A MINI PROJECT-1 Report

on

DESIGN AND IMPLEMENTATION OF AN A.I-BASED UNMANNED AERIAL VEHICLE

Submitted in partial fulfillment of the requirements for the Award of the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRICAL AND ELECTRONICS ENGINEERING

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V. R. SIDDHARTHA ENGINEERING COLLEGE (AUTONOMOUS)

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(Approved by AICTE, Accredited by NBA and NAAC 'A+' GRADE)

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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CERTIFICATE

This is to certify that the MINI PROJECT-1 report titled **"DESIGN AND IMPLEMENTATION OF AN A.I-BASED UNMANNED AERIAL VEHICLE"** is a Bonafide record of work done by **CH.RAJASEKHAR(208W1A0267), G.RAJINI(208W1A0276), K.AKSHITH ROY(208W1A0286), J.SRI JAYANTH (208W1A0278)** under my guidance and supervision and is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Electrical & Electronics Engineering, V.R. Siddhartha Engineering College, (Autonomous, Affiliated to JNTUK) during the academic year 2022-2023.

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DECLARATION

We hereby declare that the work is being presented in this MINI PROJECT 1 project report **"DESIGN AND IMPLEMENTATION OF AN A.I-BASED UNMANNED AERIAL VEHICLE"** submitted towards the partial fulfillment of requirements for the award of the degree of **Bachelor of Technology** in **Electrical and Electronics Engineering** in V. R. Siddhartha Engineering College, Vijayawada is an authentic record of our work carried out under the supervision of **Dr.B.VENKATSWARA RAO, Associate Professor** in EEE Department, in V. R. Siddhartha Engineering College, Vijayawada. The matter embodied in this dissertation report has not been submitted by us for the award of any other degree. Furthermore, the technical details furnished in various chapters of this report are purely relevant to the above **MINI PROJECT-1.**

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ABSTRACT

Drone technology is becoming more and more widespread, and it has effectively destroyed old barriers between different businesses. Drones are now essential to the operation of many businesses and governmental agencies. Drones are proven to be quite useful for a variety of tasks, like examining an inaccessible region or military post and monitoring an industry or several different places.

A drone monitoring the real-time environment with the use of an Unmanned Aerial Vehicle (UAV), such as surveillance of banks, densely populated regions, aerial traffic and security monitoring, and so on, monitoring only outside areas. This project aims to design and build low-cost, lightweight UAVs for interior use as well. In indoor applications such as monitoring equipment in factories, etc. The issue is that if the drone is mishandled, it will collide with the walls or roofs, causing the drone to be damaged.

This study aims to identify the issue of drone utilization in interior applications. As a result, one of our project's objectives is to resolve the issue. Drones have recently been used for a variety of vital activities, including infrastructure inspection, crisis response, and search and rescue missions. Such drones often employ advanced computer vision algorithms to avoid obstacles, necessitating a high level of processing power.

It is also intended to carry a payload for future enhancements. To identify things, ultrasonic sensors and radar technology are employed. The PID control system is used to maintain the flight steady.

Keywords: A.I, UAV, BLDC, DRONE, PID, DRONE, SENSORS.

CONTENTS

1. INTRODUCTION

Drones, also known as unmanned aerial vehicles (UAVs), have grown in popularity in recent years due to their flexibility and variety of uses. Drones have proven to be important tools in a variety of industries, from delivery and inspection to surveillance. Drone technology has rapidly advanced, making it possible for them to carry out difficult jobs automatically with little help from humans. Yet the integration of artificial intelligence (A.I.) into drones has expanded the technology's potential, making them smarter, more effective, and safer.

A project aimed at looking into the possibility of using artificial intelligence in drone technology involves designing and implementing an AI-based drone. The goal of the project is to create an autonomous drone that can sense its surroundings and take smart decisions in response to those views. The drone is able to carry out complicated tasks that would be difficult to do manually, such as object detection, obstacle avoidance, and course planning, thanks to the application of A.I algorithms. In large metropolitan areas, there is a need for data about vehicle classes that use a particular highway or a street. A classification and counting system like the one proposed here can provide important data for a particular decision making agency. Our system uses a single camera mounted on a pole or other tall structure, looking down on the traffic scene.

