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Automatic Aerial Vehicle based Pesticides Spraying System for Crops

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Abstract: *Unmanned Aerial Vehicles are becoming more and more popular to meet the demands of increased population and agriculture. Drones equipped with appropriate cameras, sensors and integrating modules will help in achieving easy, efficient, precision agriculture. The proposed solutions related to these drones, if integrated with various Machine Learning and Internet of Things concepts, can help in increasing the scope of further improvement. In this paper, the related work in this field has been highlighted along with proposed solutions that can be integrated into the drone using Raspberry Pi 3 B module.*

Keywords: GPS, ADXL 335, ESP 8266

I. INTRODUCTION

The application of fertilizers and pesticides in agricultural areas is of prime importance for crop yields. The use of aircrafts is becoming common in carrying out the task because of the speed, accuracy and effectiveness in spraying operation. The farmers are using the spraying bags to spray pesticides all over the farm. The farmers have to carry the pesticide spraying bag which makes them get strained. Even then the farmers are unable to evenly distribute the pesticides all over the farm. And also it will be time consuming. The farmer can spray the pesticides using drone evenly all over the field. It reduces the workload of the farmers and also completes the work very fast.

In the last years, there is a growing interest in the use of autonomous techniques for inspecting the health state of farming. Robotics jumped into this fields providing interesting and effective solutions to several phases like harvesting or the plowing [1]. Compared with the satellite technology, the use of drones in agriculture and in smart farming is very effective due to the fact that unmanned aerial vehicles (UAV) can give farmers a bird's eye view of their fields still remaining close to the terrain and so providing more precise evaluations.

In particular, the use of drones does allow the opportunity to get an overall survey of the area and make a better use of farmer time. For this purpose, our work aims at developing a system capable of analysing the soil condition with a rapid flight. The idea is to approach a correlation between radar or satellite acquired parameters and soil roughness values obtained from RGB-D cameras or laser scanners.

II. SCOPE AND RELEVANCE

The performance evaluation of drone mounted sprayer on paddy and groundnut crops has been carried out at Research Farm of University of Agricultural Sciences Raichur during the year 2016-17[5]. During field trials, the agronomic data pertaining to paddy and groundnut crops such as row to row spacing, plant to plant spacing, and height of crop, leaf area index and stage of crop were noted. For spraying operation, the recommended chemical solution as per the plant requirement was prepared separately in the tank. The data on speed of operation, swath width, discharge rate, field efficiency, and application rate, flying endurance and time losses were measured and noted for the paddy and groundnut crop.

Sue et al. (2016) developed an unmanned aerial vehicle based automatic aerial spraying system [3]. The system used a highly integrated and ultra-low power MSP430 single-chip micro-computer with an independent functional module. This allowed route planning software to direct the UAV to the desired spray area. Kale et al. (2015) used agriculture drone for spraying fertilizer and pesticides. Architecture based on unmanned aerial vehicles (UAVs) which can be employed to implement a control loop for agricultural. Applications where UAVs are Responsible for Spraying chemicals on crops. The process of applying the chemicals is controlled by wireless sensor network (WSN) deployed on the crop field. Huang et al. (2015) developed a low volume sprayer for an unmanned helicopter. The helicopter has a main rotor diameter of 3 m and a maximum payload of 22.7 kg. The helicopter used one gallon of gas for every 45 minutes. The method, system and analytical results from this study provide an extendable prototype that could be used in developing UAV aerial application systems for crop production management with higher target rate and larger VMD droplet size.



III. LITERATURE REVIEW

Spoorthi. S, Dr. B. Shadaksharappa, Suraj. S, V. K. Manasa [1] have presented system called FREYER Drone. FREYR drone is to develop a quad-copter which carries pesticides to spray all over the farm which reduces the work of farmers as well as it finishes his work soon. The application of pesticides and fertilizers in agricultural areas is of prime importance for crop yields. This is to develop a user friendly interface for the farmers. The FREYR Drone is a pesticide spraying quad copter for agricultural purpose which helps the farmer to spray the pesticides all over his land so that it reduces his work which can evenly spray all over his farm. Here the farmer can control the drone using an android app and he can connect to the app using Wi-Fi module (ESP 8266) which is interfaced in the drone. It will precisely route the land area of that particular farmer's land using GPS no matter shape of the field and type of the crop the pesticide spraying drone will get the job done.

