IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

TITLE: Implementation of Drone Based Pesticides Spraying system for Agriculture.

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Abstract

One of the main sources of income in India is Agriculture. The production rate of the crop is based on various parameters such as temperature, humidity, rain, etc, These natural factors not control by farmers. The field Agriculture also depends on some biological factors like diseases, pests, etc which can be controlled by farmers. Pesticides, fertilizers, etc helpful to increase the productivity of crops but also affect human health. So the main aim of this paper is to propose the development of an autonomous unmanned aerial vehicle (UAV) for pesticides, fertilizer spraying purpose which is control by wireless technology through a mobile application. This proposed design is capable to fly autonomously and also capable to track pre-loaded missions automatically. Proposed model based on the Internet of Things (IoT). This system used MPU6050 (3-axis accelerometer) which ensures its smooth movement. GPS system makes it more efficient in autonomous mode. All signal is processed by a powerful board which makes it more efficient and effective. This work aimed to design a quadcopter with a spraying mechanism for spraying pesticides.

Keyword: Spraying, Unmanned Arial Vehicles, Brushless Motors, Mobile Application, ESC wires, Li-Po.

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1. INTRODUCTION

Agriculture constitutes more than 60% of occupation in India. It serves to be the backbone of the Indian economy. It is important to improve the productivity and efficiency of agriculture by providing safe cultivation. Agriculture production depends on an environmental parameter such as temperature, rain, etc, It also affected by other biological factors such as diseases, pests, etc. These biological factors can be controlled by a human being with the help of pesticide spraying, ultimately it helps to improve productivity. Pesticides exposure affects human health and causes neurological and skin diseases. According to a survey conducted by WHO (World Health Organisation), They declared in every year about 3 million workers are affected by poisoning from pesticides from which a minimum of 18000 dies. This paper aims to propose the project idea which helps to overcome the ill effect of pesticides on a human being and helps to reduce the human efforts, also used to spray pesticides, fertilizer over large areas in a small interval of time by using automated areal pesticides sprayer. This model basically combination of spraying mechanism on the quadcopter frame. The autonomous quadcopter uses to spray pesticides, fertilizer with own balancing capability and flying from origin to goal using pre-set path direction. This universal spraying system uses to spray fertilizer, pesticides using the universal nozzle. The quadcopter is four-armed and four-rotor motor propelled helicopter with high stability and performance. The farmer can start pesticides spraying using the drone, Drone can lift 15 litres of load at one time, Load lifting capacity depends on thrust and torque generation capacity of the motor. In India individual farms are small and the use of a drone is useless, A group of farmers can buy this drone and use it for spraying the field.

2.SYSTEM ANALYSIS

Requirement analysis is the process of defining the expectation of a user for an application that is modified:

2.1 Hardware Analysis

- Arduino Microcontroller (Uno)
- Brushless DC Motor (EMAX MT3515)
- Li-Po Battery
- E.S.C.(40 or 60amp)
- NodeMCU or WiFi Module(ESP8266)
- GPS Module (NEO 6M)
- Gyro Scope (MPU6050)
- Ultrasonic Sensor
- Sprayer Module

2.2 Software Analysis

- Arduino IDE
- Android Studio

3. METHODS AND ALGORITHM

3.1 System Overview

To design a stable quadcopter needed to maintain some physics, mathematics and aerodynamic term. Aerodynamic helps to define movement and inertial motion. In other mathematical calculations help to lift force, balancing module, angular position graceful motion and trajectory definition.

We design a drone with a hardware system consist of different sensors. For the desire, the movement controller takes data from the sensor. 3-axis gyroscope provides data on its orientation, acceleration, and angular rate. GPS module help to make system autonomous. It helps to find out any coordinate and rich to this coordinate. Also, the quadcopter design with a spraying mechanism includes a sprayer module and nozzle, which is helpful to spray pesticides, fertilizer, etc.

Fig-1: Drone–Pesticide Spraying System Overview

The quadcopter(Agro-copter) also implemented with its control system. The wireless technology involves a mobile application to control quadcopter. Firebase(Realtime Database) provides an interface for communication between the drone and mobile application, So all instructions pass to drone through firebase. A mobile application help to transmit an instruction to the drone, So all instruction updated on firebase by the user through mobile and firebase help to instruct drone. That is the quadcopter reads signals from firebase and behaves or acts according to signal.

