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Review on Smart Agriculture Drone with Multiple Applications

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Abstract: This project introduces a Smart Agricultural Drone equipped with a dual-functionality system for precise pesticide spraying and rat detection using advanced image processing. The drone, characterized by a robust frame and efficient propulsion, integrates cutting-edge technology to optimize agricultural practices. The pesticide spraying mechanism ensures even coverage, reducing waste and environmental impact. Concurrently, the intelligent image processing system, employing machine learning algorithms, enables real-time detection of rat infestations, providing early intervention for crop protection. The drone's autonomous navigation and integration of GPS technology further enhance its operational efficiency. Through comprehensive testing and validation, this project demonstrates the potential to revolutionize precision agriculture by offering farmers a sustainable, data-driven solution to enhance crop yields and mitigate challenges in modern farming practices.

Keywords: Drone, agriculture, pesticides, image processing

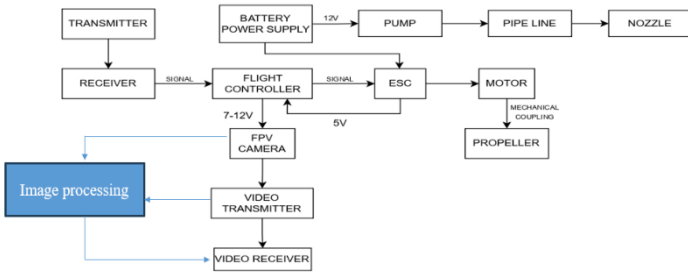
I. INTRODUCTION

Agriculture, as the backbone of global food production, continually seeks innovative solutions to meet the growing demands of an expanding population while addressing environmental sustainability. The advent of Smart Agriculture represents a transformative paradigm shift, leveraging cutting-edge technologies to enhance productivity, optimize resource utilization, and mitigate environmental impact. In this context, the Smart Agriculture Drone equipped with pesticide spraying capabilities and rat detection using image processing emerges as a beacon of innovation and efficiency in the agricultural landscape.The integration of advanced technologies in agriculture has led to the development of Smart Agriculture solutions, such as drones equipped with cutting-edge features for improved crop management. This detailed report focuses on a Smart Agriculture Drone equipped with pesticide spraying capabilities and rat detection using image processing. With the world population projected to reach 9 billion by 2050, the need for sustainable and efficient agricultural practices has never been more pressing. Traditional farming methods, often characterized by manual labor and indiscriminate pesticide use, face challenges such as resource inefficiency, environmental degradation, and increased susceptibility to pests and diseases. The integration of technology into agriculture is seen as a crucial step toward addressing these challenges and ensuring food security for the future

II METHODOLOGY

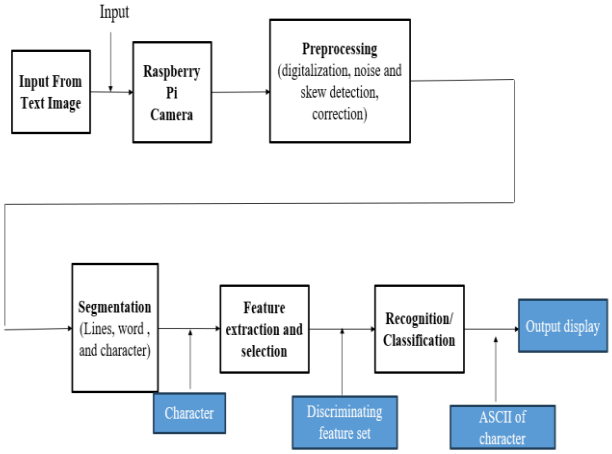
The signals will be transmitted from Transmitter and it will be received by the Receiver in the drone. From the receiver the signal goes to the Flight controller where the signal will be processed with accelerometer and gyroscope sensors. The processed signal will be sent to the ESC, which allows the specific amount of current to the motor based on the signal it receives. The propellers are mechanically coupled to the motors so that they rotate and produce thrust. The FPV camera takes current supply from the flight controller and it records the video, the video signals will be processed by the transmitter and it will be received by the receiver in ground.

