Design of UAV (Drone) for Crop, Weather Monitoring and for Spraying Fertilizers and Pesticides

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Design of UAV (Drone) for Crop, Weather Monitoring and for Spraying Fertilizers and Pesticides

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***Abstract*: UAV (Unmanned Aerial Vehicle) are mostly used for multiple purposes nowadays. Our main aim in developing this paper is that to bring cultivation and agriculture as farmer friendly, this can be done only when farmer enjoys his profession. Operations like spraying of pesticides, sprinkling fertilizers are very tedious.**

We wanted to design an Agricultural drone for spraying pesticides as well as crop and environment monitoring by using a Raspberry Pi and various sensors (DH11, LDR, Water Level monitoring sensors). In developing countries like India agricultural drones have been changing the face of farming and cultivation heavily the past 3-5 years, and completely changing the way that many farmers and other entities go about their business.

It is very important to improve the efficiency and productivity of agriculture by replacing laborers with intelligent machines like robots using latest technologies. This project is to mainly overcome the ill-effects of pesticides on human beings and also to maintain the record of agricultural practices this help us a lot.

***Index Terms*— UAV, Raspberry Pi, Agricultural drone, fertilizers, pesticides, sprinkler, weather and crop monitoring, BLDC motors, ESC's**

I. INTRODUCTION

This paper mainly focuses particularly on how to reduce the tedious effort applied by the farmers and also to bring a massive change in the old methods of agriculture. Many surveys all over the world are stating that farmers are losing their lives mainly because of the spraying the harmful pesticides and fertilizers manually. One of the famous paper reviled that in the Midwest of the U.S death rates among the farmers are twice that of the general population during 1997-2005. In order to bring this count down, new ways of farming has to be implemented so that farmers' lives are saved. In this digitalized world one has to think of the best practices that ultimately lead farmers to increase their income making them love their profession much better than they do now. To achieve this, an Unmanned Aerial vehicle (Drone) is designed by using spare parts like BLDC (Brush Less DC) motors, ESC's (Electronic Speed Controllers), Flight Controller, Propellers, drone base, power distribution board, RF Transmitter, receiver etc. for controlling purpose are integrated to it. In addition to that several applications like spraying, crop and weather monitoring are also added. For these, the required components are water level sensor, DH11, LDR, water sprinkler, connecting wires, motor driver and finally, an advanced Raspberry Pi for controlling all the components. It has inbuilt Wi-Fi, Bluetooth, serial and parallel bus connectors, audio, video jack, hdmi cable, usb ports, ether net jack and 40 GPIO (General Purpose Input Output) pins. Due to all these special features in-built in Raspberry pi, it is chosen over the other controllers in this project. Python language is used for programming the Raspberry pi. Raspberry pi is treated as the minicomputer i.e. a system on hand. Rasbian is the OS available in the internet for free of cost. One can download that and install it into the memory card and use it as a computer. For particular components to interface, special drivers have to be installed.

II. PROPOSED SYSTEM

We can categorize this into two parts, they are: UAV and the application part using raspberry pi.

Block diagram

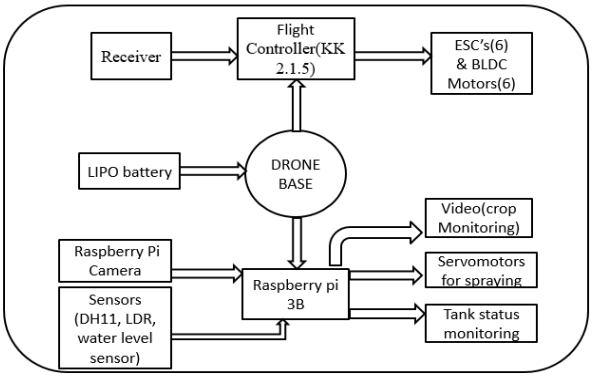


FIG 2A: Block Diagram

UAV:

For the drone base we connect the flight controller where it receives signal from the transmitter which is operated by a human. All the six ESCs and six motors are connected to the flight controller, signals are given by the operator and accordingly motor speed will be varied accordingly. In order to change its directions according to the given signal change will be observed in the output by changing its direction.

Fig 2B: UVA (Hex copter)

The changing in the direction of drone are explained as follows

Throttle: It controls the vertical up and down motion of the drone. Positive throttle will make the drone fly higher and negative throttle will make the drone fly lower

Yaw: is the left and right rotation of the drone. Positive yaw will make the drone turn to the right and negative yaw will make the drone turn to the left.

Pitch: is the forward and backward tilt of the drone. Positive pitch will make the drone tilt and move forward and negative pitch will make the drone tilt and move backwards.

Roll: This is the side to side tilt of the drone. Positive roll will make the drone tilt to the right and negative roll will make the drone tilt to the left.

This is all about the drone and its movement according to the given input which are mentioned above.

Application:

It is the major thing where a Raspberry Pi controls all the sensors and gives the required output.

