Quadcopter Using Arduino

Vidya Rajendra Kamble[1], Samadhan Navnath Babar[2], Pranjali Ajinath Babar[3], Prof.V.U.Bansude[4]
[1, 2, 3] Dept of Electronics and Telecommunication
[4]Professor, Dept of Electronics and Telecommunication
[1, 2, 3, 4] S.B. Patil College of Engineering, Indapur, Pune, Maharashtra 413106

Abstract- *In the contemporary world, as technology advances, so does the number of vehicles on the road, resulting in traffic congestion, noise pollution, and air pollution. Technological advances in the realms of rescue operations and remote package delivery systems have resulted in the creation of a quadcopter. A quadcopter is a flying device that may be used to transport objects from one location to another in less time or for monitoring. The flight controller of the quadcopter is an Arduino microcontroller, and its flying motions are controlled by a transmitter-receiver system. The quadcopter is primarily intended for use in search and rescue missions as well as remote product delivery. A pressure, temperature, and humidity sensor are mounted to the quadcopter and provides information for a specific location. A magnetometer is also connected, which displays the orientation of the quadcopter in relation to where it is facing. Using a server-client model, these readings are sent from the quadcopter to a base station. A Wi-Fi module, the ESP8266, was utilized for this. A GPS module would be installed later in the project to provide the coordinates of the location to which the quadcopter is travelling. In addition, a camera would be attached to provide a live view of the region for improved quadcopter performance.*

Keywords- Quadcopter, GPS, Arduino, Wi-Fi module, Propellers, ESCs (Electronic speed controller), Transmitter and Receiver, etc.

I. INTRODUCTION

Quadcopter is an assistive device which has a high demand in the industrial & surveillance sector. As the technology has matured and become more mainstream, a number of practical and very interesting uses of Quadcopter technology have emerged. The present work includes the design and development of the Quadcopter using ESP8266. This system will either use a GPS system or it will use a camera for identification of path being traveled by it. This system will be controlled by a remote system or a transmitter by sitting inside our home, office, or any place within its transmitter range. This concept will thus facilitate the surveillance activities. The quadcopter is useful for in many situations. From the scope of the quadcopter, it’s used for aerial photography, security and rescue, industrial inspection and much more. The result of this project will help people in natural calamities by reaching the dense areas where humans cannot reach immediately. Practically, quadcopter is being used for object detection through image processing in border security of the nation.

Overview of Quadcopter

Quadcopters are also called multirotors, due to having 4 or more small rotors instead of one like the traditional helicopter. Some models have more than 4 rotors and are called multirotors. As a general rule, the more rotors a drone has, the stronger and more stable it becomes.

Quadcopters generally have two rotors spinning clockwise (CW) and two counterclockwise (CCW). Flight control is provided by independent variation of the speed and hence lift and torque of each rotor. Pitch and roll are controlled by varying the net center of thrust, with yaw controlled by varying the net torque.

a. Principle of Quadcopter:

Based on Newton's third law, each of these can be achieved using the quadcopter's four propellers. When the propellers spin, they push air down. Similar to a helicopter, pushing the air down is the action in Newton's third law of motion. The reaction is a force, called lift, which pushes the quadcopter up.

b. Hardware description:

The quadcopter uses an Arduino microcontroller Atmel328 as the core controller and is designed and developed to achieve the real time operating system. This system uses one receiver attached on a controller board and a transmitter that controls the motion of a quadcopter. The hardware consists of simple Arduino board with an ATmega2560, propellers, ESCs & flight controller board (FCB), transmitter & receiver and gyroscope for a balanced flight as shown in fig.

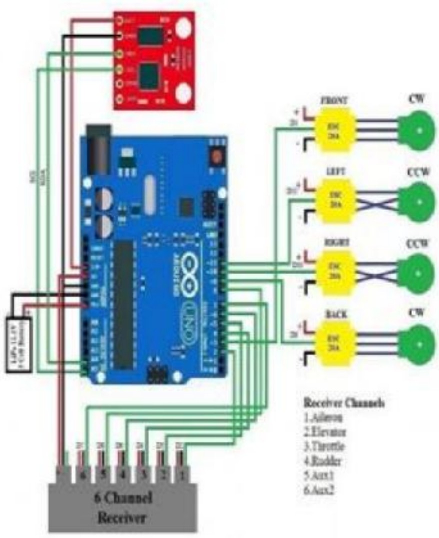

Fig.1.1. Hardware description of Quadcopter

Hardware is programmed in C language. The controller board and ESC's work together. FCB gives the command to ESCs which is further connected to BLDC motors for the rotation.

c. Uses of the quadcopter:

Finding disease:The basic process is really pretty simple, quadcopters are equipped with bug collection device and then flown around outdoors in various areas of interest. The quadcopter returns with the collected bugs which are then used by scientists for analysis. The Analysis is then used to predict outbreaks for local areas. Local area outbreaks can be analyzed for regional and national outbreaks.

Product/Food Delivery:One of the innovative uses for quadcopters that quickly received a lot of media attention was product and food delivery via quadcopters. Major companies like Amazon, FedEx, DHL, and Dominos are exploring the use of quadcopters for local delivery of their products.

Geographic Mapping: quadcopters can reach difficult-to-access locations like eroded coastline or mountaintops and acquire very high-resolution data to create 3D maps. The technology is already available to amateurs and professionals, enabling them to collect data and instantly download the imagery. Some are even using the collected data to contribute to crowd sourced mapping applications.

Agriculture uses : Farmers no longer need to monitor their crops on foot. They can survey land in minutes instead of hours or days. Agricultural quadcopters can do amazing things like count plants, examine soil properties like moisture level, and analyze water usage. The result is more efficient and higher yielding crops.

d. Components of the quadcopter:

There are different designs of quadcopters. Every design depends on the use of the quadcopter and its mission. For example, quadcopter used in military domain differs from personal one (ex. used in delivery services).

In general, there is a common design which has the main components used for constructing a quadcopter.