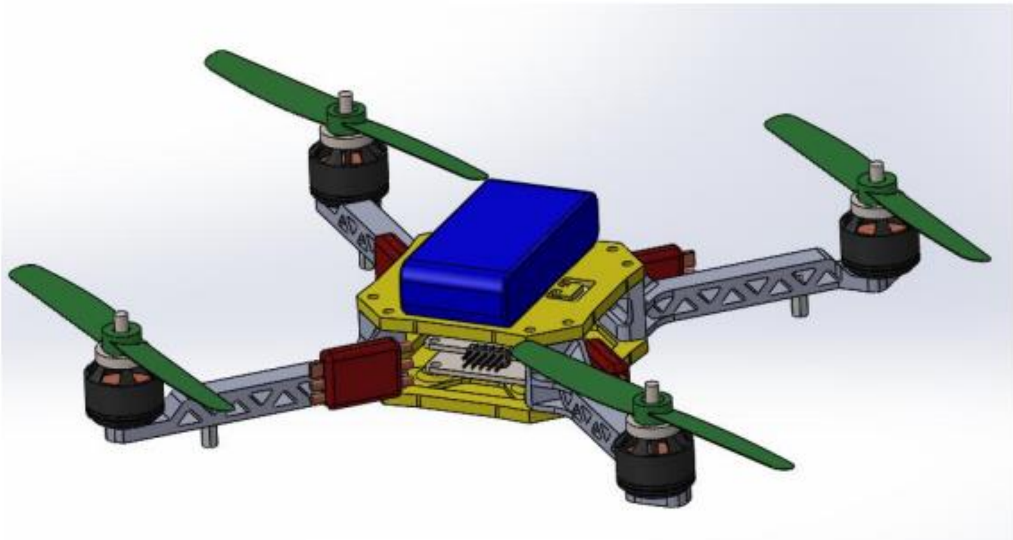

Fig.1 Design of Drone

1.1. LITERATURE REVIEW

1. The study proposes a method to design and implement an intelligent UAV system for autonomous navigation using computer vision and machine learning techniques. The proposed system can autonomously navigate through unknown environments using a combination of obstacle avoidance, target tracking, and path planning algorithms. "Design and Implementation of an Intelligent UAV System for Autonomous Navigation" by Wei Yang, Wei Lu, and Yongming Li (2018)[1]
2. This study presents the design and implementation of an autonomous quadcopter using AI techniques such as deep learning and fuzzy logic. The proposed system can perform tasks such as object detection, obstacle avoidance, and path planning in real-time. "Design and Implementation of an Autonomous Quadcopter using AI Techniques" by Nalini Sharma and Sukhdeep Kaur (2019)[2]
3. The study proposes the design and implementation of an AI-based UAV for surveillance applications. The proposed system uses AI techniques such as deep learning and computer vision to detect and track objects of interest. The system also includes a decision-making module that can autonomously decide on the course of action to be taken based on the situation. "Design and Implementation of an AI-Based UAV for Surveillance Applications" by Ahmed Al-Yamani, Azzam Sleit, and Ihab Aljarah (2020)[3]

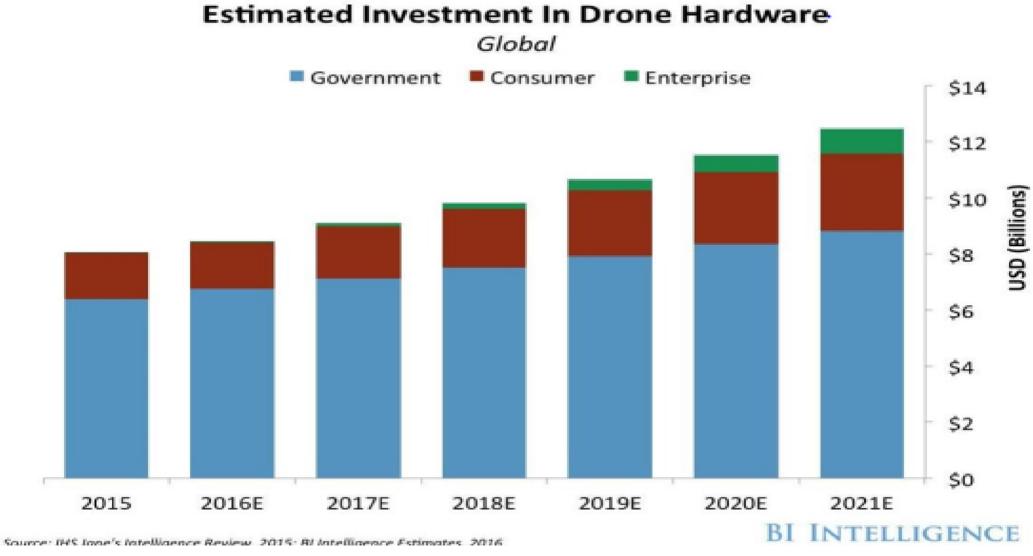

Fig.2:Investment of drone hardware(estimated)

1.2. Motivation

One of the significant challenges faced bydronesis securely navigating through congested and difficult surroundings. A critical component of drone technology is obstacle avoidance since collisions with objects or barriers can seriously harm the drone and harm people and property.We can increase the safety and reliability of drones and make them more suited for a variety of applications by building an obstacle avoidance quadcopter. Drones may be used in search and rescue efforts, for example, to find missing individuals or scan disaster areas, but in order to be effective, they must be able to move around obstacles like rubble. Similar to how they may be used for inspection and monitoring in industrial settings, collision avoidance drones can navigate through challenging areas like factories and construction sites.