Various sensors we are using are

A. DHT11:

DHT11, Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition and temperature & humidity sensing techniques, it ensures high reliability and excellent long-term stability.

B. LDR:

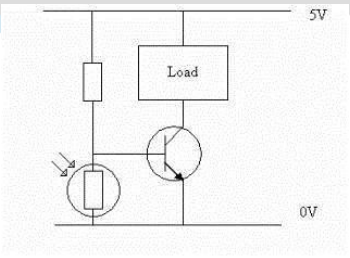


FIG 2C: Circuit diagram of LDR

The circuit shown above is a simple way of designing an automatic lighting system that turns ON when it goes dark. In this circuit the LDR and the other Resistor form a simple 'Potential Divider' circuit, where the centre point of the Potential Divider is connected to the Base of the NPN Transistor.

When the light level decreases, the resistance of the LDR increases. As this resistance increases in relation to the other Resistor, which has a fixed resistance, it causes the voltage dropped across the LDR to also increase. When this voltage is large enough (0.7V for a typical NPN Transistor), it will cause the Transistor to turn on.

C. Water float sensor:

Fig 2D: Water float sensor

Water float sensor is used to monitor the tank status. Whenever the fertilizer tank is empty, there will be a buzzer indication so as to refill the tank

D. L293D: Motor Driver

Motor driver is used to drive water sprinklers. This accepts 5V DC power and when signal is obtained it delivers that same voltage to the motors (water Sprinklers) This motor drier IC is also called as Dual H- Bridge motor driver because of its special feature that it can drive two motors parallel, so this is chosen for that particular reason.

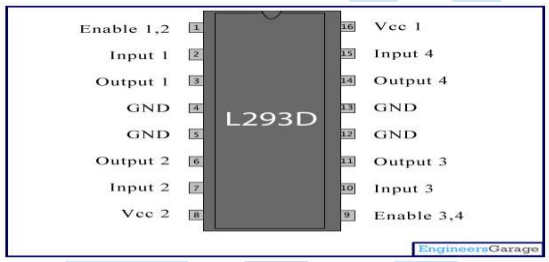


Fig 2E: Motor Driver IC

E. Water Sprinkler: A water sprinkler is used here to spray fertilizers and pesticides. It is attached to the tank and this can be controlled by the operator. There are various voltage ranges for this. Here, a 6v DC water sprinkler is used here.

Fig 2F: Water Sprinkler

Flow Chart

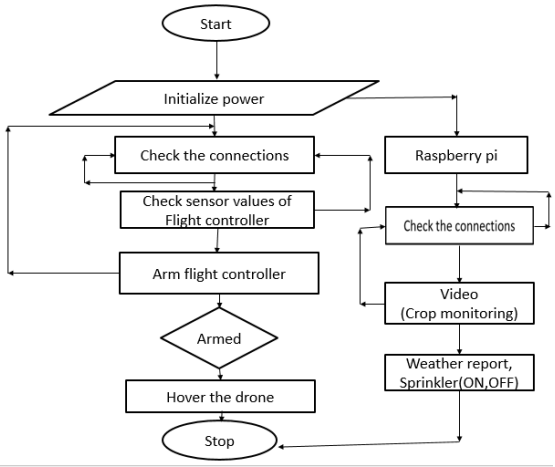


Fig 3A: Flow chart

III EXISTNG SYSTEM

In the existing system it just focuses only on the sprinkling of pesticides and fertilizers by using a drone. It is constructed by using an ARM controller and additional sensors like gyro and magnetometer are attached to it externally this reduces the efficiency of Hovering.

Self-level is missed in this existing method without this self-level the stability of drone is not going to be achieved. These are the various drawbacks which we have identified in the existing system.

IV METHODOLOGY

Raspberry Pi 3B:

It look like a credit card but it perform as a mini computer .it used for many things that desktop PC does like video word processing,spread sheets,home automation server,parent detectors to weather stations,tweeting houses of birds with IR cameras etc.

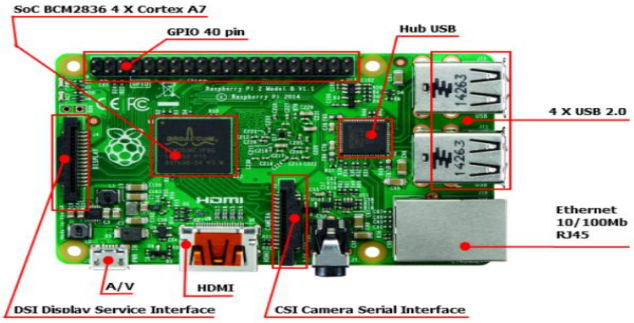


Fig 4A: image of raspberry-pi

To install the Raspbian OS we have to copy the image file into the SD card, for this purpose we require Win 32 Disc imager software. We can select the path where the image file was stored and also the device to which we require to copy image file and then select the write option.