Here is what you need for the common design: 1. Frame. 2. Motor x4. 3. Electronic Speed Control (ESC) x4. 4. Flight Control Board. 5. Radio transmitter and receiver. 6. Propeller x4 (2 clockwise and 2 counter-clockwise). 7. Battery and Charger.

e. Mechanics of quadcopter:

Mechanics of Propellers

Lift force : The force needed to keep an aircraft in the air.

Drag force : force which tries to oppose the motion of the aircraft through the air.

The principle of these forces is Fluid Mechanic. A fluid flowing past the surface of a body exerts a force on it. Lift is the component of this force that is perpendicular to the oncoming flow direction. It contrasts with the drag force, which is the component of the surface force parallel to the flow direction.

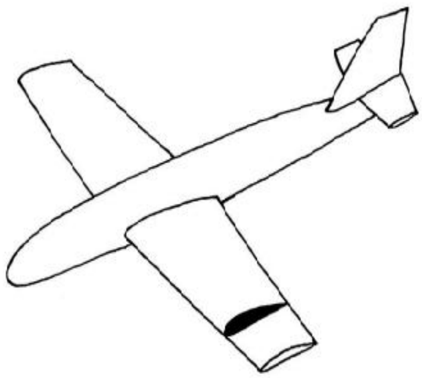

Fig.1.2. Wing of aircraft

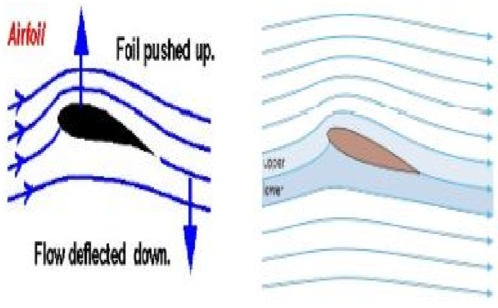

Fig.1.3. Flowing fluid on the wing

The high velocity of the fluid(air in our case) above the wing causes low pressure in the same time that low velocity of the fluid under the wing causes high pressure. This difference of pressure causes the total force.

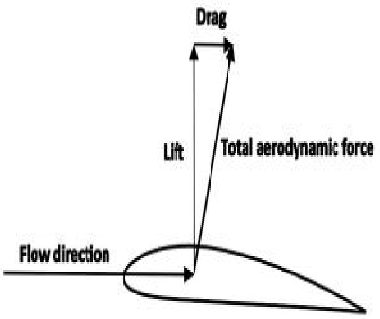

Fig.1.4. Lift and Drag Force

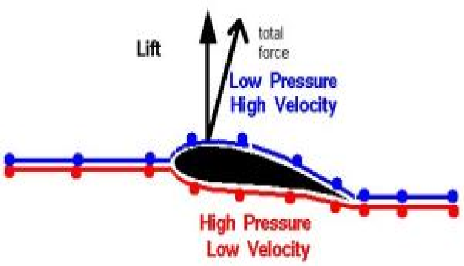

Fig.1.5. Cause of lift Force

It is clear that we should increase lift force and decrease drag force as much as possible. In fact, yes, the propeller contains two blades. Each blade acts as a wing. The propeller rotates around its axis, and each blade should be curved up to make the direction of movement suit each blade. So, the Propeller which rotates in clockwise direction differs from that which rotates in counter Clockwise.

Newton's third law says that every action has an equal and opposite reaction, so when propeller's blades spin in one direction, something must spin in the other to conserve the angular momentum. To avoid this spinning , we make two propellers rotate CCW and the other two rotate CW.

Movement of the quadcopter

An important remark is to know kind of the flight configuration of the quadcopter as there are two of them: configuration + or configuration X. The difference between them is the orientation of the X-Y frame in terms of the arms of the quadcopter which the four propellers make a shape like X or +. We will discuss X design in this section. Let (X Y Z) the coordinate of the earth (inertial frame) and (X' Y' Z') the coordinate which is related to the quadcopter.

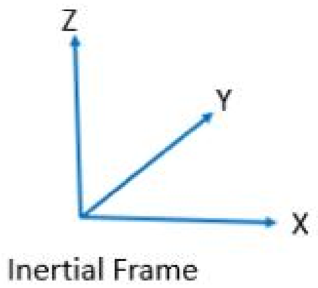

Fig.1.6. Quadcopter frame

Taking off and landing: This command is provided by increasing (or decreasing) all the propeller speeds by the same amount. It leads to a vertical force which raises or lowers the quadrotor.

f. Working principle:

Quadcopter system works on the principle of air lifting phenomena with high pressure. The propellers force the air in downward with high pressure due to which an uplift force is created and as a result action reaction law is applied on the whole system. When this uplift force dominates the earth's gravitational force, the whole system starts flying in the air. But there is a problem with the rotation of propellers. If we rotate the propellers in clock wise direction then due to this rotation, a torque will be applied over the whole system in one direction .And similarly if we rotate the propellers in anti-clock wise direction then also a torque will be produced over the whole system and the whole system will start rotating anticlockwise. To overcome this problem, we rotate two propellers in clockwise direction and remaining two propellers in anticlockwise direction. This phenomenon produces torque in opposite direction and they get balanced and the system remains stable while flying.

Two basic phenomena are used for movement of quadcopter, thrust and torque. Quadcopter uses its four propellers attached to motors which creates thrust and help quadcopter to elevate high. Motion of quadcopter are defined based on the input values (x, y, z, θ, ϕ, ψ) given to it. Out of four motors attached with propellers, two motors rotate in clockwise (CW) direction while other two in counter clockwise (CCW) direction. Motion of quadcopter is thus controlled mainly by three movements. These movements are classified as Yaw Rotation (ψ), Pitch Rotation (θ) and Roll Rotation (ϕ).