Fig-2 : Agriculture Spraying System with Drone

3.2 SYSTEM BLOCK DIAGRAM

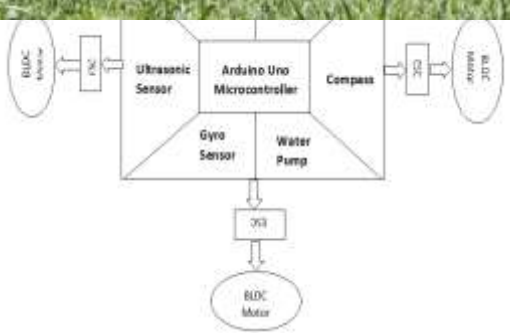

Fig-3: Proposed Block Diagram of UAV

3.3 E.S.C CALIBRATION

This algorithm help to calibrate to the E.S.C., In E.S.C. contain signal pin which connect to i/o digital pin :

```
#include <Servo.h>
#define MIN_PULSE_LENGTH 1000
#define MAX_PULSE_LENGTH 2000

Servo motA;
char data;
void setup() {
  Serial.begin(9600);

  motA.attach(4, MIN_PULSE_LENGTH,
MAX_PULSE_LENGTH);
  displayInstructions();
}

void loop() {
  if (Serial.available()) {
    data = Serial.read();
    switch (data) {
      case 48 : Serial.println("Sending minimum
throttle");

motA.writeMicroseconds(MIN_PULSE_LENGTH
);
              break;
      case 49 : Serial.println("Sending maximum
throttle");

motA.writeMicroseconds(MAX_PULSE_LENGT
H);
              break;
      case 50 : Serial.print("Running test in 3");
              delay(1000);
              Serial.print(" 2");
              delay(1000);
              Serial.println(" 1...");
              delay(1000);
              test();
      break;
    }
  }
}
void test()
{
  for (int i = MIN_PULSE_LENGTH; i <=
MAX_PULSE_LENGTH; i += 5) {
    Serial.print("Pulse length = ");
    Serial.println(i);
    motA.writeMicroseconds(i);
    delay(200);
  }
  Serial.println("STOP");
```

```
motA.writeMicroseconds(MIN_PULSE_LENGTH
);
}
void displayInstructions()
{
   Serial.println("READY - PLEASE SEND
INSTRUCTIONS AS FOLLOWING :");
   Serial.println("\t0 : Send min throttle");
   Serial.println("\t1 : Send max throttle");
   Serial.println("\t2 : Run test function\n");  }
```

3.4 GYRO SCOPE CALIBRATION

This algorithm helps to calibrate the gyro sensor, In gyroscope SDA, SCL pin connect to SDA, SCL to the microcontroller and also connect signal pin :

```
#include "I2Cdev.h"
#include "MPU6050.h"

#if I2CDEV_IMPLEMENTATION ==
I2CDEV_ARDUINO_WIRE
   #include "Wire.h"
#endif

MPU6050 accelgyro;

int16_t ax, ay, az;
int16_t gx, gy, gz;

#define OUTPUT_READABLE_ACCELGYRO
#define LED_PIN 13
bool blinkState = false;

void setup() {
   #if I2CDEV_IMPLEMENTATION ==
I2CDEV_ARDUINO_WIRE
      Wire.begin();
   #elif I2CDEV_IMPLEMENTATION ==
I2CDEV_BUILTIN_FASTWIRE
      Fastwire::setup(400, true);
   #endif

   Serial.begin(38400);
   Serial.println("Initializing I2C devices...");
   accelgyro.initialize();

   Serial.println("Testing device connections...");
   Serial.println(accelgyro.testConnection() ?
"MPU6050 connection successful" : "MPU6050
connection failed");

   pinMode(LED_PIN, OUTPUT);
}

void loop() {
   accelgyro.getMotion6(&ax, &ay, &az, &gx,
&gy, &gz);
   #ifdef OUTPUT_READABLE_ACCELGYRO
      Serial.print("a/g:\t");
      Serial.print(ax); Serial.print("\t");
      Serial.print(ay); Serial.print("\t");
      Serial.print(az); Serial.print("\t");
      Serial.print(gx); Serial.print("\t");
      Serial.print(gy); Serial.print("\t");
      Serial.println(gz);
   #endif

   #ifdef OUTPUT_BINARY_ACCELGYRO
      Serial.write((uint8_t)(ax >> 8));
Serial.write((uint8_t)(ax & 0xFF));
      Serial.write((uint8_t)(ay >> 8));
Serial.write((uint8_t)(ay & 0xFF));
      Serial.write((uint8_t)(az >> 8));
Serial.write((uint8_t)(az & 0xFF));
      Serial.write((uint8_t)(gx >> 8));
Serial.write((uint8_t)(gx & 0xFF));
      Serial.write((uint8_t)(gy >> 8));
Serial.write((uint8_t)(gy & 0xFF));
      Serial.write((uint8_t)(gz >> 8));
Serial.write((uint8_t)(gz & 0xFF));
   #endif

   blinkState = !blinkState;
   digitalWrite(LED_PIN, blinkState);
}
```

4. IMPLEMENTED DESIGN

Total hardware design of proposed UAV is given below :

