent thrust while turning in a similar speed lifting the quad copter in an upward way [7].

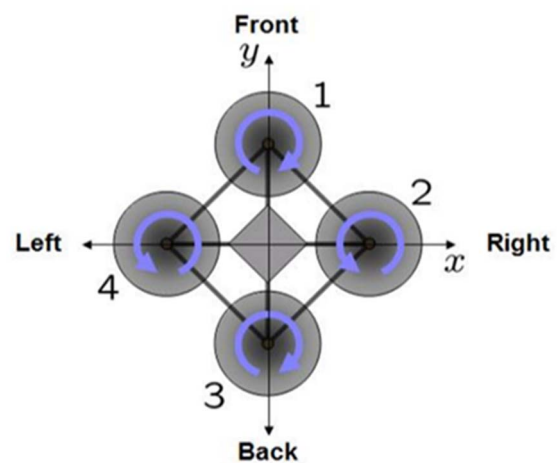


Fig. 1. Schematic Diagram of the Quad Copter

Gesture technology is body language, which can be body motion or speech to communicate with others. But this research paper is only on hand gesture technology and consider to experiment [8]. The basic goal of hand gesture is to control the machines/virtual environment. At present, gesture innovation is building an exceptionally more extravagant and solid scaffold between individuals and machines without any confinements. It furnishes people to interface or connects with machines in the most well-disposed manner. Christopher Lee and Yangsheng Xu [9] developed a glove motion system that had the alternative to see 14 of the letters from the hand alphabets, adapt new signals and prepared to revive the model of each movement in the

structure in online mode, with a rate of 10Hz. Throughout the year propelled glove gadgets have been structured, for example, the Sayre glove, Dexterous Hand Master Power Glove and Dexterous Hand Master [10-11].

Most of the remotely pilot UAV quad copters are controlled by different remotes, which require some joysticks, and push buttons and these methods are tough to control the UAV quad copters [12-15]. Comparing these conventional controllers so a wireless hand gesture based controller is design, which enable UAV quad copter in all three dimensions.

Section II describes the method and designing of the Quad copter whereas section III present the algorithms and serial communication between the quad copter and glove. In section IV discusses the results in simulation mode and real time. Finally, conclude the paper in section V.

II. METHOD AND DESIGN

The overall block diagram is shown in Fig. 2. Input is taken from the sensors, mounting on the glove from the motion of the hand. The input data send into the microcontroller and microcontroller transmit the receive data in serial form. On the other side, the receiver receives the set of data and sends this set of data to the microcontroller and microcontroller through this data to the APM2.8 flight controller. According to the command, received by the user side, the APM flight controller gives the command to the electric speed controller to move the motors.

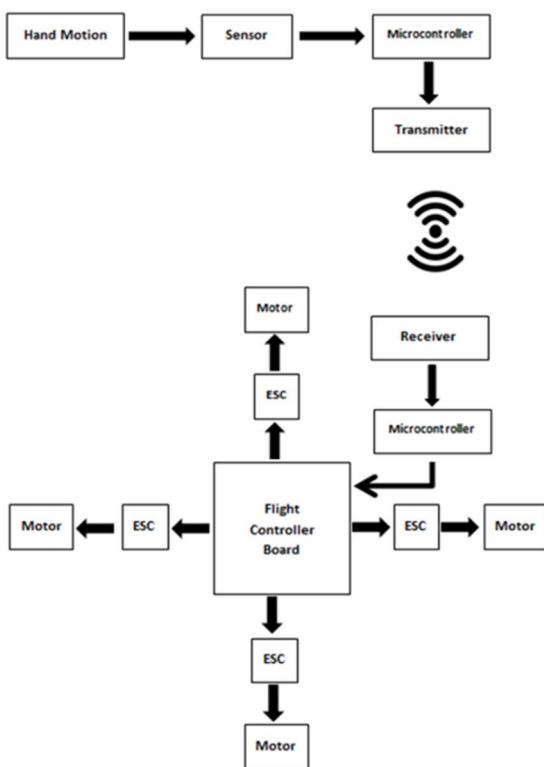


Fig. 2. Block Diagram

For the hand gesture technique, firstly the designing of the circuit for transmission data and for receiving data is done. The adxl 335 sensors is utilized for detection of motion in hand and flex sensor are utilized for the thrust of a quad copter. AVR microcontroller is utilized for processing of sensor

output data. RF module sends data to the other side. RF module on the other side takes data, sends it to the microcontroller, which processes this set of data, and gives it to the APM2.8.