The pump **takes** current supply from the Li-Po battery and pressurizes the liquid from the storage tank then the pressurized liquid flows through the pipeline and enters the nozzle then gets sprayed. The flow rate of the pump can be controlled by varying the input current which can be controlled from the transmitter



III IMAGE PROCESSING

Image Acquisition: The drone captures images of the target area using its onboard camera.
Preprocessing: Preprocess the images to enhance features and reduce noise. This may include adjusting brightness, contrast, and filtering.
Segmentation: Use image segmentation techniques to separate the image into meaningful regions. This helps in isolating potential rat shapes from the background.
Feature Extraction: Extract relevant features from the segmented regions. Features could include size, shape, color, or texture characteristics that are indicative of rats.
Classification: Employ a classification algorithm to determine whether each segmented region contains a rat or not. Machine learning techniques, such as deep learning with convolutional neural networks (CNNs), are commonly used for this task. The algorithm needs to be trained on a dataset of rat and non-rat images to learn to make accurate predictions**.**



IV PESTICIDES SPRAYING

The pesticide spraying mechanism in agricultural drones represents a transformative approach to precision farming, introducing efficiency and environmental consciousness to the application of pesticides. At its core, this system integrates a precision spraying mechanism comprising a well-designed reservoir, a pumping mechanism, and strategically configured nozzles. The reservoir, aerodynamically shaped for optimal weight distribution, holds the pesticide while diaphragm or centrifugal pumps pressurize and regulate its flow. Nozzle configuration is pivotal, determining spray patterns and droplet size, with considerations for different crops and formulations. This system harmoniously interfaces with the drone's flight controller, ensuring synchronized operation and coordinated pesticide release during flight. Utilizing GPS-guided navigation, the drone follows precise flight paths, optimizing pesticide application based on geospatial data. The integration of monitoring sensors and cameras allows real-time assessment of field conditions, contributing to informed decision-making for farmers. This comprehensive mechanism addresses environmental concerns through drift reduction technologies and the use of eco-friendly pesticides, offering a sustainable solution for targeted and efficient pesticide application in modern agriculture

V LITERATURE SURVEY

1)"Design and Development of a Drone for Spraying Pesticides, Fertilizers and Disinfectants" by Karan Kumar Shaw, Vimalkumar R.
From this paper we have learnt design of a drone mounted spraying mechanism for Agricultural purpose and for spraying disinfectants. This method of spraying pesticides on Agricultural fields reduces the number of labours, time, cost and the risk involved to the personnel involved in spraying the liquids. This drone can also be used in spraying disinfectant
liquids over buildings, water bodies and highly populated area.

2) "Design and Development of an autonomous pesticides spraying agricultural drone" by Kazi Mahmud Hasan, S.H Shah Newaz, Md. Shamim Ahsan, Md. Tariq Hasan, Abdullah-Al-Nahid.
From this paper we have learnt the development of an aircraft type autonomous agricultural drone for spraying pesticides over crops' field. The drone can fly under different altitude ranging from 5 to 400 meters. The cruise speed of the drone varies between 30–60 kilometer/hour. The drone can carry ~ 2 liters of pesticides as payload. The drone consists of a pesticides spraying device, the function of which is remotely controlled from the ground control station. By varying the speed of the drone and sprayer installed with the drone, we can control the spraying area. The spraying device can release pesticides at a rate of 0.3 liters/sec. When the drone is flown at 36 kilometer/hour at an altitude of 5 meters and angular frequency of the pesticides sprayer of 10 revolutions/sec, it can cover maximum 12.4 square meters of land just within a second. The endurance of the drone is ~ 20 minutes. The proposed drone will not only decrease the number of required manpower and pesticides spraying time but also reduce health hazards of the farmers**.**

3) "Development of an Aircraft type portable autonomous drone for agricultural applications" by Kazi Mahmud Hasan, Wida Susanty Suhaili, S.H Shah Newaz, Md. Shamim Ahsan.
From this paper we have learnt about the design and development of an aircraft type portable autonomous drone suitable for agricultural applications. The portable drone consists of six separate parts that are easily installable within just ten minutes. Moreover, these parts can be fit inside a portable box allowing easy portability. We have integrated a high definition camera with the drone to transmit real-time video of any desired crop's field to the ground control station. To scare the birds and to announce emergency to the farmers, we have installed a loud speaker with the bird-shaped drone. The drone can fly under different altitude varying from 10 to 200 meters. The maximum cruise speed of the drone is 60 kilometers/hour, whereas the maximum endurance time is ~ 30 minutes. The drone can carry ~ 1.4 kilograms of payload (e.g. seeds) and deliver to the farmers when required. The agricultural drone has Return Home feature for autonomous return to the ground control station when its battery voltage reduces

down to a certain level or any communication failure is detected. The drone will not only monitor the possible threats of the agricultural fields including diseases and harms caused by birds or other animals but also supply light weight emergency goods to the farmers.