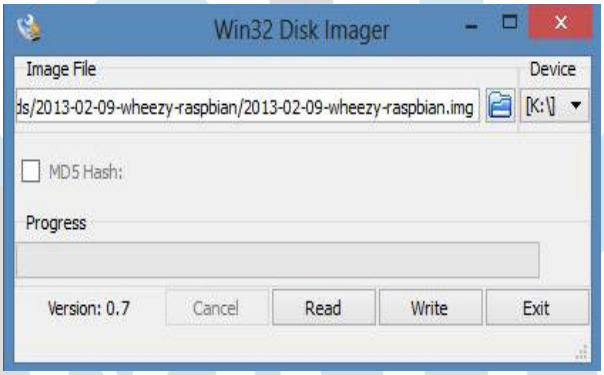


Fig 4B: The screen shot of win 32 disc imager

After installing the Raspbian OS we can get the Raspberry pi desktop as shown in the fig 1.2 which is similar to our normal computer desktop.

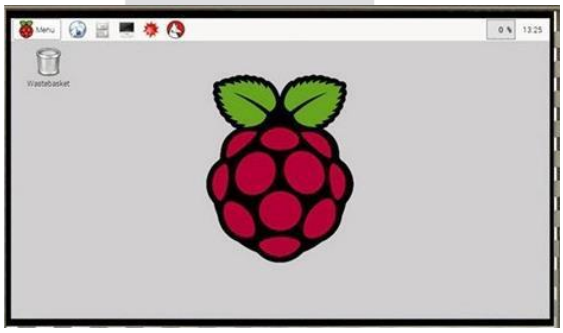


Fig 4C: Screen shot of Raspberry Pi 3B desktop.

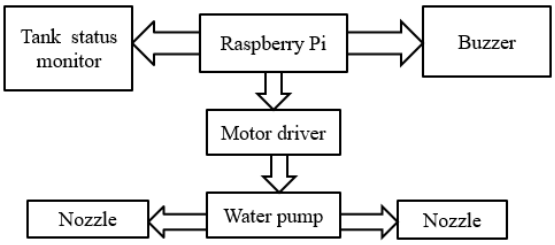
Spraying Mechanism

Usage of UAVs as liquid fertilizer sprayers is ineffective. UAVs can spray different types of plant protection chemicals. There are a lot of plant protection products exist today. Main pesticides that used in precision agriculture are:

- Insecticides
- Fungicides
- Herbicides

Crops spraying UAVs suited ideally for such task, because most fields needs ultra-low application volumes of pesticides per hectare, only on some specific zones of a field and only at some specific time.

Spraying mechanism



V. OUTPUT

Great amounts of unmanned aerial platforms for agriculture exist around the globe. Most of them are small drones, equipped with different types of special cameras and sensors for agricultural fields monitoring as well as weather monitoring. Here we have all the parameters like temperature, humidity, intensity of light, motor for sprinkling turning on and off, tank status as well as video monitoring are done simultaneously.

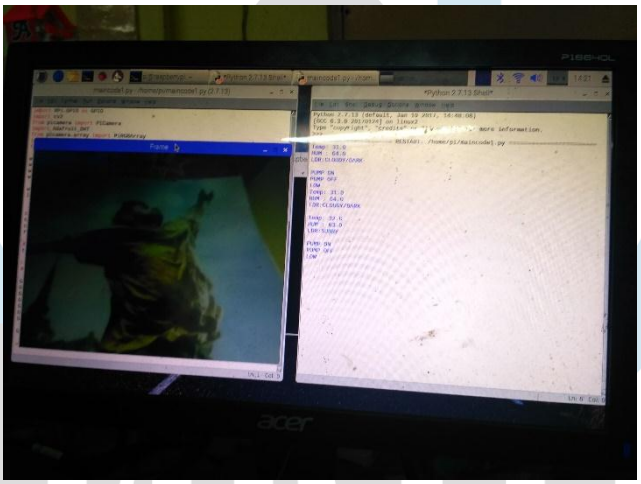


Fig 5A: Output of code using Raspberry Pi

ADVANTAGES:

- Low fuel consumption
- High productivity
- Ultra-low volumes spraying methods, avoids waste of water and ground waters contamination
- Low noise pollution
- No chemical contamination risks for operator
- No risk for operator/pilot because low working altitude
- Multifunctional frame
- Crop dusting costs are much lower

VI. CONCLUSION

In this paper we have described a design of an unmanned aerial vehicles (UAVs) that can be employed to implement a control loop for agricultural applications where UAVs are responsible for spraying chemicals on crops and monitoring of both agricultural fields, environment. However precision agriculture is about to know a further progress and UAVs will play a crucial role. Important savings (20% - 90%) in terms of water, chemic maltreatments and labor are expected. Flight regulations are an issue but UAVs, for most agriculture applications, have low weight and fly at low altitudes over uninhabited and private areas.

VII Future scope

- The maximum quantity of fertilizer that the drone carries can be increased.
- Battery life can be increased.

- Many sensors can be integrated for better results.
- Deceased crops can be distinguished from the normal ones using DIP techniques.

ACKNOWLEDGMENT
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