Flight Dynamics And Developments

A quadcopter is operated by varying spin RPM of its four rotors to control lift and torque. The thrust is determined using altitude, pitch, and roll angles and is obtained from the ratio of the angles. The thrust plays a key role in maneuvering, enables the user to perform flying routine which includes aerial maneuvers. To conduct such maneuvers precise angle handling is required. It serves as a solution to handle the copter with angular precision which illustrates how the spin of four rotors is varied simultaneously to achieve angular orientation along with takeoff, landing and hovering at an altitude.

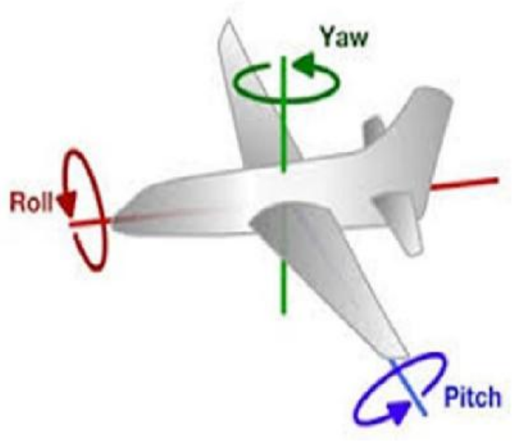

Fig.1.7. Roll, pitch, Yaw of a quadcopter

Early Developments

The earliest invention of the quadcopter dates back to 1907 when Louis Breguet invented and flew the first quad rotor helicopter. The drones were then used mainly by the US army for military purposes. The literal introduction of quadcopter was in the late 2000s where advances in electronics allowed the production of cheap lightweight flight controllers which had the capability of flying an Unmanned Aerial Vehicle. Furthermore, a number of sensors were incorporated into the flight controller in order to increase the stability of the quadcopter. These sensors were accelerometers ,gyroscope and magnetometer. This resulted in the quadcopter becoming popular for small unmanned aerial vehicles. With their small size and maneuverability, these quadcopters can be flown indoors as well as outdoors. But these quadcopters at the initial stages lacked in basic stability and controllability. Thus, new designs were incorporated in the quadcopters using more stable sensors. These sensors increased the stability of the quadcopter and also allowed it to hover at a predefined altitude. At this stage, the microcontrollers used were complex in nature and flight control was difficult as well due to errors from the controller output.

Latest Developments

The developments with these drones is huge. Previously, the drones could follow a pre-determined path. But the drone was vulnerable to collisions. Lately, quadcopters are being designed which has the technology of obstacle detection and collision avoidance. The quadcopters use a number of ultrasonic sensors in coordination to detect objects around it and avoid them by using simple algorithms. The signals from the sensors are controlled by an Arduino microcontroller. Here the signals from the sensors are integrated to give a collision avoidance display on the remote controller which can be used to control the quadcopter precisely. But then again, the quadcopter could not provide the location to where it was travelling. This was eliminated in the future where a gps module is introduced in the system which allows the quadcopter to fly between two coordinates avoiding collision. This development found applications in package delivering avoiding collisions on the way.More latest developments have been made where the quadcopters are being controlled by voice commands of the user or by simple hand gestures. These developments are still in the development stages but are soon to become a reality.

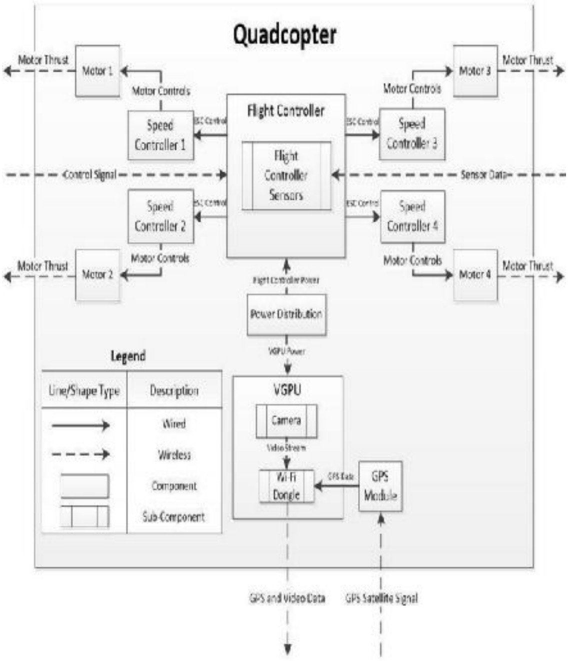

Fig.1.8. Block diagram of quadcopter

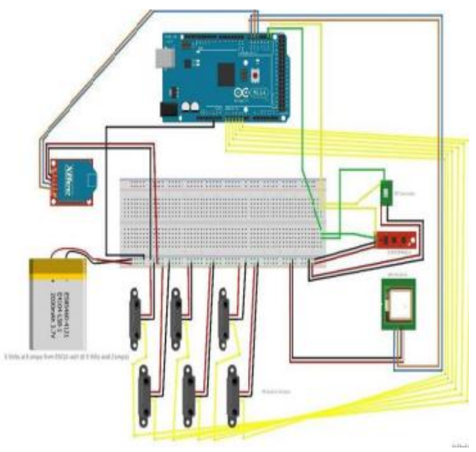

Fig.1.9. Circuit diagram of quadcopter

Advantages

In most cases, quadcopters tend to be more stable than helicopters, and this is the reason why they have been used for applications such as aerial photo and videoshooting. This is something that quads seem to do better than RC helicopters. DJI Phantom2 Quadcopter. The higher the stability the easier to fly. Drones use rotors for propulsion and control. You can think of a rotor as a fan, because they work pretty much the same. Spinning blades push air down. Of course, all forces come in pairs, which means that as the rotor pushes down on the air, the air pushes up on the rotor Drones are very popular because mass media networks patronize its functionality and efficiency when capturing videos and images. You will notice that drones are common in touristy areas due to travel blogger promotions. Video bloggers use drones to further increase the popularity of their videos; hence, promoting the device to other new bloggers. Travel companies use drones to maximize the tourism potential of an area that is popular to all tourists.