Fig-4: Real view of the implemented design

Fig-5: Complete View of assemble drone mounted sprayer

4.1 SOFTWARE IMPLEMENTED DESIGN

4.1.1 Welcome Page

The welcome page shown below contain one link for main window page of the dashboard page:

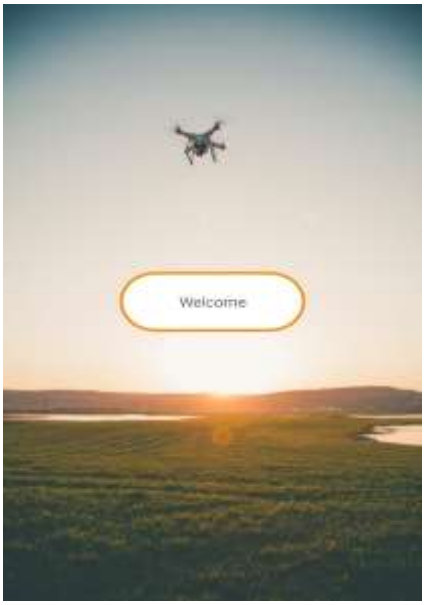

Fig-6: Welcome Page of Mobile App

4.1.2 Main Dashboard Page

Dashboard page contains four tabs such as information page, control panel, developer window, current location window of the drone:

Fig-7: Main Dashboard Panel

4.1.3 Information Panel

Information panel contains two tabs, one is user manual includes control panel information and another contains the component list:

Fig-8: Information Panel

4.1.4 Developer Window

Developer window contains personal plus professional details about developers:

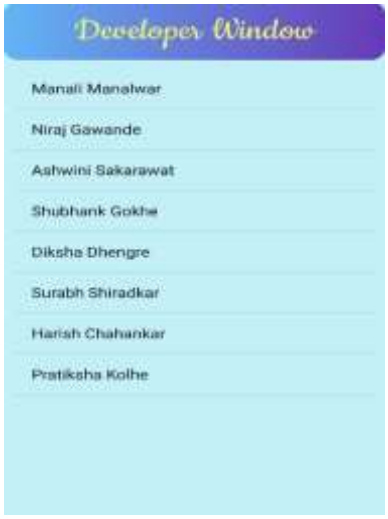

Fig-9: Developer Window

4.1.5 Control Panel

Control Panel help to control copter manually:

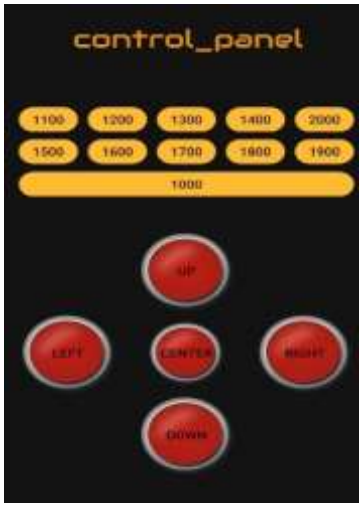

Fig-10: Control Panel

5. CONCLUSION

By effective implementation of such proposed idea for affective spraying of pesticides can be achieved. The exposure of highly toxic pesticides to humans can be prevented. One can hasten the pesticide spraying process and cover a larger area in a short interval of time. Agriculture wonder drone system using Atmega-328 microcontroller with GPS is implemented with a different model. From all over analysis we can conclude that the overall performance of the system is stable with different flying modes without complexity. The main modes are manual mode, auto mode. In manual mode, a drone is controlled by remote devices through wireless technology mobile applications and in other modes, the drone flies autonomously. Thus here conclude that the farmers can use drone technology for spraying pesticides, fertilizer to reduce the ill effect of pesticides and fertilizer on human beings and also reduce human efforts, The agro-drone implemented successfully with its own application.

6. FUTURE SCOPE

Weight lifting capacity of the quadcopter can be increased by increasing the number of motors or by increasing the propeller size or by increasing the rpm of the motor. Increased weight lifting capability will allow us to carry more pesticides in the tank. Pesticide carrying capacity can be increased by increasing the size of the tank. Flight time can be increased by increasing the battery capacity. But the problem is that when battery capacity increases the weight of the battery will also increase. In the future, there may come batteries that have better capacities and lesser weight.

Larger areas can be covered by using more nozzles which can be arranged in the form of an array. Using more number of nozzles will result in the pesticide in the container depleting faster. In

the future components may become more affordable. At that time a completely autonomous drone will be more suitable. It can have a GPS module that can go to the field on its own. It can have a camera that can understand what type of crop it should spray and adjust the sprayer in such a way that it may be suitable for the crop. It can also be IoT enabled which means that the user can get custom notifications on his smartphone when the quadcopter has completed the spraying action. The user can also use his smartphone to turn on the quadcopter anywhere in the field and remotely enable it to go spray in his particular field.

7. REFERENCES

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