4) "Smart Agricultural Seeds Spreading Drone for Soft Soil Paddy Fields" by Udaya Dampage, MDR Navodana, USG Lakal, A.M Warusavitharana. This research is on the design and fabrication of an autonomous agricultural drone for sowing seeds in paddy fields. A seed spreading nozzle was specially developed and integrated with the drone in order to reduce the seed sowing time. The drone consists of a global positioning system (GPS) and auto-pilot system in which the flight path can be controllable in both auto and manual modes. The flying path can be programmed in a software prior the flight and can be altered if required. In addition, the agricultural drone is manually controllable using long range remote controller. The seed sowing rate is controlled by the parameters of the nozzle. The proposed agricultural drone will provide a solution for seed sowing in soft soil paddy fields and it can also be used in other paddy fields. The field trials proved that the proposed method is accurate and precise enough for paddy cultivation requirement as specified by agricultural experts.

5) "AgrOne: An Agricultural drone using Internet of Things, Data Analytics and Clod Computing Features" by M V Suhas, S Tejas, Snigdha, Sitaram Yaji, Sanket Salvi.

In this paper, they have discussed a Do-It- Yourself (DIY) approach to build own Agricultural Drone. Paper highlights, national and international work related to usage of modern computer guided tools, followed by our proposed design, components required, its assembly and implementation. We have used Cloud Computing and Internet of Things features for achieving this task. The Quadcopter autonomously fly and captures images of the field, which are processed to find the condition of the crops. This image and corresponding result is stored on Cloud. The On-Ground sensors and sensors present on the Quadcopter help to monitor the temperature and humidity for better yields. By leveraging usage of Cloud, user can have ubiquitous access to remotely monitored farm data. Results obtained shows, that using available technology how one can build Drone and On-Ground Sensor Devices for Agricultural Assistance. We have also discussed, future course of the project related to improvements in design and its potential extensions by performing advanced image processing and additional sensors

6) "Custom and Design of Agri Drone" by A Muthukumar, M V Muthukumar, S Tamil Varshini, N Prem Mathavan, and K Vishnu. The primary reason for using the proposed Agricultural drone is to spray fertilizer. Utilizing 3D printing technology, the Agri drone is manufactured. The Flight controller (KK2.1.5), electronic speed controllers (ESCs), transmitter and receiver (six channels), Brushless DC motors (1000 KV), propellers (1045), relay, and a 12 volt dc power pump are part of the electronic parts used in quadcopters. Electronics parts and 3D printed pieces are used to assemble the agricultural drone. It is urgently necessary to update old agricultural practices due to the world's population growth and shrinking arable land. The problem of effective and productive farming is serious on many levels, particularly in a country like India, which was once regarded as the "land of farmers". The only answer to this issue is modernization of agricultural methods. Innovations in biotechnology, appropriate instruction, and the use of cutting-edge farming equipment can all help to achieve this. Drones for agriculture might be one such instrument. Assembly mistakes, sizing problems, and weight balancing problems were challenges faced throughout the drone's development. The agricultural drone is made using contemporary technologies like 3D printing, fast prototyping, and drone technology. An open environment is used to test the Agri drone's ability to spray fertilizer

7) "IOT Based Agricultural Drones for Pest Control" by K Mohan Raj, N. Balaji, K.S. Vairavel, P Sharmila, R. Azhagumurugan, S. Jayakushal.

Drones, also known as unmanned aerial vehicles (UAVs), have become more ubiquitous as a result of their capacity to work swiftly and have a wide range of applications in many situations in real life, use of UAVs for precise navigation. The scientific community has recently paid a lot of attention to farming. This study examines the use of drones to help with area of precision agriculture. This study significantly advances the field by examining communication protocols and using them. The agricultural process can be supported by the Internet of Things (IoTs)., which can scale from small to large farmers. The application of IoT in several aspects of agriculture has been examined in this research. Farmers are unable to stand in front of the enormous markets. Increased yield costs result in lower returns on investment for farmers. Drone proponents have long promoted precision agriculture, or crop management that makes use of Big data & GPS, as a method to boost agricultural productivity which is to be addressing the world's food and water issues.