Paolo Tripicchio and Massimo Satler [2] have presented the use of drones in agriculture is becoming more and more popular. The paper presents a novel approach to distinguish between different fields plowing techniques by means of an RGB-D sensor. The presented system can be easily integrated in commercially available Unmanned Aerial Vehicles (UAVs). In order to successfully classify the plowing techniques; two different measurement algorithms have been developed. Experimental tests show that the proposed methodology is able to provide a good classification of the fields plowing depths.

Arnab kumar Saha, Jayeeta Saha, Radhika Ray, Sachet Sircar, Subhojit Dutta, Soumyo Priyo Chattopadhyay, Himadri Nath Saha [3] have presented IoT-based drone for improvement of crop quality in agricultural field. Unmanned aerial vehicles are becoming more and more popular to meet the demands of increased population and agriculture. Drones equipped with appropriate cameras, sensors and integrating modules will help in achieving easy, efficient, precision agriculture. The proposed solutions related to these drones, if integrated with various Machine Learning and Internet of Things concepts, can help in increasing the scope of further improvement. In this paper, the related work in this field has been highlighted along with proposed solutions that can be integrated into the drone using Raspberry Pi 3 B module.

Marthinus Reinecke Tania Prinsloo [4] has presented the influence of drone monitoring on crop health and harvest size. Their Work looks at the benefits of drones in agriculture, and their limitations, illustrating from examples how drones operate on farms. Such case, the point cloud is firstly used to obtain a mesh and with (relative distance between the RGB-D camera and the terrain) to make the dimensions consistent among the different samples. A second step would be to sample the mesh with an equally spaced grid.

Y.A. Pederi Research and Development Dept. Aero Drone [5] have presented unmanned aerial vehicles and new technological methods of monitoring and crop protection in precision agriculture. Their work is combination of new approaches and technologies in modern-day agriculture. Perspectives and benefits of usage of Unmanned Aerial Vehicles in different spheres of agriculture considered on the base of spraying drone project called "Aero Drone".

Deepak Murugan, Akanksha Garg, and Dharmendra Singh [6] have presented That For better agricultural productivity and food management, there is an urgent need for precision agriculture monitoring at larger scales. In recent years, drones have been employed for precision agriculture monitoring at smaller scale, and for past few decades, satellite data are being used for land cover classification and agriculture monitoring at larger scales.

The monitoring of agriculture precisely over a large scale is a challenging task. In this paper, an approach has been proposed for precision agriculture monitoring, i.e., the classification of sparse and dense fields, which is carried out using freely available satellite data (Landsat8) along with drone data. Repeated usage of drone has to be minimized and hence an adaptive classification approach is developed, which works with image statistics of the selected region. The proposed approach is successfully tested and validated on different spatial and temporal Landsat8 data.

Deepak Murugan, Akanksha Garg, Tasneem Ahmed, Dharmendra Singh [7] has presented the system fusion of drone and satellite data for precision agriculture monitoring. Precision agriculture makes use of real-time information from sensors and geospatial techniques (remote sensing, geographic information system) and helps in making smarter decisions for better productivity. The use of wireless sensor networks for precision agriculture is widely used. Usage of drones or unmanned aerial vehicle for precision agriculture is the latest trend.

Masaaki katayama, Tomoya Morbie, hiraku Okada, Kentaro Kobayashi [8] have presented System on combination of a wireless sensor network and drone using infrared thermometers for smart agriculture. For efficient collection of the leaf temperature data over the entire farm, we simultaneously use a drone in the sky and sensor nodes on ground that are both equipped with infrared thermometers. In this study, we propose a communication protocol for wireless sensor network (WSN). The preliminary results of a prototype experiment show that the measurements are sufficiently synchronized for collecting useful leaf temperature data.

