Piloting a Drone Using Hand Gesture Control System

[1] Sanjana Reddy Nellipalli, [2]Navya Sree Pindi, [3]Maddikuntla Sai Sri, [4]Shruthika Dopathireddy,[5]Shanthi Munaganooru

[1,2,3,4]Student, [5]Assistant Professor

[1,2,3,4,5]Department of Electronics and communication Engineering

[1,2,3,4,5]G. Narayanamma Institute of Technology & Science, Hyderabad, India

[1]sanjanareddy1120@gmail.com, [2]pindinavyasree@gmail.com, [3]maddikuntlasaisri@gmail.com, [4]shruthikareddy11@gmail.com, [5]m.shanthi@gnits.ac.in

Abstract-

Nowadays, drones are employed for many different applications all around the world. The problem with methods like remote controls and joysticks is that they are prone to interference noise and have a range of electromagnetic radiation that is limited. The complexity of using a joystick-button controller, however, necessitates an experienced pilot to carry out these activities with the drone, which is extremely expensive.
In this project, we will try to solve the issue by using a motion controller to steer a drone with basic hand movements. The hand controller, the communication base, and the quadcopter are the three subsystems that make up this concept.

In this project, we will try to solve the issue by controlling the movements of a drone with just one hand using a motion controller. The hand controller, the communication base, and the quadcopter are the three subsystems that make up this concept. The positional data is sent to the communication base by the hand controller, which resembles a glove. Based on data from the hand controller, the communication base is built to determine the current gesture and communicate this information to the quadcopter using the appropriate signals. According to the commands of the communication base, the quadcopter is built to fly.

*Index Terms-***Drone, remote control, joysticks, hand-controller, quadcopter, electromagnetic radiation.**

I. Introduction

Unmanned aerial vehicles, sometimes known as drones, have recently attracted a lot of attention in fields such as the military, agriculture, industry, etc. Drones' small size and simple control are their key benefits. A low-cost system can be designed by using hand gestures as one method of controlling a drone's functioning. A multi-rotor drone with four motors attached is called a quadcopter. Using an electrical sensor and control system, the quadcopter stabilizes the flight. Even though convertiplanes and quadrotor helicopters have been flown experimentally for a long time, the configuration remained mysterious until the development of the current UAV or drone. The primary goal of this project is to build an autonomous quadcopter that can be operated via hand gestures.

II. Related Work

According to [1], authors have suggested a Gesture Controlled Quad-Copter, by representing an idea on the use of quad copter for the sake of pivotal issues like defense tasks and climate calamities, describing the sensing of hand gestures using sensors like accelerometer and gyroscope. The proposed design of gesture controlled gimble gives movement in X, Y axis when the quadcopter is in aerial flight state.

The authors in [2], has suggested Quad copter flight Dynamics, which says the precise handling is fundamental to flying by following a user-defined complex trajectory-based path and also while performing any type of missions. This paper serves as a solution to handling the quadcopter with angular precision by illustrating how the spin of the four rotors should be varied simultaneously to achieve correct angular orientation along with standard flight operations such as taking-off, landing and hovering at an altitude.

The authors in [3], have suggested Simple GUI Wireless Controller of Quadcopter, which 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.

According to [4], the authors have suggested Gesture-Controlled Quadcopter System which addresses the problem of using joystick by designing and building a one-handed gesture-controlled quadcopter.