First, interface adxl335 with a microcontroller. It gives 3 analog outputs in X, Y, Z axis. When some change in any axis it gives the output. Then connect with a microcontroller. Firstly, the analogue output is converted into digital output using microcontroller internal ADC. Quad copter needs throttle for altitude. It only gives the change in X, Y, Z direction. Which is used for roll, pitch and yaw movement. So use flex sensor for throttle.

Flex sensor resistance change when it bends, so places flex sensor on the back of the hand finger. Connect an 80Kohm resistor with flex sensors in series, and get the analog input using voltage divider then connect this output with a microcontroller ADC.

After interfacing the flex and adxl335 with a microcontroller. The digital output data is displayed on the LCD, different conditions on the data is applied by using programming and convert it in different commands i.e. Forward, Backward, Right, Left, Yaw Right, Yaw Left and Throttle. Then this command is sent serially to the quad copter using RF module. Fig. 3 shows the complete hand gesture circuit block diagram.

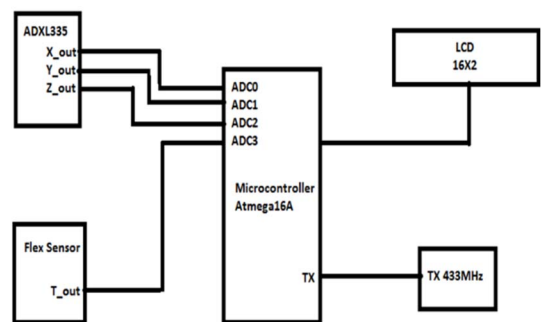


Fig. 3. Hand Gesture Circuit block diagram

For receiving a hand gesture command, connect the RX module with microcontroller and receive the data using UART. Generate the 4 PWM (Pulse width modulation) of 50Hz for different commands. Its Circuit diagram is shown in Fig. 4.

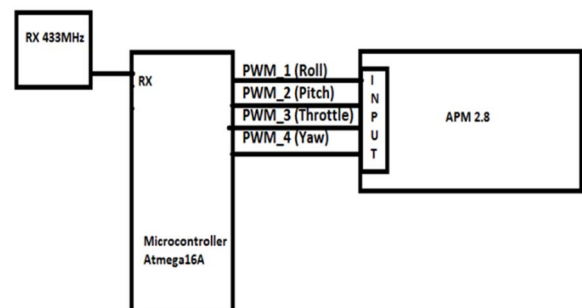


Fig. 4. Receiver Side Circuit block diagram

Finally, connect the GPS, Telemetry module with APM. Power distribution board with battery use for the powering up

the APM, ESCs and motors. Fig.5 shows the complete interfacing of APM.

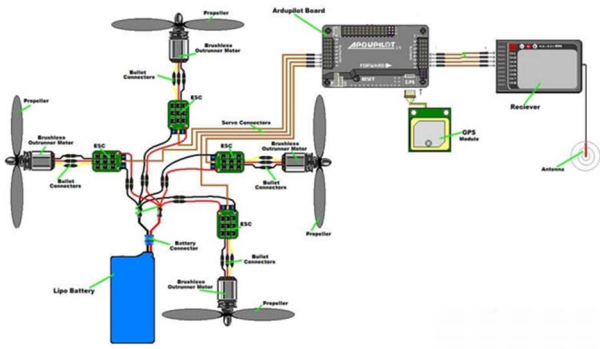


Fig. 5. Complete Interfacing APM

III. ALGORITHM AND SERIAL COMMUNICATION

In this section, explain all the algorithms and serial communication.

A. Algorithm

This procedure is explained in two parts. The first part explains the interfacing of sensors with ADC and LCD interface with microcontroller AVR atmega16A. In the second part, the serial communication between the transmitter and receiver is explain. The entire algorithm summarizes using a flow chart diagram.