Application

Quadcopters are a useful tool for uninvent researchers to in a number of different fields, including flight control theory, navigation, mal time vises, and robotics. In recent years many universities have shown quadcopters performing increasingly complex aerial maneuvers. Swarms of quadcopters can hover in mid-air There are numerous advantages to using quadcopters as versatile tespatiems. They are relatively cheap, available in a variety of sizes and their simple mechanical design men's that they can be built and maintained by amateurs. Due to the multi-disciplinary tattun operating a quadcopter, academies from a number of fields need to work together in order make significant improvements to the way quadcopters perform Quadcopter unmanned aerial vehicles are used for surveillance and recommissance by military and law enforcement agencies, as well as search and rescue missions in utan environments. One such example is the Aeryon Scout, created by Canadian company Aryon Labs, which is a small UAV that can quietly hover in place and use a camera to observe people and objects on the ground. The largest use of quadcopters in the USA has been in the field of aerial imagery. Quadcopter UAVs are suitable for this job because of their autonomous nature and huge cost savings. In the USA, the legality of the use of remotely controlled aircraft for commercial purposes has been a matter of debute. Quadcopter projects are typically collaborations between electronic and computer science, electrical engineering and mechanical engineering specialists

II. LITERATURE REVIEW

AdiletTagay et.al. (2021) conducted research on Development of control algorithm for a quadcopter. This paper focuses on deriving a mathematical model of the quadcopter with its characteristic properties to solve the auto-balancing problem. The research determines the mathematical model of the unmanned aerial vehicles (UAV) and then incorporates characteristic values of the constructed model to the general model. The derived equation is used in identifying the controlling parameters of the quadcopter. The key focus of this research is to develop a cost-effective, self-stabilizing, and robust control system using affordable components. A gyroscope MPU6050, a transmitter, and a receiver (with at least 4 inputs) were integrated with microcontrollers to develop the system.

E. S. B. Santosa et.al. (2019) conducted research on Teaching Microcontrollers using Arduino Nano Based Quadcopter. This study aims to motivate students in learning and knowing students' responses about the use of Arduino Nano based quadcopter learning media. The first stage of this learning is students learn about components that exist in the quadcopter and remote control. The second stage of students integrates between components to form a quadcopter and remote-control system. The last stage is students learn to program using Arduino. Data is obtained by using a questionnaire to determine students' responses to learning by using these media. Data are obtained from students' motivational questioner in 1 Magelang public vocational high school in Indonesia with a total of thirty-two students. The result showed that motivation students increased after participating in learning using Arduino Nano based quadcopter.

VNV Aditya Sharma et.al. (2018) conducted research on Building a quadcopter: An approach for an Autonomous Quadcopter. In this paper we have focused on making a drone from starting. By making own flight controller using Arduino Mega and Obstacle detection and Avoiding Unit using Raspberry Pi with the help of Accelerometer, Gyroscope and Barometer sensors along with GPS modules and camera modules to make quadcopter go autonomous. Raspberry Pi makes the Real Time calculations for the Obstacle Detection and Avoidance and Arduino Mega steers the quadcopter according to the commands received from the Raspberry Pi or the receiver and calculations made using dedicated PID controller.

Arijit Ghosh et.al.(2018) conducted research on Arduino Quadcopter. In this paper the quadcopter's flight controller is developed using Arduino Uno R3 based microcontroller board and its flight movements can be controlled using a transmitter-receiver setup. A gyro cum accelerometer module is attached to give the exact coordinate location of the place where the quadcopter is positioned whereas the magnetometer module indicates the direction of travel. The microcontroller is supplied with a LIPO battery. The microcontrollers are programmed to turn on the quad rotors using electronic speed controllers (ESCs).

Muhammad Talha et.al. (2018) conducted research on Fuzzy Logic-Based Robust and Autonomous Safe Landing for UAV Quadcopter. This paper includes a landing system based on laser rangefinder, Arduino Mega MCU, and Pixhawk flight controller. The lookup table technique is used to implement fuzzy logic inside Arduino Mega. This technique takes very small execution time for data processing in fuzzy logic, which is essential for high-speed data processing and updating. Autonomous landing process can be triggered and override at any time using remote controller. Furthermore, various tests are performed on a quadcopter to verify the feasibility of proposed algorithm.

VibhaKishor et.al. (2017) conducted research on Design and Development of Arduino Uno based Quadcopter. At industry level applications, quadcopter is made using KK board module which comes with preprogrammed KK board and balanced gyroscope module which is not economical for smaller applications. It's not a cost effective method. To make the quadcopter economical and efficient for small level applications this work is proposed, which design and develop a quadcopter using Arduino Uno board instead of preprogrammed KK flight Controller board. It has wide application like quadcopter mounted with camera and GPS tracker could be used for surveillance of wide areas such as forest and coast guard applications etc.

Lo Ngai Hung et.al. (2016) conducted research on A Quadcopter-based Auto Cameraman System. In this project, a quadcopter-based auto cameraman system is designed and implemented. The quadcopter equips with an ordinary camera for both video recording and target tracking. Via tracking the position and orientation of the markers on the reporter's microphone, the quadcopter can move to the corresponding position relative to the microphone such that the onboard camera can always have a good view of the reporter. The quadcopter is further installed with sonar and optical flow sensors to maintain its tracking capability and to provide obstacle avoidance functionalities. Sensing data are collected and processed locally using the onboard Intel compute stick and an Arduino Nano board. The proposed system can greatly reduce the manpower involved in live outdoor news anchoring.

Ankyd Ji et.al. (2015) conducted research on Development of a Low-Cost Experimental Quadcopter Testbed using an Arduino controller for Video Surveillance. This paper outlines the process of assembling an autonomous quadcopter platform from scratch and designing control laws to stabilize it using an Arduino Mega. Quadcopter dynamics are explored through the equations of motion. Then a quadcopter is designed and assembled using off-the-shelf, low-cost products to carry a camera payload which is utilized for video surveillance missions. The unstable, non-linear quadcopter dynamics are stabilized using a generic PID controller. System identification of the quadcopter is accomplished through the use of sweep data and CIFER to obtain the dynamic model.