III. System Overview

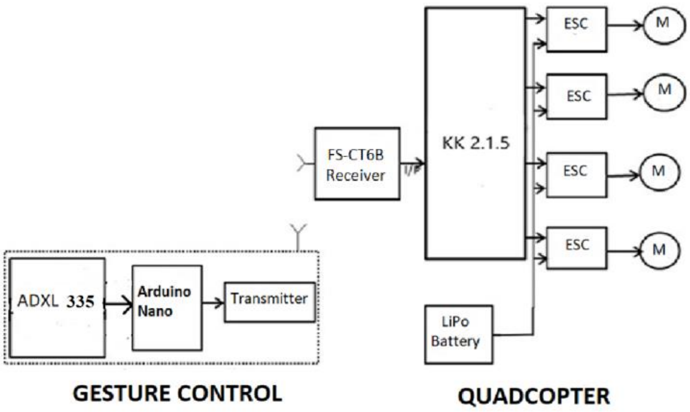

Fig 1. Block Diagram for proposed system

The flying of (mainly) quadcopters is controlled by the KK2.1 multi-rotor controller. To accomplish this, it receives signals from the on-board gyroscopes (roll, pitch, and yaw) and passes them to the Atmega324PA processor, which then processes the signals in accordance with the user's chosen firmware (for example, quadcopter) and passes the control signals to the installed Electronic Speed Controllers (ESCs). The combination of these signals tells the ESCs to fine-tune the rotational speeds of the motors. The Atmega324PA IC is connected to the aileron, elevator, throttle, and rudder user demand inputs by the KK2.1 multi-Rotor control board, which additionally utilizes radio system signals via a receiver (Rx). Once it has been analyzed, this data is transferred to the ESCs, which then modify each motor's rotational speed to regulate flying orientation (up, down, backwards, forwards, left, right, yaw)

The positional data is sent to the communication base by the hand controller, which resembles a glove. A PPM (Pulse-Position Modulation) signal that can be delivered to the quadcopter is created by the communication base using data from the hand controller. The PWM (Pulse-Width Modulation) signal from the PPM is received by the quadcopter, which turns it into an s-bus signal before sending it to the flight controller.

IV. Hardware Requirement

A. Flight Controller-KK 2.1.5

The quadcopter's brain is called a flight controller (FC). It is a circuit board with various sensors that can track the quadcopter's movement as well as user commands. This information is then used to control the motor speed, causing the craft to travel in the direction specified. The ATMEL Mega 644PA 8-bit AVR RISC-based microprocessor with 64k of memory powers the KK 2.1.5.

Fig 2. KK 2.1.5

Features:
• IC: Atmega644 PA
• Gyro/Acc: 6050MPU InvenSense Inc.
• Auto-level: Yes
• Input Voltage: 4.8-6.0V

B. Brushless DC Motors

One of a drone's most crucial components are the drone motors. By switching the polarity of the input supply, these brushless motors with extremely high RPM can rotate in either a clockwise (CW) or a counterclockwise (CCW) orientation. Specifically designed to power quadcopters and multirotor, the A2212 brushless outrunner DC motor. It has a 1000 kV motor. High performance, superpower, and stunning efficiency are all provided. These motors are ideal for medium-sized quadcopters with propellers between 8 and 10 inches in diameter. May use this to create strong, effective quadcopters.

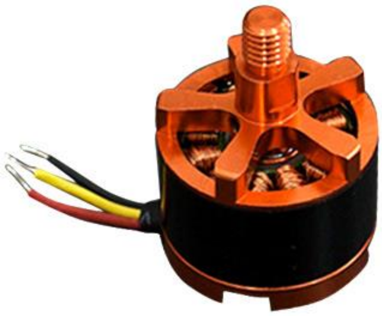

Fig 3. A2212 DC Motor

Specifications of A2212 motor:
• KV: 1000 KV(RPM/V)
• No load Current: 10 V: 0.5 A.
• Current Holding Capacity: 18A/60s
• No Load Current @ 10V: 0.5A
• LiPo Batteries: 2S-3S

C. ADXL335 Accelerometer

A compact, low-power triple axis MEMS accelerometer with extraordinarily low noise, the ADXL335, serves as the module's brain. The sensor's whole sensing range is about ±3g. In tilt-sensing applications, the accelerometer can measure both static and dynamic acceleration brought on by motion, shock, or vibration. The ADXL335 supply pins are near to a single 0.1 μF capacitor, designated CDC, which effectively isolates the accelerometer from power supply noise for the majority of applications.