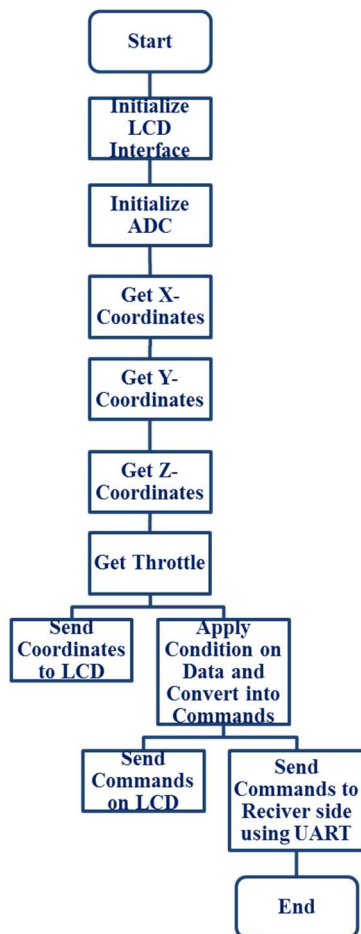


Fig. 6. Algorithm of Hand Gesture Flow Chart



Fig. 7. Algorithm of Receiver Side Flow Chart

B. Serial Communication

For serial communication, the UART is utilized. First, the conversion of the data into commands in the frame is done. The frame contains a frame delimiter, starting byte, data and checksum. This frame is sent by using the RF module.



Fig. 8. Frame Structure

At the receiving side, this frame is received using UART and extracts the data from the frame.

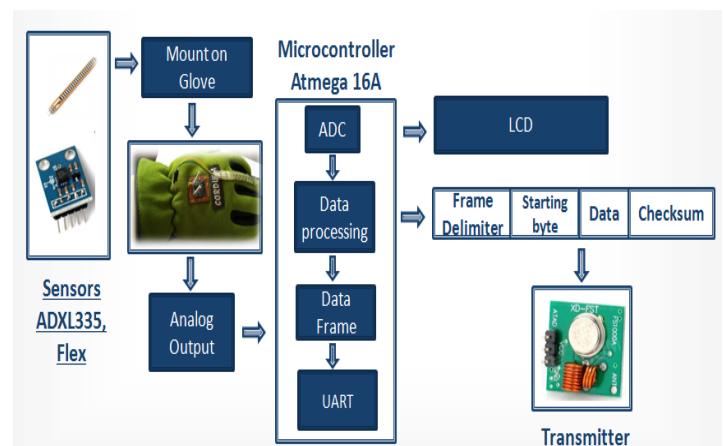


Fig. 9. Working diagram of Hand Gesture

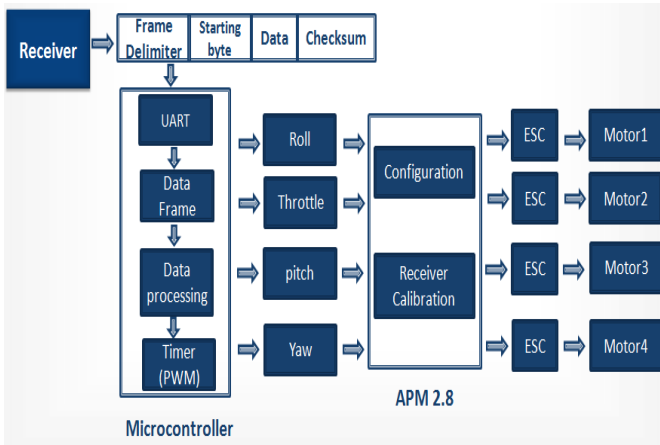


Fig. 10. Working Diagram of Receiver Side

C. Configuration of APM2.8

For the configuration of APM2.8, firstly the mission planner software is installed on window 8. Then follow the steps given below:

1. Connect the APM2.8 with a laptop using a USB port.
2. Installing the quad copter firmware on the APM2.8 and upload the firmware and verified.
3. Click on the flight data icon and connect the APM with a laptop using com port 4 and baud rate 115200. Then configure it and calibrating the APM.
4. Click on the initial setup icon and select the frame type.
5. Move on a compass and select onboard APM compass. Then the accelerometer is calibrated.
6. Then calibrate the transmitter and receiver by clicking the radio calibration.
7. Then select flight modes to stabilize.
8. Disconnect the APM from a laptop and connect the battery with a quad copter.