And hence, the goal of developing an obstacle avoidance drone is to increase the unmanned drone vehicle's flexibility, reliability, and safety while also increasing the uses for them and improving drone technology.

1.3. Objectives of the project

The objective of this study isto create an obstacle-avoidance drone that can automatically and securely fly through challenging settings. In order to provide the drone, the ability to see its surrounds and identify obstacles in its route, this project attempts to integrate sensors inside it, such as ultrasonic, infrared, or Lidar sensors. The drone can automatically fly around obstacles and make intelligent decisions by fusing sensor data with algorithms. The resultant obstacle avoidance drone can have substantial effects on a variety of industries, including environmental monitoring, industrial inspection, search and rescue, and others where the capability to navigate through congested and dangerous environments is crucial.

2. PROBLEMDESCRIPTION

The crashing of drones due to obstacles is a major problem that has been faced by drone operators and manufacturers for many years. Obstacles such as trees, buildings, power lines, and other objects pose a significant threat to the safe operation of drones. In some cases, these obstacles are hard to see, making it difficult for drone operators to avoid them, leading to collisions and crashes. These accidents not only cause damage to the drone but can also result in serious injuries or property damage.

Additionally, drones can be expensive, and accidents involving them can result in large financial losses, especially for people or companies that depend on drones for their operations. Drones' growing use in a variety of industries, including delivery, agriculture, and surveillance, as well as their rising popularity, further amplify the issue by raising the possibility of errors.

3.CONVENTIONAL METHODS AND SOLUTIONS

There are several solutions to prevent the collision of drones with obstacles:

Sensor technology: The integration of sensors such as ultrasonic, infrared, or Lidar sensors can provide accurate distance measurements and help drones to detect obstacles in their path. This data can be used by advanced algorithms to calculate a safe flight path, allowing drones to navigate around obstacles automatically.

Computer vision technology: The use of cameras and advanced software can enable drones to recognize and avoid obstacles. Machine learning algorithms can be used to train the software to detect and classify objects, enabling the drone to navigate around them safely

GPS and mapping technology: GPS technology combined with high-resolution mapping can enable drones to navigate through complex environments safely. The mapping data can provide information about obstacles, allowing drones to avoid them.

Training and education: Proper training and education of drone operators can help to reduce the risk of collisions with obstacles. Operators should be trained on safe drone operation and the proper use of obstacle avoidance technology

4. SOLUTION

Sensor technology: Drones can be equipped with sensors, cameras, and lidar technology to detect obstacles and other drones in their vicinity. These systems work together to identify potential collisions and take evasive action to avoid them. Sensors are used to detect the presence of objects, while cameras provide visual data to help the drone navigate its environment. Lidar technology uses lasers to create a 3D map of the drone's surroundings, allowing it to identify obstacles and other drones with high accuracy.

Once a potential collision is detected, the drone's collision avoidance system acts to avoid it. This can involve changing the drone's flight path, adjusting its altitude, or even stopping the drone altogether to prevent a collision. In addition to preventing collisions, collision avoidance technology can also improve the overall safety of drone operations. By providing drones with real-time information about their environment, pilots can make more informed decisions about how to operate their drones safely.

4.1 Working Principle

Drones, also known as unmanned aerial vehicles (UAVs), are aircraft that are operated remotely or autonomously without a human pilot on board. The working principle of a drone involves a combination of hardware and software components that work together to control the drone's flight.

Here are the basic components and working principles of a drone:

Frame and Body: The frame and body of a drone provide the structure and support necessary to hold all of the components together. They are usually made of lightweight materials such as carbon fiber or plastic to reduce weight and increase maneuverability.

Propellers and Motors: Drones use electric motors to power their propellers, which provide the lift and thrust needed to keep the drone airborne. The number and placement of the propellers vary depending on the drone's design and purpose.

Flight Controller: The flight controller is the brain of the drone. It receives data from the sensors and translates it into commands for the motors, which control the drone's movement and stability.

Sensors: Drones are equipped with a variety of sensors, including GPS, accelerometers, gyroscopes, and barometers, to gather information about the drone's position, altitude, orientation, and speed.

Remote Control: The remote control or transmitter allows the pilot to communicate with the drone and control its movement, altitude, and orientation.

Battery: Drones are powered by rechargeable batteries that provide the electricity needed to operate the motors and other components.

Camera and Payload: Many drones are equipped with cameras or other sensors to capture images, video, or data for various applications, including photography, videography, mapping, surveillance, and research.