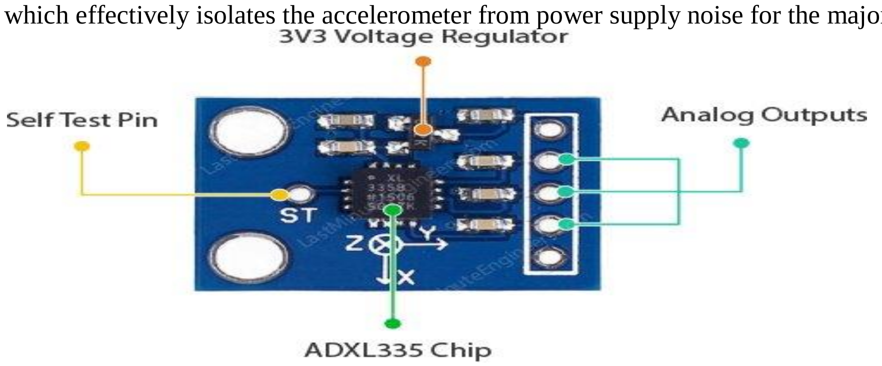

Fig 4. ADXL335 Accelerometer

Specifications:
• Operating Voltage: 1.8V – 3.6V
• Operating Current: 350μA (typical)
• Sensing Range: ±3g (Full Scale)
• Temperature Range: −40 to +85°C
• Sensing axis: 3 axes

D. Electronic Speed Controller

An electronic speed controller is a device that controls both the direction and speed of a motor. It modifies the switching rate of field effect transistors while adhering to a speed reference signal. The speed of the transistor can be altered by altering the duty cycle or switching the frequencies.

Fig 5. ESC

Specifications:
• Output: 30A continuous; 40Amps for 10 seconds
• Input voltage: 2-4 cells Lithium Polymer / Lithium Ion battery or 5-12 cells NiMH /NiCd.
• BEC: 5V, 3Amp for external receiver and servos
• Max Speed: 2 Pole: 210,000rpm; 6 Pole: 70,000rpm; 12 Pole: 35,000rpm
• Weight: 32gms
• Size: 55mm x 26mm x 13mm

E. Propellers

These are merely fans that serve to generate upward force from the motion of the motor. They are constructed of flexible fibres to prevent breaking after a crash landing. Size 10 inches 0.45 inch in thickness 0.8 inch in diameter 22 g in weight Type Pusher and puller pair.

Fig 6. Propellers

F. Battery

A straightforward rechargeable battery with various current ratings and cell counts is the lithium polymer battery, sometimes known as the Li-po battery. In this instance, lithium ions are added to the polymer, an electrolyte. Type Number of Li-po cells mAh 3S (3 cells) 5200mAh Voltage at Output 400 g for 12.5 volts

Fig 7. LiPo Battery

Features:
• Product Type: Lithium Polymer Battery Pack
• The Orange LiPo battery has matched resistance.
• Good Temperature Control.
• Minimum weight in Class

G. Transmitter & Receiver

The Transmitter serves as the user's controller. It is a wireless control system that communicates via radio. Through the antenna in a receiver, the signal from the transmitter is received by the receiver mounted to the drone's frame. The KK board receives the signal from a receiver. This board will broadcast the signal to every electronic speed controller so that the transmitter can control the motor's speed. Pulse position modulation is the modulation method utilised between the transmitter and receiver (PPM). Table 6 lists the details of the FSCT6B transmitter and receiver. channels at 2.4GHz in frequency Operating voltage: 10 to 12 volts 50 gms for the receiver 1st antenna er

Fig 8. Transmitter & Receiver

H. Frame

There are numerous different drone frame types. They have an integrated PCB for soldering ESCs and battery cables and are composed of fibre. We were able to identify the Drone's orientation thanks to different colour coding. Table 7: Drone Specifications Frame X-shaped frame Height 55mm Width 450mm Weight 280 gms holes for motor mounting

Fig 9. Frame

I. Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328.It can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The ATmega328 has 2 KB of SRAM and 1 KB of EEPROM.Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts.