IV. OBJECTIVES OF PROPOSED WORK

The main objectives of proposed system are as follows:

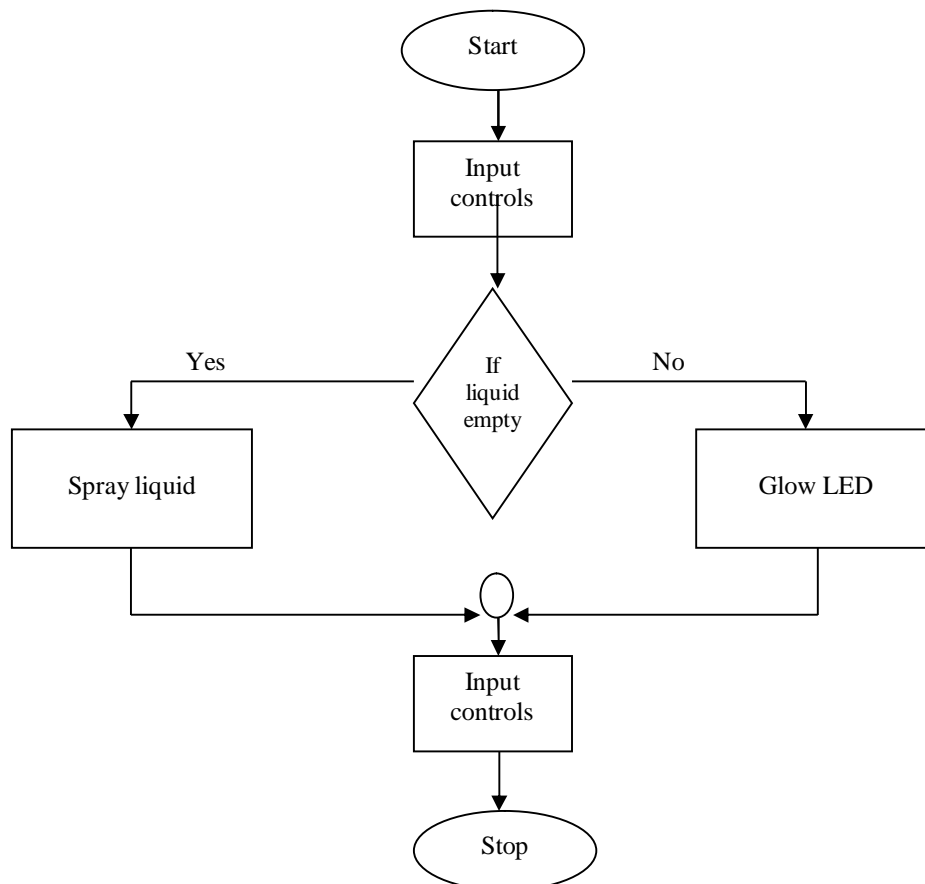
- A. To provide automatic pesticides spraying capability to an Arial vehicle (drone).
- B. To use sensor fusion concept using accelerometer and gyroscope for direction and orientations of Arial vehicle.
- C. To design and use efficient algorithm for achieving desire rotation of motors for propose of getting direction speed and spraying pressure
- D. To implement the system based on Arduino platform.

V. METHODOLOGY

At first any user (farmer) must connect to WIFI secured with WPA2 in android based mobile so that he can connect and then operate with our FREYR Drone. LiPo rechargeable battery is connected to run motors. We use ARDUINO mega 2560 which helps in interfacing the app with the motors of drone that is interfacing software with hardware. An android app is interfaced with the ARDUINO mega board through Wi-Fi module. The ARDUINO MEGA-2560 is an 8-bit processor, 16MHz clock speed. This Arduino board can be programmed using the Arduino software (IDE). The accelerometer will measure the acceleration forces and the acceleration forces may be static or dynamic. We use an accelerometer + gyroscope (IMU) is connected to hardware system and interfaced with Arduino board.