The working principle of a drone involves the interaction between these components to achieve controlled flight. The flight controller uses information from the sensors to adjust the speed and direction of the motors, which control the movement and stability of the drone. The pilot uses the remote control to send commands to the drone and adjust its altitude, orientation, and speed. The battery provides the power needed to operate the motors and other components, while the camera or payload captures data for various applications.

4.2 Architecture Design(hardware model description)

1. Propellers:

The primary working of the frame is to hold all equipment and the propellers work is to blow the wind downwards, basically, these are made with different materials like ABS plastic, carbon fiber, nylon and glass fibers, aluminum etc. among them carbon fiber is preferable because of its weight consideration and toughness.

The physics behind a fixed-pitch propeller, the kind typically found on all camera drones, is simple. When a motor spins, the propeller does as well, causing the wind to blow downwards. Once spinning fast enough, the wind is enough for the aircraft to ascend, and when the motors slow down it descends.

This is a structure (frame) in which all the other parts fit in. It acts as a skeleton in which different components are placed in such a manner that they uniformly distribute the drone's center of gravity. Different drone designs have different quadcopter frames with a minimum of 3 propeller fitting gaps

The propellers are usually located at the front of the Quad copter. There are very many variations in terms of size and material used in the manufacture of propellers. Carbon plastic propellers (10*4.5 inch) as in Fig.3

Fig.3:propellers

2. Brushless Motors:

Brushless DC electric motors also known as electronically commutated motors (ECMs, EC motors). Primary efficiency is the most important feature for BLDC motors. Because the rotor is the sole bearer of the magnets and it doesn't require any power i.e., no connections, no commutator and no brushes. In place of these, the motor employs control circuitry. To detect where the rotor is at certain times, BLDC motors employ controllers, rotary encoders or a Hall sensor.

In this motor, the permanent magnets attached to the rotor. The current-carrying conductors or armature windings are located on the stator. They use electrical commutation to convert electrical energy into mechanical energy

BLDC motor works on the principle similar to that of a brushed dc motor. The Lorentz force law states that whenever a current-carrying conductor is placed in a magnetic field it experiences a force. As a consequence of the reaction force, the magnet will experience an equal and opposite force. In the BLDC motor, the current-carrying conductor is stationary and the permanent magnet is moving. A general rule is that the motors should be able to provide twice as much thrust as the total weight of the quad. If the thrust provided by the motors is too little, the quad will not react well to your control and may even experience issues on take-off.

You may infrequently observe something like “12N14P”. The number before the letter N refers to the number of electromagnets in the stator, and the number before P refers to the number of perpetual magnets in the motor.

In BLDC motors there's an important rating called KV it doesn’t mean voltage it means the ratio of no-load rpm to respective voltage for example a 1000kv motor runs at (5x1000rpm) for 5v under ideal conditions. Brushless motors are considered to be more efficient in terms of performance and operation as opposed to the brushed motors. Here 1000kva motors are used, it means for 1v 1000rpm it will rotate as shown in Fig.4

Fig.4:BLDC motor

3.Electronic Speed Controllers:

The term ESC stands for electronic speed controller is an electronic circuit used to change the speed of an electric motor, its route and also to perform as a dynamic brake. By activating the appropriate MOSFETs to create the rotating magnetic field so that the motor rotates. The higher the frequency or the quicker the ESC goes through the 6 intervals, the higher the speed of the motor will be. One need to know the position of the rotor and there are two common methods used for determining the rotor position 1.EMF method 2. Hall sensor method. There are three essential components like a voltage regulator/BEC, a processor and switching FETS. THE BEC is a separation of electronic speed control that will transmit power back to your receiver after that to servos this also includes one secondary function like when the motor is operated through a battery then the motor gets the smallest 6 voltage then the BEC will keep some power for the flight control in dangerous situations so the motor doesn’t total power from the battery.The main function of this processor is to decode the data being provided to it from the receiver within the model as well as to regulate the power toward the motor using FETs. In an ESC, this transistor plays a key role by performing all the work. It observes the complete current & voltage of the motor as well as a battery. This transistor works like a switch to control the current flow to throttle the electric motor.

Specifications of 30A esc: Constant Current: - 30A (Max 40A<10s)

BEC: 5V 3A

Input Voltage: 11.1 ~ 11.7 V.

Li-Po battery: 2S ~ 3S.

Ni-MH 4-10 CELLS Auto Detect.

It's a Mosfet based switch which controls power to motor here in this project Simonk 30A Esc are used as in Fig.5

Fig.5:ESC

4.Flight Controller:

The flight controller is basically the motherboard of the drone. It is responsible for all the commands that are issued to the drone by the pilot. Here in this project KK2.1.5 board is used as shown in Fig.6.