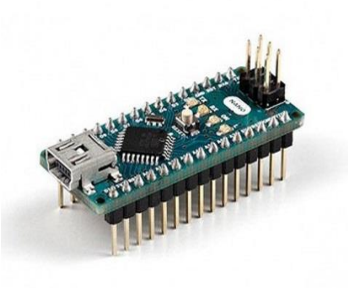

Fig 10. Arduino Nano board

J. Capacitor & Resistor

If additional decoupling is needed, a 100 Ω (or smaller) resistor or ferrite bead can be inserted in the supply line. Additionally, a larger bulk bypass capacitor (10 µF or greater) can be added in parallel to CDC.

V SOFTWARE REQUIREMENT

A. Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

VI WORKING

A. Gesture Control

- The model is controlled with the conventional transmitter and a potentiometer attached to it on a glove for controlling throttle.
- Accelerometer traces the position of the controller's hand.
- The ADXL335 outputs acceleration on each axis as an analog voltage between 0 to 5V
- Capacitors and resistors are used to convert digital signals to analog.
- These signals are sent to transmitter to control the motion of the drone.
- The glove will send the signals through the radio module in the transmitter.
- The throttle is controlled by potentiometer on the glove.

- Yaw and pitch are controlled by inputs from accelerometer sensor.

Fig 13. Hand Gesture Control Glove

B. Drone

- Flight controller receives input signals from receiver.
- KK 2.1.5 Multi-rotor LCD Flight Control Board is provided with 5 input channels on the left side and 8 output channels on the right side.
- 5 input channels are connected with the receiver while 8 output channels are connected to the ESC's to control Brushless DC Motors.
- The 4 switches on the flight controller helps in programming the quadcopter.
- The flight control board gives commands and coordinates with all the components connected to it.
- It processes the commands and executes the whole operation.
- The LiPo battery supplies power to all the components

Fig 14. Drone

VII RESULT

Initially, we have implemented the quadcopter and tested the flight of the quadcopter using fly sky transmitter. Later, Gesture Control Glove is made and integrated with quadcopter to control its flight using hand gestures.

Table 1. Drone movements with distances

Movement	Time(sec)	Distance(m)	Description
Pitch Forward	3	15	When hand is tilted forward, signal is given to move the drone by 15m in forward direction.
Pitch Backward	3	15	When hand is tilted backward, signal is given to move the drone by 15m in backward direction.
Roll Right	3	15	When hand is tilted to right, signal is given to move the drone by 15m toward right.
Roll Left	3	15	When hand is tilted to left, signal is given to move the drone by 15m toward left.
Throttle Up	1	5	Drone raises an altitude of 5m
Throttle down	1	5	Drone moves downwards by 5m.

Speed is adjustable.
Speed is 0 (min) to 5 (max) meters per second.

VIII CONCLUSION

The primary goal of this project is to apply paint using a drone. Drone fabrication and glove implementation for hand gesture control of the drone are complete. Using a hand glove, the drone is controlled. The project's goal is to replace the remote control with a hand glove for controlling the drone. An accelerometer and a potentiometer are fitted to the hand glove. Drone applications include rescue missions, eavesdropping, and studying inaccessible environments. Drones using accelerometer sensors are less expensive. An autonomous drone like the one built for this research might be put to a lot of practical uses. They are grouped in accordance with the relevant uses. Some are equipped with missiles and bombs for military use, while others are used for surveillance and reconnaissance.

XI FUTURE SCOPE

Future of agriculture will be revolutionized by quadcopters. To serve the crops and take pictures, a quadcopter camera is installed to the drone's gimbal, which can rotate up to 360 degrees. Think of surveillance as an eye in the sky. These soaring items can serve as eyes that can fly to and linger over particular spots and places. Drones can be used for espionage and intelligence gathering with remote monitoring. These can be used to conduct inspections and offer real-time video at building sites. During medical situations, drones can be used to transfer tiny medical equipment, medications, and lab samples for testing. A life could be saved if action is taken quickly. Furthermore, it is entirely possible that these flying machines will eventually find their way into a variety of businesses.

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