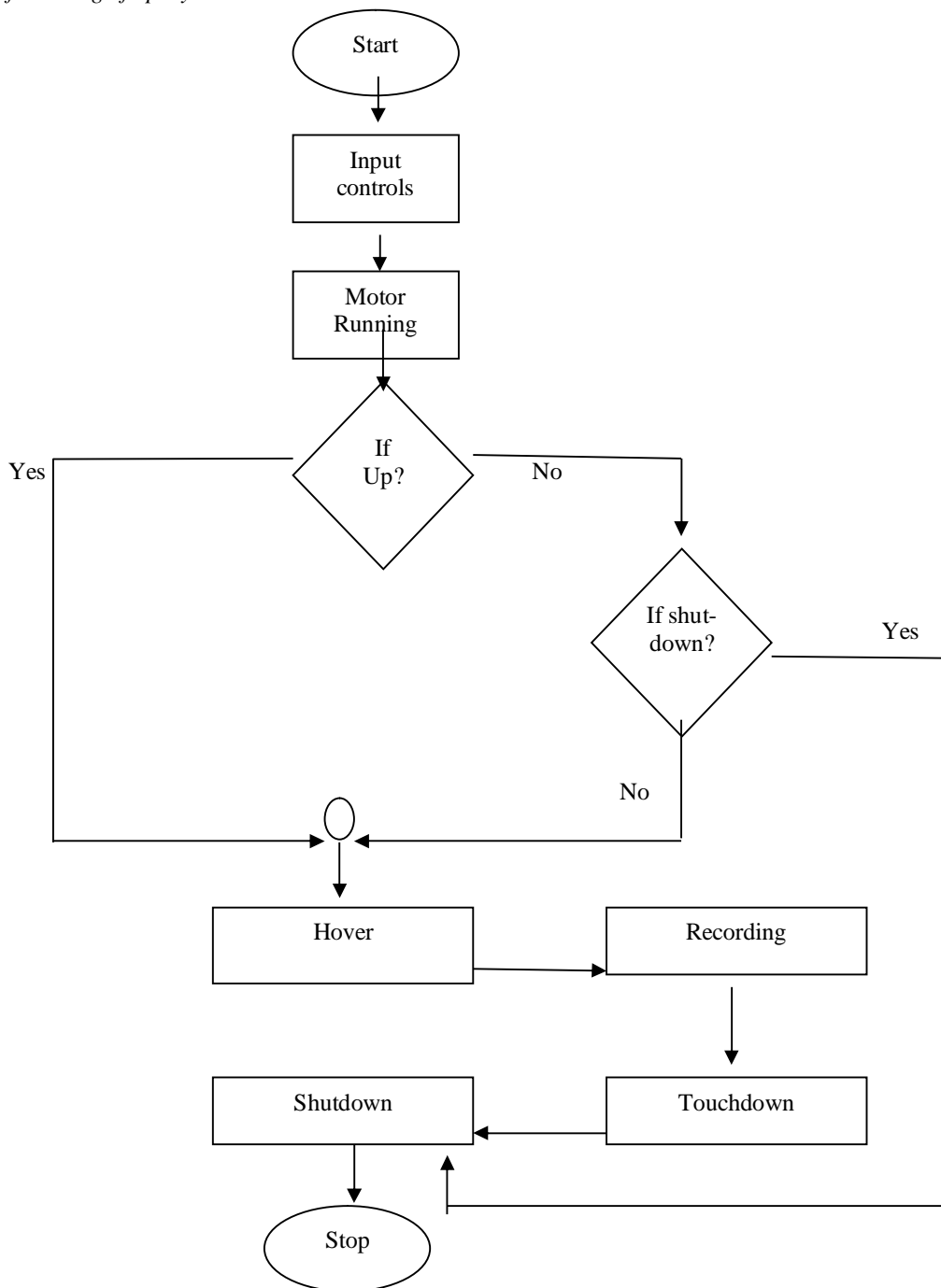
Gyroscope is a sensor which gives output to Arduino board and maintains the orientation of the drone. The gyroscope helps in balancing and stability of drone by giving values of x, y, z. GPS UBLOX NEO 6M is cost effective and high performance and helps in initializing the location of crop yield. We used an immersable pump which is immersed inside the fertilizers tank it then pumps the fertilizers and sends to the sprinkler to spray.

A. Flow Chart For Drone Controlling



Flowcharts are used for used in designing and documentation of process and programmes. For controlling of drone at first step drone start with the help of input controls also motor starts running. If liquid in container is empty then LED indicator is glowed. Else liquid is sprayed from the container.

B. Flow Chart of Working of Spray



This is flowchart of working of spray.at initial stage drone starts then motor starts running with help of input controls if up then drone starts its movements like Hover, recording, touchdown, shutdown. If drone is not goes in upward direction then it will shut down.