IV. RESULTS AND DISCUSSION

The simulation of the AVR code is done on software. After the simulation of the code, the test is done of the hardware design on software. Some of the hand gesture testing results are given below Fig. 11-15.

Fig. 11 shows when the hand glove in stable mode and Fig. 12 shows the when the throttle is high and Fig. 13 shows the forward and throttle high mode.

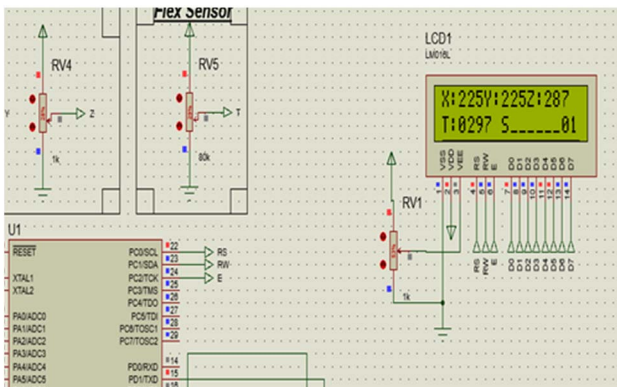


Fig. 11. Software Test Result (stable)

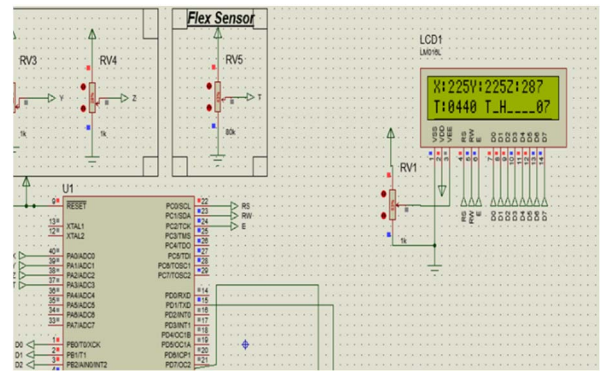


Fig. 12. Software Test Result (Throttle High)

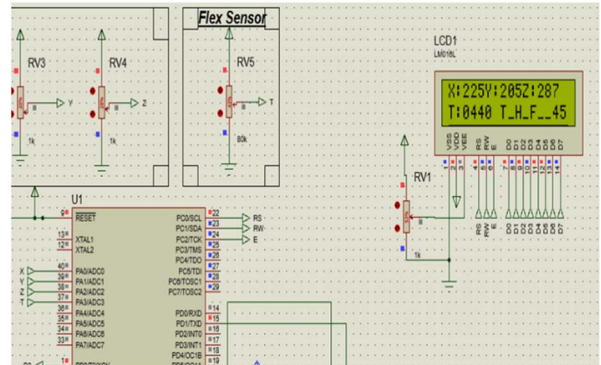


Fig. 13. Software Test Result (Throttle High and Forward)

Fig. 14 and 15 show the hardware of the hand gesture glove and quad copter.

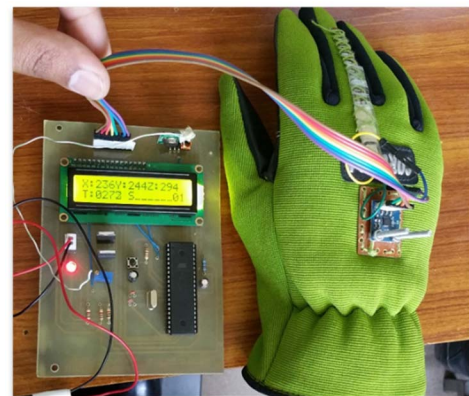


Fig. 14. Hand Gesture Hardware



Fig. 15. Quad copter Hardware

V. CONCLUSION

The quad copter consists of both electrical and mechanical components. There are a lot of difficulties regarding the design of quad copter dimensions due to lack of expertise in mechanical components. But this project was very challenging. This helped to learn a lot of things from this project in the field of robotics.

Our project starts with a goal to control the quad copter using the hand gesture technology. We achieve this goal and control the quad copter using the hand gesture glove. It needs more work on it for better performance and stability. This project increases interest in robotics and autonomous system, knowledge which will use throughout our professional careers.

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