Fig.6:Flight controller

5. Receiver:

The receiver is the unit responsible for the reception of the radio signals sent to the Quad copter drone through the controller as in Fig.7

6.Transmitter:

The FlySky FS-i6 is a great low-cost entry level 6-channel 2.4 GHz Transmitter and Receiver that uses solid and reliable Automatic Frequency Hopping Digital System (AFHDS) spread spectrum technology. The FlySky FS-i6 has both a nice quality look and feel, while the programming is simple to use. It also comes with a FS-iA6 6-channel receiver. Suitable for controlling Quadcopetrs, Multirotor, Heli, and Airplane, the FlySky FS-i6 is a superb budget computer radio for both new pilots and experienced pilots alike. The ultra slim case design ergonomically fits your hands leading to less hand fatigue especially during long flights. With a low-profile antenna, the FS-i6 is easy to store and no worries about breaking it. Adjustable length sticks, and a loop for attaching a neck strap round out the list of comfort features this radio offers. For changing flight modes or multiple flap position options, the FS-i6 has a 3-position switch, as well as two adjustable knobs. Expand the capabilities of your models or just know what is going on with the optional telemetry receivers and variety of sensors. Normally you would have to spend hundreds of dollars to get a transmitter with this capability. Not so with the availability of the FS-i6. The transmitter is the unit responsible for the transmission of the radio signals from the controller to the Quadcopter drone to issue commands of flight and directions as in Fig7

Fig.7:Receiver

7. Battery:

This battery is a rechargeable battery. It is a lithium-ion technology using a polymer electrolyte instead of a liquid one. The device which converts chemical energy into electrical energy is called a battery. LIPO stands for lithium-ion polymer battery or Lithium polymer battery. The abbreviations for this battery are Lipo, LIP, and Li-poly etc. These batteries provide higher specific energy as compared to other lithium battery types. They are used in applications where weight is a critical feature, like mobile devices and radio-controlled drones and aircraft the battery is the part of the drone that makes all actions and reactions possible. Without the battery, the Quadcopter drone powered from this source, example as shown in Fig.8

Fig.8:Battery

8.Arduino:

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

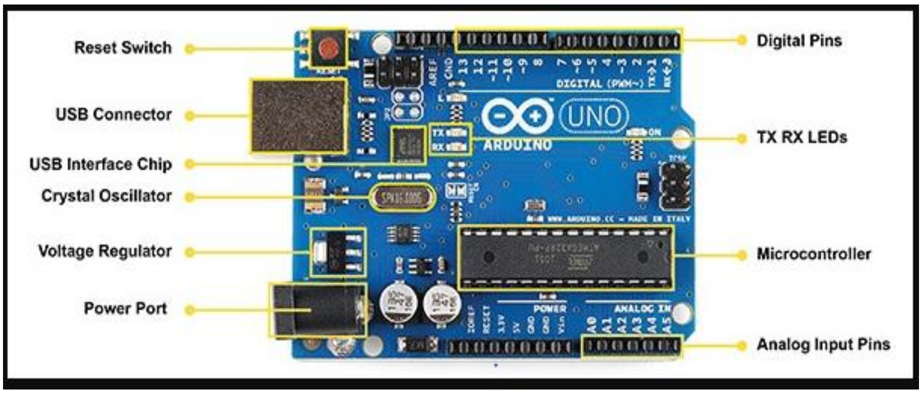

Fig.9:ARDUINO Board

9.Ultra-Sonic sensor:

The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. It's ideal for any robotics projects you have which require you to avoid objects, by detecting how close they are you can steer away from them!

Fig.10:Ultrasonic Sensor

10.Buzzer Sensor:

An active buzzer sensor module has a built-in oscillation circuit; thus, the sound frequency is fixed. It is able to generate the sound itself. So, you can simply turn it on and off with an Arduino pin, just like the way of turning on and off a Led which is connected to Arduino board.

Fig.11:Buzzer

4.3 Working of ARDUINO Board

An Arduino board can be used to interface with an ultrasonic sensor. Here are the general steps:

1. Connect the ultrasonic sensor to the Arduino board. Typically, an ultrasonic sensor has four pins: VCC, GND, TRIG, and ECHO. Connect VCC to the 5V pin on the Arduino, GND to the GND pin, TRIG to a digital pin (for example, pin 2), and ECHO to another digital pin (for example, pin 3).
2. Write a program in the Arduino Integrated Development Environment (IDE) that reads the distance measured by the ultrasonic sensor. The program should do the following:
   - Send a 10-microsecond pulse to the TRIG pin to trigger the sensor.
   - Measure the time it takes for the pulse to bounce back and be received by the ECHO pin.
   - Convert the time to distance using the formula: distance = time * speed_of_sound / 2, where speed_of_sound is the speed of sound in air (around 343 meters per second).
   - Output the distance to a display, such as a serial monitor or an LCD screen.
3. Upload the program to the Arduino board using a USB cable.
4. Power on the Arduino board.
5. The program will now continuously read the distance measured by the ultrasonic sensor and output it to the display.