Kamran Turkoglu et.al. (2015) conducted research on Development of a Low-Cost Experimental Quadcopter Testbed Using an Arduino Controller and Software. This paper explains the integration process of an autonomous quadcopter platform and the design of Arduino based novel software architecture that enables the execution of advanced control laws on low-cost off-the-shelf products based frameworks. Here, quadcopter dynamics are explored through the classical nonlinear equations of motion. Next, quadcopter is designed, built and assembled using off-the-shelf, low-cost products to carry a camera payload which is mainly utilized for any type of surveillance missions. Experimental results demonstrate the validation of the integration and the novel software package running on an Arduino board to control autonomous quadcopter flights.

Dirman Hanafi et.al. (2013) conducted research on Simple GUI Wireless Controller of Quadcopter. This paper presents the development of remotely operated Quadcopter system. The Quadcopter is controlled through a graphical user interface (GUI) where the communication between GUI and Quadcopter is constructed by using wireless communication system. The Quadcopter balancing condition is sensed by FY90 controller and IMU 5DOF sensor. For smooth landing, Quadcopter is equipped with ultrasonic sensor. All signals from sensors are processed by Arduino Uno microcontroller board and output from the Arduino Uno microcontroller board is implemented to control Quadcopter propellers. The GUI is designed using Visual Basic 2008 Express as interfacing communication between the Proportional, Integral and Derivative (PID) controller and the Quadcopter system. The experiment shows that the Quadcopter system can hover while maintain it balancing and the stability is guaranteed. Moreover, the developed system is able to cope with load disturbance up to 250 g during the hover position. Maximum operated time of Quadcopter is six minutes using 2200 mAhLipo battery and operate time can be increased by using largest battery capacity.

Michael Y. Chen et.al. (2013) conducted research on Designing a Spatially Aware and Autonomous Quadcopter. The research team focused on continuing previous year efforts of another team to utilize commercial offtheshelf (COTS) technologies in the development of more flexible and cost-effective ISR systems. The primary goal was to design and implement an autonomous quadcopter that integrated an Android smartphone, an Arduino microcontroller, and several ultrasonic sensors to independently explore and map an unknown area. The project was broken down into three main tasks: construction of the quadcopter and integration of ultrasonic sensors, Android phone, and Arduino microcontroller, development of an Android application that generates navigation commands and avoids collisions, and development of an Android application that uses sensor data for Simultaneous Localization and Mapping (SLAM).

III. METHODLOGY WORK PLAN

In this project, as a group have decided to make a quadcopter which would be used in remote package delivering systems and rescue operations.

A. Methodology Process

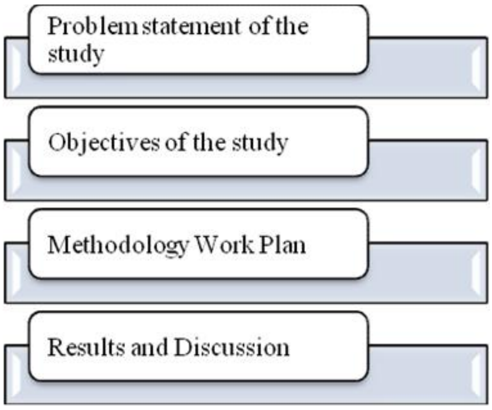

Fig.3.1. Methodology Process

B. Problem Statement

Firstly, in this study studied the associated works related to the quadcopter developments over the last few decades. Then have compiled the reviews of the individual papers and made a single literature review out of the individual papers. Next, have bought the individual components of the quadcopter. After that we have done the interfacing of individual sensors with the Arduino, then have assembled all the sensors together to achieve interfacing with Arduino and also to calibrate it. Next, have used the ESP8266 MOD as the server client concept to send some data over a WiFi network. Here we have used server to send some data over the network by generating an IP address and the client is being used here to receive those data which is being sent. For this we have done the interfacing of all the sensors individually with the ESP8266 MOD and later have combined all the sensors together to achieve interfacing with this Wi-Fi module. Next, have made all the required connections of Arduino with different sensors to make the quadcopter fly. Hence, have done the quadcopter setup with the transmitter and also Esc's (Electronic Speed Controller) calibration is made. Moreover, have uploaded the flight controller program on Arduino platform and the controlling of the quadcopter is achieved through transmitter. The only thing which needs to be done is to make it fly by controlling the transmitter.

C. Objectives of the study

The main objective of our project is to make a quad copter which could be used in rescue missions as well as in package delivering operations. The quadcopter was controlled by an Arduino microcontroller which will be program flexible according to the user. The flight was made stable with the accumulation of various sensors like the gyroscope, accelerometer and magnetometer. Additionally, a GPS module, a camera and infrared sensors was increasing its performance. The GPS module would give the coordinates of the quadcopter to where it was flying and the camera would provide live streaming of the area back to the ground controller. The quadcopter is estimated to give a flight time of nearly 6 minutes. The quadcopter was controlled using Wi-Fi instead of a radio controller to increase its range.