VI. BLOCK DIAGRAM OF AUTOMATIC ARIAL VEHICLE BASED PESTICIDES SPRAYING SYSTEM FOR CROPS

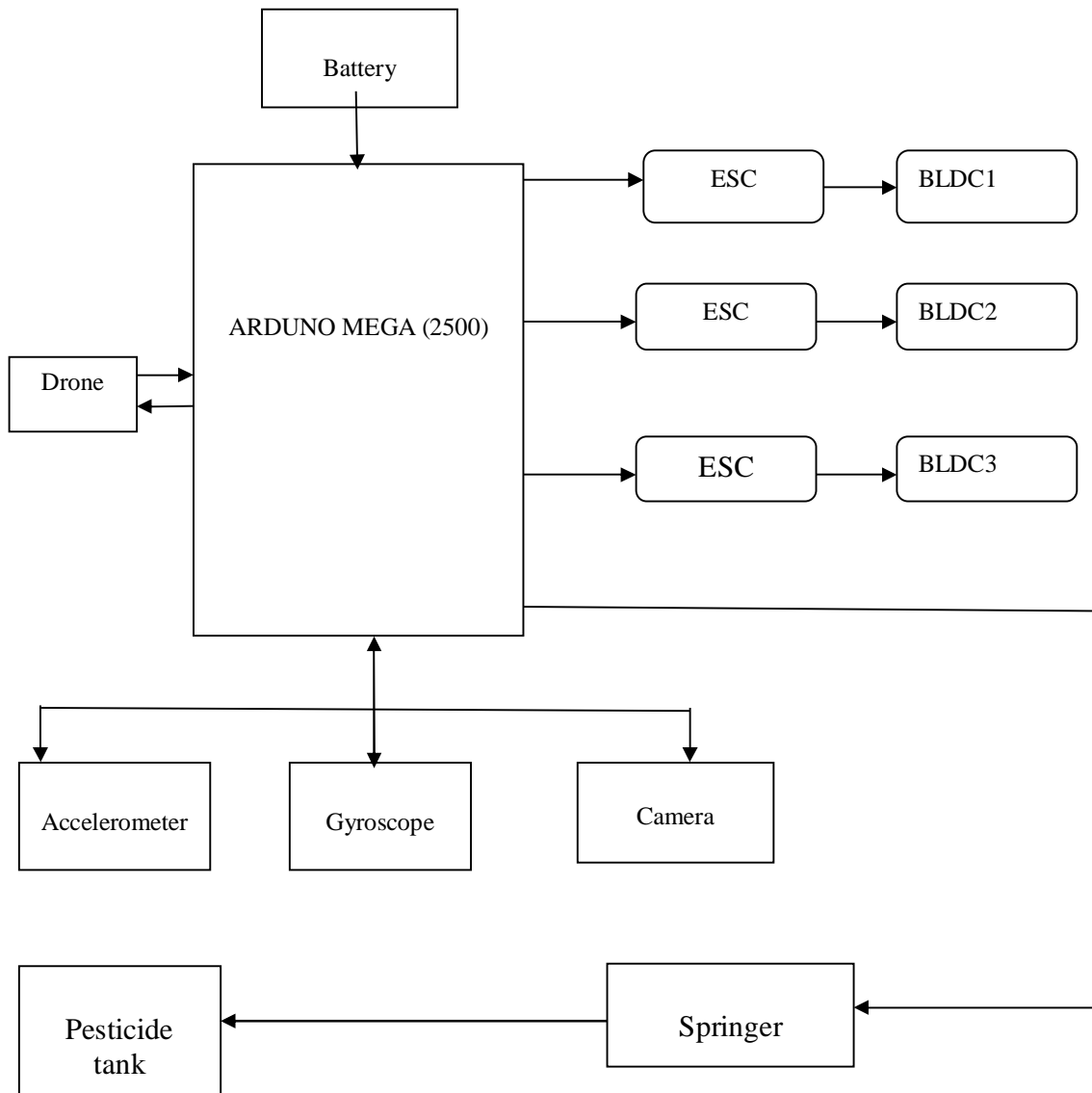


Fig.1 Block Diagram of Automatic Aerial Vehicle based Pesticides spraying system For Crops

VII. DESIGN STEPS

- 1) Step 1: Designing of block diagram of the system & selection of components.
- 2) Step 2: Interfacing of Wi-Fi module with Aerial vehicle.
- 3) Step 3: Interfacing of Arduino board Wi-Fi module.
- 4) Step 4: Utilization of accelerometer (ADXL 335), GYRO (MPU-6050), and magneto meter (HMC5883L).for balancing of the Aerial vehicle.
- 5) Step 5: Designing system for automatic parameters measurement and linking of parameters with actions of Aerial vehicle.
- 6) Step 6: System Implementation
 - a) Completion of the hardware part.
 - b) Coding



c) Testing of an overall system.

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