Note that the above steps are just a general guideline. The exact steps and program code will depend on the specific ultrasonic sensor and Arduino board being used. It's important to consult the sensor and board documentation and follow best practices for interfacing and programming.

4.4 Workingof Sensors Using Tinker Cad Software

To simulate the working of multiple ultrasonic sensors using Tinkercad software, you can follow these steps:

1. Open Tinkercad: Go to the Tinkercad website (www.tinkercad.com) and sign in to your account. If you don't have an account, you can create one for free.
2. Create a New Circuit: Click on the "Create new design" button to start a new project.
3. Add Components: In the Components panel on the right-hand side, search for "Ultrasonic Sensor" and drag one onto the workspace. Repeat this step to add more ultrasonic sensors according to the number you want to simulate.
4. Connect Components: For each ultrasonic sensor, you will need to connect the pins to the Arduino board. Each sensor has four pins: VCC, Trig, Echo, and GND. Connect the VCC pin of each sensor to the 5V pin on the Arduino board, the GND pin to the GND pin, the Trig pin to a digital pin (e.g., Pin 2), and the Echo pin to another digital pin (e.g., Pin 3). Make sure to connect them appropriately.
5. Code the Arduino: Click on the Code button at the top of the Tinkercad interface to open the Arduino code editor. In the editor, you can write the code to control the ultrasonic sensors. Here's an example code that reads distance measurements from multiple sensors:
6. Simulate and Test: After writing the code, click on the Start Simulation button to simulate the circuit. You should be able to see the measurements from each ultrasonic sensor in the Serial Monitor.

By repeating steps 3 to 6, you can add and simulate multiple ultrasonic sensors in Tinkercad using Arduino. Remember to adjust the pin connections and code accordingly for each additional sensor you add to the circuit**.**