D. Flow chart for Quadcopter Designing

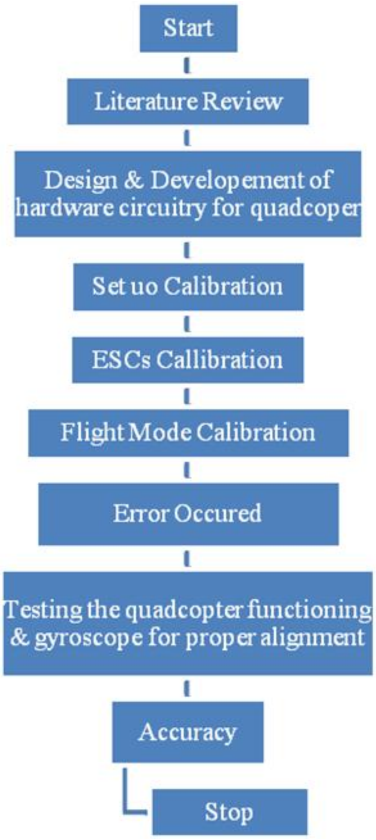

Fig.3.2. Flow chart for Quadcopter Designing

Cost Estimation Structure

Table.3.1.CostEstimationTable

Sl. No	**Componentname**	**Quantity**	**Description**	**Price(Rs.)**
1	ArduinoMega	1	Usedasthemainflightcontroller	810
2	MPU-6050	1	3-axisgyroscope&accelerometer.Usedtobalanceflight.	289
3	HMC5883L	1	Usedtosensethedirectionofflight	375
4	BME280	1	Usedtomeasurepressure,humidity ofaplace	719
5	BLDCmotors	4	Usedastherotorstoliftthequadcopterandfly	1900
6	ESCs	4	Usedtoprovidepropercurrenttothe motors	1400
7	Propellers	4	Usedtoprovidethe thrustandlifttothequadcopter.	400
8	NodeMCU Esp8266	2	Used in communication between thequadcopterandthetransmitter	898
9	Connecting Wires		Usedinconnections	200
10	Li-Pobattery	1	Usedtopowerthewholequadcopter	1200
TOTAL				8191

IV. RESULT AND DISCUSSION

Firstly, the values of different sensors are displayed on the serial monitor while interfacing with Arduino. Then, a Wi-Fi network is created and the server-client concept is implemented using two ESP8266 modules. Next, the various data of the sensors are displayed on the client side's serial monitor. Lastly, the calibration and the setup of the quadcopter is achieved through transmitter and the controlling of the motors with the different speeds of rotation is done.

A. Tools Used

➢ **Sensors**

Table.3.2. Values of Sensors

SENSORS	PARAMETERS	DISPLAYEDVALUE
1.BME280	Temperature	32.577C
	Humidity	69.8%
	Dewpoint	22.0F
	Pressure	1000.5 hPa
2. MPU6050	Gyro(Xaxis)	4.519
	Gyro(Yaxis)	10.710
	Gyro(Zaxis)	14.702
	Acc(X axis)	9.077g
	Acc(Y axis)	0.028g
	Acc(Zaxis)	1.054g
3. HMC5883L	HeadingAngle	23.2409

Datasheets

➢ **HMC5883L**

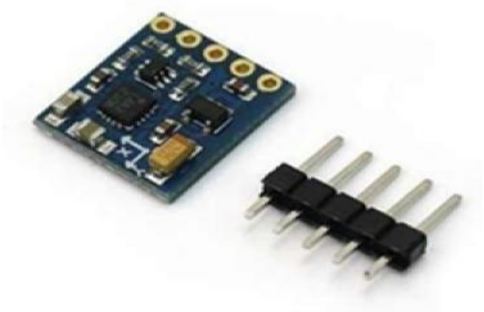

Fig.4.1. HMC5883L magnetometer front view (datasheet)

Description

The Compass Module is designed for low-field magnetic sensing with a digital interface and perfect to give precise heading information. This compact sensor fits into small projects such as UAVs and robot navigation systems. The sensor converts any magnetic field to a differential voltage output on 3 axes. This voltage shift is the raw digital output value, which can then be used to calculate headings or sense magnetic fields coming from different directions.

Specifications

- Power 3V-5VDC
- Chipset HMC5883L
- Communication via I2C protocol
- Measuring range:±1.3-8Gauss
- Dimensions14.8x13.5x3.5mm

Pin Configuration

Fig.4.2. HMC5883L magnetometer back view (datasheet)

1. VCC:3V-5VDC
2. GND: ground
3. SCL: analog input (A5)
4. SDA: analog input(A4)
5. DRDY: not connected

➢ **MPU-6050**

The MPU-60X0 is the world’s first integrated 6-axis Motion Tracking device that combines a 3- axis gyroscope, 3-axis accelerometer, and a Digital Motion Processor™ (DMP) all in a small 4x4x0.9mm package. With its dedicated I2C sensor bus, it directly accepts inputs from an external 3-axis compass to provide a complete 9-axis Motion Fusion™ output. The MPU-60X0 Motion Tracking device, with its 6-axis integration, on-board Motion Fusion™, and run-time calibration firmware, enables manufacturers to eliminate the costly and complex selection, qualification, and system level integration of discrete devices, guaranteeing optimal motion performance for consumers. The MPU-60X0 is also designed to interface with multiple non-inertial digital sensors, such as pressure sensors, on its auxiliary I2C port. The MPU-60X0 is footprint compatible with the MPU-30X0 family.

The MPU-60X0 features three 16-bit analog-to-digital converters (ADCs) for digitizing the gyroscope outputs and three 16-bit ADCs for digitizing the accelerometer outputs. For precision tracking of both fast and slow motions, the parts feature a user-programmable gyroscope full-scale range of ±250, ±500, ±1000, and ±2000°/sec (dps) and a user-programmable accelerometer full- scale range of ±2g, ±4g, ±8g, and ±16.

The MPU-6050 module has 8 pins:- INT:
Interrupt digital output pin.

AD0: I2C Slave Address LSB pin. This is 0th bit in 7-bit slave address of device. If connected to VCC then it is read as logic one and slave address changes.
XCL: Auxiliary Serial Clock pin. This pin is used to connect other I2C interface enabled sensors SCL pin to MPU-6050.
XDA: Auxiliary Serial Data pin. This pin is used to connect other I2C interface enabled sensors SDA pin to MPU-6050.
SCL: Serial Clock pin. Connect this pin to microcontrollers SCL pin. SDA: Serial Data pin. Connect this pin to microcontrollers SDA pin. GND: Ground pin. Connect this pin to ground connection.
VCC: Power supply pin. Connect this pin to +5V DC supply.
MPU-6050 module has Slave address (When AD0 = 0, i.e., it is not connected toVcc) as,
Slave Write address(SLA+W): 0xD0 Slave Read address(SLA+R): 0xD1