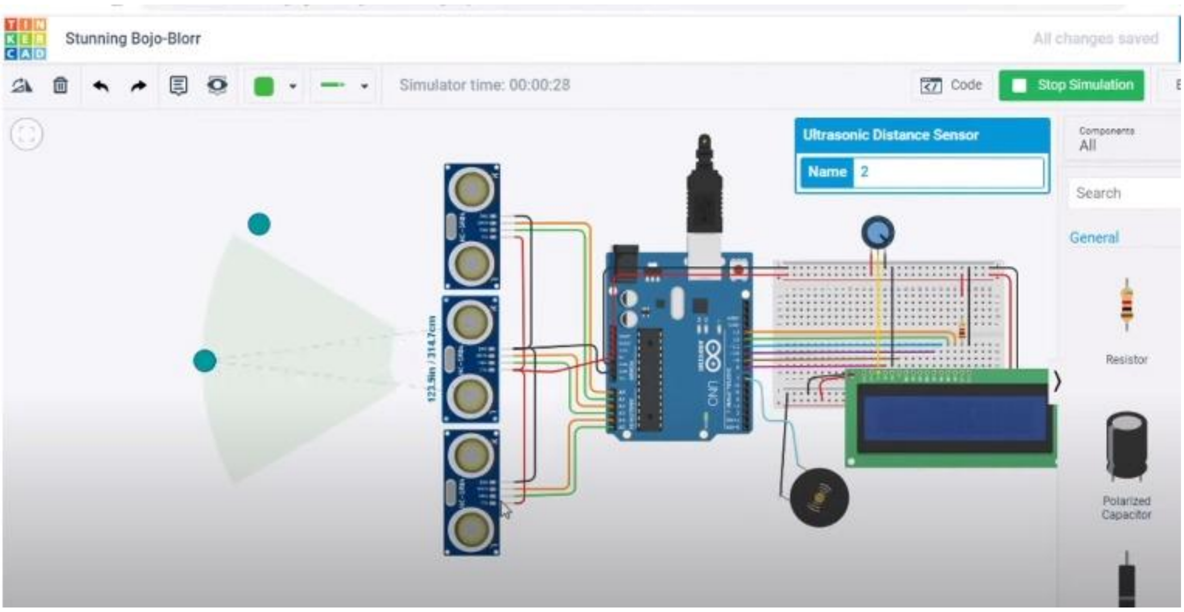

Fig.12:Tinker CadSoftware

C Program:

```
const int trigPin1 = 2;

const int echoPin1 = 3;

const int trigPin2 = 4;

const int echoPin2 = 5;


void setup() {

Serial.begin(9600);

pinMode(trigPin1, OUTPUT);

pinMode(echoPin1, INPUT);

pinMode(trigPin2, OUTPUT);

pinMode(echoPin2, INPUT);

}

void loop() {

  long duration1, distance1;

  long duration2, distance2;
```

```
  // Sensor 1
digitalWrite(trigPin1, LOW);
delayMicroseconds(2);
digitalWrite(trigPin1, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin1, LOW);
  duration1 = pulseIn(echoPin1, HIGH);
  distance1 = (duration1 / 2) / 29.1;

  // Sensor 2
digitalWrite(trigPin2, LOW);
delayMicroseconds(2);
digitalWrite(trigPin2, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin2, LOW);
  duration2 = pulseIn(echoPin2, HIGH);
  distance2 = (duration2 / 2) / 29.1;

  // Print distances
Serial.print("Distance from Sensor 1: ");
Serial.print(distance1);
Serial.print(" cm");
Serial.print("Distance from Sensor 2: ");
Serial.print(distance2);
Serial.print(" cm");
delay(1000);
}
```

5.BLOCK DIAGRAM

A drone consists of a flight controller, motors, ESCs, a battery, a radio transmitter/receiver, and sensors. The flight controller processes sensor data for stability and control. Motors provide thrust, ESCs regulate their speed and direction, and the battery powers the drone. The radio transmitter/receiver enables remote control. Sensors gather information on orientation, altitude, position, and obstacles.

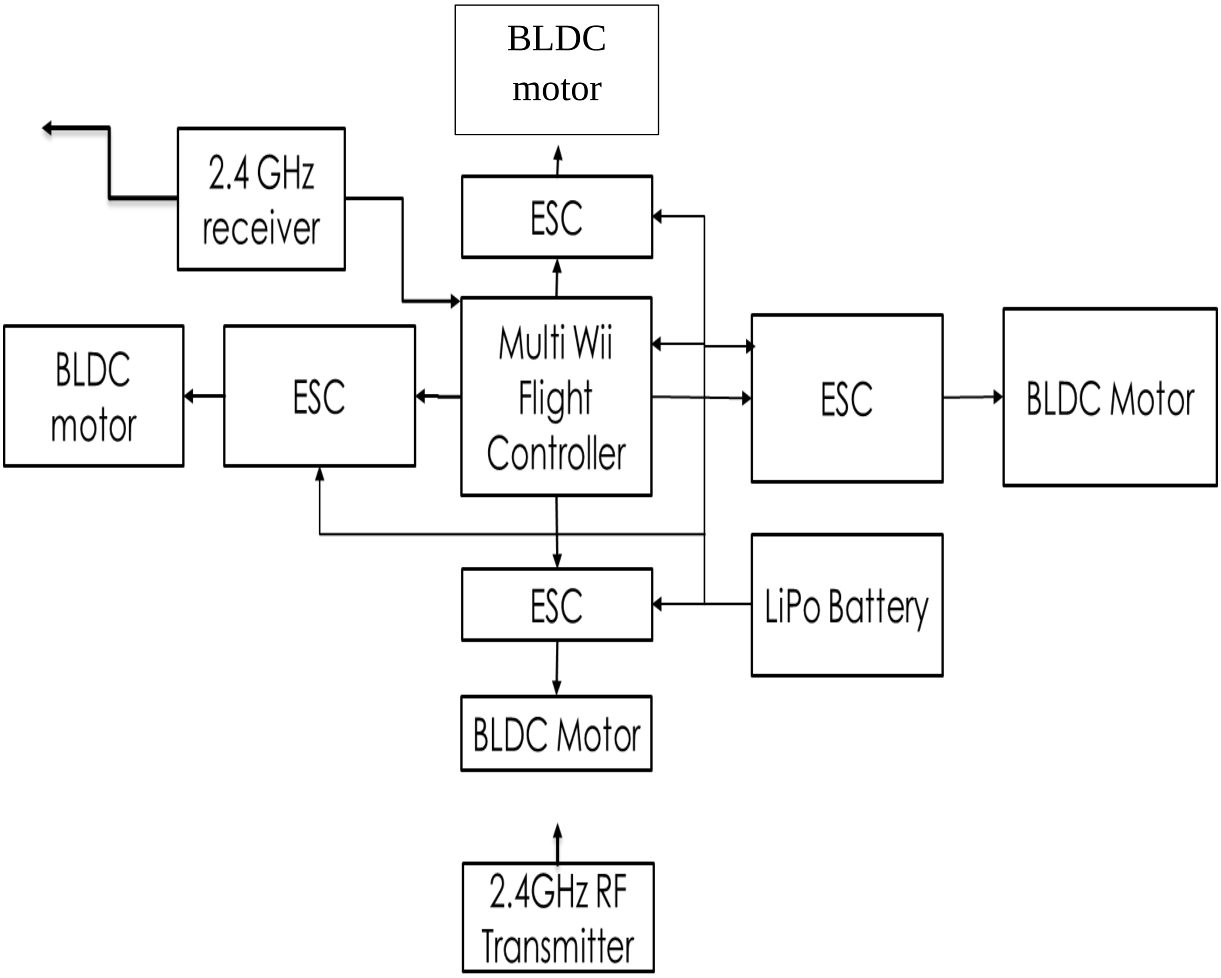

Fig.13:Block diagram for Drone

6.Technical Specifications

The drone's technical specification is nothing more than a document that through technical data makes a clarified description for the drone's specific use, functionality, or performance levels. We should hence abridge the previous concept by claiming that the quadcopter's technical specification is a set of key performance indicators (KPIs), which is able to describe the performance competence of a quadcopter. The set of the significant technical data or the technical specification plays a crucial role when it comes to make a formal decision about choosing the ideal drone; especially, when making a comparison between different quadcopter models. Nonetheless, when acquiring the right indicators of the technical specifications is not always easy for two reasons. The first onebecause some fundamental parameters are hidden by some manufacturers as they are not optimal when compared to the rivalry [20].

Metric	Value
Dimensions	405mm x 371mm x 70mm
Weight	1000 g
Power	200 W
Rotors	4
Propellers	10" x 4.5" (10 inches in diameter and 4.5 inches in pitch).
Battery	3300 mAh (C) 3S LiPo 35C (Max)
Controller	Arduino uno
Payload Mass	150 g
Diagonal Size (Propellers excluded)	520 mm
Motors (for medium size quadcopter 500mm)	A2212 brushless outrunner dc motor, 1000kv. No load current @ 10V: 0.5A Thrust @ 3S with 1045 propeller: 800gms approx.
Current Capacity	12A/60s
Motor Dimensions	27.5 x 30mm
ESC Specification	18A (30A Recommended)
Propellers RPM	7536 RPM
Input Voltage	11.1V
Pitch Speed	32.1 MPH (51 KMH)
Efficiency	80%
Weight that the drone can lift	2 kg or more
Flight Time	Up to 15 minutes

7.LIST OF COMPONENTS AND THEIR SPECIFICATION

S. No	Name Of Component	Quantity	Specification	Cost
1	Quad copter frame	1	F450	800
2	Flight controller	1	KK2.1.5	2800
3	Arduino	2	Arduino UNO	800
4	Lipo battery	1	12v,3300mah,3s	3200
5	Motors	4	1000kva ,bldc	1400
6	propellers	4	Carbon fibre 10*4.5 inch	200
7	FlySky FS-i6	1	2.4G 6CH PPM RC Transmitter With Receiver	3800
8	Sound sensor	2	Digital output type	200
	Total			13,520

8.RESULTS

Obstacle avoidance drones are equipped with sensors and algorithms that allow them to detect and avoid obstacles in their path. Here are some of the potential results of using obstacle avoidance drones:

1. Increased Safety: Obstacle avoidance drones can help reduce the risk of collisions and crashes, which can be particularly important in industries such as search and rescue, inspection, and surveying.
2. Improved Efficiency: Obstacle avoidance drones can fly autonomously, which can save time and reduce the need for human intervention. They can quickly navigate complex environments, avoiding obstacles and optimizing their flight path.
3. Enhanced Accuracy: Obstacle avoidance drones can be programmed to fly along precise paths and capture data or images from specific angles. This can be particularly useful in industries such as agriculture, where farmers need accurate data to make informed decisions about their crops.
4. Expanded Capabilities: Obstacle avoidance drones can be used in environments where traditional drones cannot operate, such as indoor or urban settings. This can open up new applications and use cases for drones.
5. Reduced Costs: Obstacle avoidance drones can help reduce the costs associated with drone operations, such as repairing or replacing damaged drones, and the costs of insurance and liability.
6. Overall, obstacle avoidance drones can help increase safety, efficiency, and accuracy in a variety of industries. They have the potential to revolutionize the way we approach tasks that were previously difficult or dangerous

Fig.14:Drone at flying condition

9. CONCLUSION

In conclusion, obstacle avoidance technology has become an essential feature in the development of drones. Drones equipped with obstacle avoidance sensors are capable of detecting obstacles in their path and autonomously adjusting their flight path to avoid collisions. This technology is particularly important for drones used in industries such as aerial photography, surveying, and search and rescue missions.

There are several obstacle avoidance technologies available, including infrared, ultrasonic, and optical sensors, as well as computer vision and machine learning algorithms. Each technology has its advantages and limitations, and the choice of technology depends on the specific application and environment in which the drone will be operating.

Overall, obstacle avoidance technology has greatly improved the safety and efficiency of drone operations. As the demand for drones continues to increase, we can expect to see further advancements in obstacle avoidance technology that will enhance the capabilities of these unmanned aerial vehicles.

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