➢ ARDUINO MEGA

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

<u>Technical Specifications:</u>

Microcontroller: ATmega2560
Operating Voltage: 5V
Input Voltage (limits) 6-20V
Digital I/O Pins: 54 (of which 14 provide PWM output)
Analog Input Pins: 16
DC Current per I/O Pin: 40 mA
DC Current for 3.3V Pin: 50 mA
Flash Memory 256 KB of which 8 KB used by bootloader
SRAM: 8KB
EEPROM: 4KB
Clock Speed: 16MHz

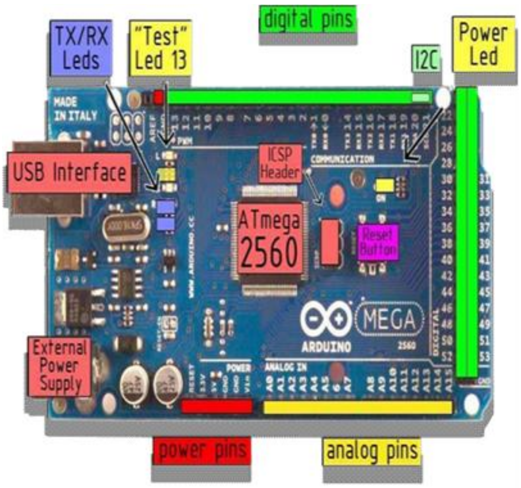

Fig.4.3. Arduino mega front view (datasheet)

The Mega2560 differs from all preceding boards in that it does not use the FTDI USB-to- serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

The ATmega2560 has 256 KB of flash memory for storing code (of which 8 KB is used for the bootloader), 8 KB of SRAM and 4 KB of EEPROM (which can be read and written with the EEPROM library).

Each of the 54 digital pins on the Mega can be used as an input or output, using pinMode(),digitalWrite(), and digitalRead()functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

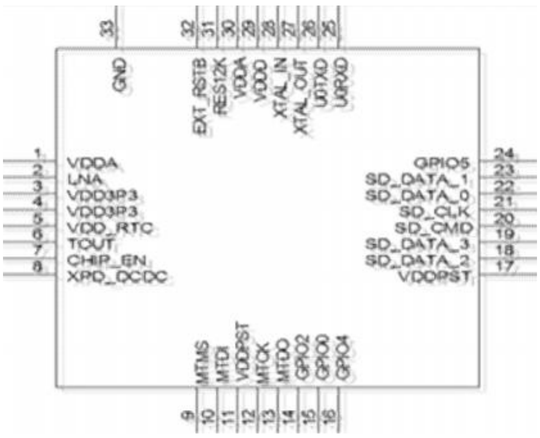

Fig.4.4. Pin configuration of Node MCU Esp8266 Wi-Fi module

➢ Wi-Fi Protocols

802.11 b/g/n/e/i support.Wi-Fi Direct (P2P) support.P2P Discovery, P2P GO (Group Owner) mode, GC(Group Client) mode and P2P Power Management. Infrastructure BSS Station mode / P2P mode / SoftAP mode support.Hardware accelerators for CCMP (CBC-MAC, counter mode), TKIP (MIC, RC4), WAPI (SMS4), WEP (RC4), CRC.WPA/WPA2 PSK, and WPS driver.Additional 802.11i security features such as pre-authentication, and TSN.Open Interface for various upper layer authentication schemes over EAP such as TLS, PEAP, LEAP, SIM, AKA, or customer specific.802.11n support (2.4 GHz).Supports MIMO 1×1 and 2×1, STBC, A-MPDU and A-MSDU frame aggregation and 0.4 μs guard interval.Multiple queue management to fully utilize traffic prioritization defined by 802.11e standard.UMA compliant and certified.802.1h/RFC1042 frame encapsulation.Scattered DMA for optimal CPU off load on Zero Copy data transfer operations.Antenna diversity and selection (software managed hardware).Clock/power gating combined with 802.11-compliant power management dynamically adapted to current connection condition providing minimal power consumption.Adaptive rate fallback algorithm sets the optimum transmission rate and Tx power based on actual SNR and packet loss information.Automatic retransmission and response on MAC to avoid packet discarding on slow host environment.Seamless roaming support.Configurable packet traffic arbitration (PTA) with dedicated slave processor-based design provides flexible and exact timing Bluetooth co-existence support for a wide range of Bluetooth Chip vendors.

- **CPU**

ESP8266EX integrates Ten silica L106 32-bit micro controller (MCU) and ultra-low-power 16-bit RSIC. The CPU clock speed is 80 MHz It can also reach a maximum value of 160 MHz The CPU includes the interfaces as below.

Programmable RAM/ROM interfaces (iBus), which can be connected with memory controller, and can also be used to visit flash.

Data RAM interface (dBus), which can have connected with memory controller. AHB interface which can be used to visit the register.

- **Memory**

ESP8266EX Wi-Fi SoC integrates memory controller and memory units including SRAM and ROM. MCU can access the memory units through iBus, dBus, and AHB interfaces. All memory units can be accessed upon request, while a memory arbiter will decide the running sequence according to the time when these requests are received by the processor.

According to our current version of SDK, SRAM space available to users is assigned as below.

RAM size < 50 kB, that is, when ESP8266EX is working under the Station mode and connects to the router, programmable space accessible in heap + data section is around 50 kB.

There is no programmable ROM in the SoC, therefore, user program must be stored in an external SPI flash.

B. Input Output Results

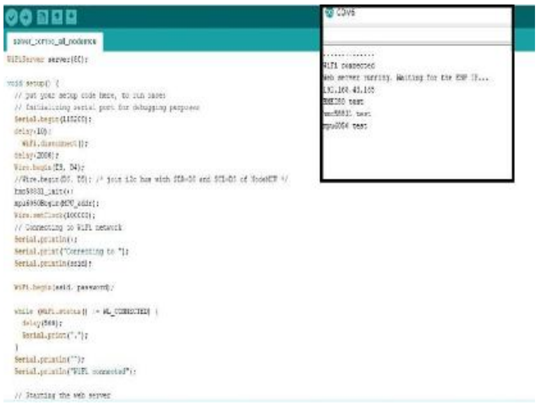

Fig.4.6. Server code & output

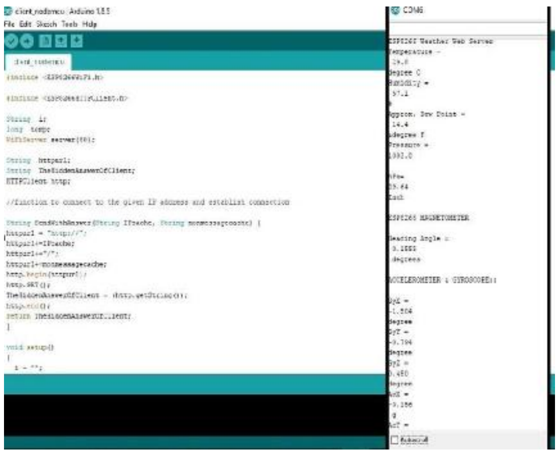

Fig.4.7. Clientcode&output

V. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The overall objective of this project endeavor was to approach the design of a man- portable drone from a system engineering standpoint. The focus was to be on the system and its use as a whole, not isolating any one or two subsystems or using an external environment to facilitate the drone movement in the terrain. The derivation of the modeling equations and the raw implementation of a simulation model and controller allowed for the understanding of the physical characteristics that dictate the behavior of the drone. The platform is comprised of several subsystems, each of which have been studied in-depth to understand how the various subsystems can work together for synergistic benefit. These systems include the avionics, sensors, actuators, chassis, and user control architecture. The test flight experiments performed using the drone build prototype indicates that successful flight is possible with adequate funding. Although faulty sensors and subsystem components paired with a lack of continued funding kept this current prototype confined to the test bench, small tweaks to the avionics loop and the addition of lipo promise to make for a stable, autonomous platform.

B. Future Scope

In this project, have developed a quadcopter using Arduino microcontroller, which will be used in remote package delivering as well as in search & rescue operations. The quadcopter at present is being manually controlled using a remote-controlled transmitter. But in future, an autonomous control can be incorporated using a pre-designed algorithm. Additionally, a camera could be fixed on the quadcopter for a live transmission of the location to where the quadcopter is flying. This feature can be used to survey a remote location from a safe location without actually going there. Also, the coordinates of the remote location can be obtained by attaching a GPS module in the quadcopter.

REFERENCES

[1] A. Al-Kafri, “Introduction To Quadcopters,” *High. Inst. Appl. Sci. Technol.*, no. January, p. 17 pages, 2016.

[2] E. S. B. Santosa and S. Waluyanti, “Teaching Microcontrollers using Arduino Nano Based Quadcopter,” *J. Phys. Conf. Ser.*, vol. 1413, no. 1, 2019, doi: 10.1088/1742-6596/1413/1/012003.

[3] O.-L. Ouabi*et al.*, “Learning the Propagation Properties of Plate-like Structures for Lamb Wave-based Mapping Learn-ing the Propagation Properties of Plate-like Structures for Lamb Wave-based Mapping Learning the Propagation Properties of Plate-like Structures for Lamb Wave-b,” *Ultrasonics*, vol. ..., no. ..., p. 106705, 2022, doi: 10.1177/ToBeAssigned.

[4] V. N. V. A. Sharma and M. Rajesh, “Building a quadcopter: An approach for an Autonomous Quadcopter,” *2018 Int. Conf. Adv. Comput. Commun. Informatics, ICACCI 2018*, pp. 1252–1258, 2018, doi: 10.1109/ICACCI.2018.8554718.

[5] M. Y. Chen *et al.*, “Designing a spatially aware and autonomous quadcopter,” *2013 IEEE Syst. Inf. Eng. Des. Symp. SIEDS 2013*, pp. 213–218, 2013, doi: 10.1109/SIEDS.2013.6549521.

[6] A. Ghosh, H. Roy, and S. Dhar, “Arduino quadcopter,” *Proc. - 2018 4th IEEE Int. Conf. Res. Comput. Intell. Commun. Networks, ICRCICN 2018*, pp. 280–283, 2018, doi: 10.1109/ICRCICN.2018.8718695.

[7] D. Hanafi, M. Qetkeaw, R. Ghazali, M. N. M. Than, W. M. Utomo, and R. Omar, “Simple GUI Wireless Controller of Quadcopter,” *Int. J. Commun. Netw. Syst. Sci.*, vol. 06, no. 01, pp. 52–59, 2013, doi: 10.4236/ijcns.2013.61006.

[8] L. N. Hung and L. S. Bon, “A quadcopter-based auto cameraman system,” *VCACS 2016 - 2016 IEEE Virtual Conf. Appl. Commer. Sensors, Proc.*, 2017, doi: 10.1109/VCACS.2016.7888783.

[9] V. Kishor and M. S. Singh, “Design and Development of Arduino Uno based Quadcopter,” *Int. J. Eng. Manuf. Sci.*, vol. 7, no. 1, pp. 14–19, 2017.

[10] A. Tagay, A. Omar, and M. H. Ali, “Development of control algorithm for a quadcopter,” *Procedia Comput. Sci.*, vol. 179, no. 2020, pp. 242–251, 2021, doi: 10.1016/j.procs.2021.01.003.

[11] A. Ji and K. Turkoglu, “Development of a low-cost experimental quadcopter testbed using an arduino controller for video surveillance,” *AIAA InfotechAerosp.*, no. January, pp. 1–12, 2015, doi: 10.2514/6.2015-0716.

[12] M. Talha, F. Asghar, A. Rohan, M. Rabah, and S. H. Kim, “Fuzzy Logic-Based Robust and Autonomous Safe Landing for UAV Quadcopter,” *Arab. J. Sci. Eng.*, vol. 44, no. 3, pp. 2627–2639, 2019, doi: 10.1007/s13369-018-3330-z.