8) "Prediction of Plant Leaf Diseases using Drone and Image Processing Techniques" by N Bharathiraja, K Pradeepa, I. Jaya Sheela, G Sudhakar, M Vinoth Kumar, Gaganpreet Kaur. In Asia, there are many countries where paddy serves as the primary agricultural product. Diseases on paddy plants have the potential to reduce paddy production and damage its quality. Detecting the disease earlier will help to prevent serious infection of the paddy and also minimize crop loss. Drones have recently been utilized for agricultural surveillance, along with cameras and GPS sensors. It is a different instrument for swiftly and autonomously obtaining information in a large area. This study describes a drone implementation system that depends upon the Internet of Things (IoT) architecture that uses information in actual instances, information collection, and examination of information strategies to increase paddy productivity. By using a GPS sensor to specify the location in the actual instances, the system is capable of mapping the location of diseased paddy plants on paddy fields along with data analysis. With the installation of the IoT architecture, this framework was created and also put forth as an initial system to support the systems earlier and to detect disease in actual time.

9) "Autonomous Drone for Smart Monitoring of an Agricultural Field" by Ahnirudh Y Raj, Akshaya Venkatraman, Anish Vinodh, Hariharank Kumar. The paper proposes using an Unmanned aerial vehicle (UAV) or a drone with swarm communication capabilities to monitor the agricultural field and help the farmers have a smooth and profitable yield of the crops. The control system discussed in the paper is integrated with the drone, which is designed from scratch. The overall body of the drone is designed using lightweight materials made from recycled ocean waste. The main idea is to make use of the swarm communication method between drones and divide the

agricultural field into different regions and each drone monitoring a particular region. The swarm communication is achieved using a CC2520 RF transceiver and a GPS module integrated with the control system of the drones. The swarm communication between the drones is mainly to avoid collision between two drones when they are monitoring different parts of the field. The drones are also designed to follow pre-defined paths on the agriculture fields with the help of the GPS module. The control system of the drone makes use of sensors which help in keeping away the pests in the agricultural field, monitoring the water level in the field, checking the health of the crops using optical crop sensors. The drone is mainly used to reduce the burden of a farmer in monitoring their fields from time to time. The farmer can make use of the application installed on their smart devices to monitor their field. The drone and its working are designed in such a way that it is made easier for farmers to control the drone and monitor their fields from anywhere.

10) "Application of Drone Technology for Mapping and Monitoring of Corn Agricultural Land" In this research, we will produce a system proposal that will provide the effectiveness of using drones, in image processing that can be used as monitoring and mapping on maize farms in Indonesia, with the experimental use of drones, it will be known how the effectiveness is in determining the level of harvest in a certain area. agricultural land. one of the uses of technology that has been done is the use of creation technology using images taken from above To find out how the conditions of the planted agricultural plants are, whether they are suitable for harvesting or are still waiting for the process to ripen, with the Drone technology, the imaging system will be easier to monitor because with Drone technology, taking pictures that are initially difficult will become easier. The research method used in this research is to use literature review and conduct experiments on drones that will be used in this experiment, with data testing it will produce research that has a high level of validity, the experiment proves that the use of drone technology is very useful for agriculture, especially corn agriculture. The use of Image processing media has indeed been widely used in research in the field of agriculture, but the use of Drone technology is still rarely used because technology is still the latest technology, and is still not widely applied in many agricultural fields

11) "Development of Agricultural Drone for Coconut Farming" by Orapadee Joochim, Kridtat Satharanond, Wirachat Kumkun, Nutthapong Changkaew, Wuttipat Chokanantasab. In this paper, an innovative new drone is created for developing the current ability of today's drone. This research starts with developing the agriculture drone for spraying fertilizer and pesticides in coconut tree farms. The developed drone can be utilized for inspecting and finding coconut tree pests using sensor image processing in order to solve the problems of using the general solutions of the pest control. These problems are as follows. Firstly, the use of a long stick tied to the hose and pesticide spray from below results in the drops of pesticide to the ground for more than 75%. Secondly, the use of chemicals injected into the trunk cannot be used for the coconut trees with less than 12 meter high particularly for aromatic coconut trees with around 5 meter high according to chemical residue. Finally, the pesticide is controlled by using a level of fertilizer higher than the recommendation. Farmers generally spray all coconut trees without consideration in which trees have the pests. The developed drone can be used for solving all of the above mentioned three problems. In the early stage of development for processing to locate the pests, the implemented program has the ability to visualize the leaf of the coconut tree that is likely to have a problem. The drone can fly to inspect and specify the pest area, spray from the top of the trunks and spray at the specific point resulted in the reduction of chemicals costs

12) "Wild Animals Intrusion Detection for Safe Commuting in Forest Corridors using AI Techniques", In this paper they have stated that There are many animal attacks on human is being reported in the recent days particularly in the forest area which claims innocent lives , so using YOLO algorithm they have proposed a system that works with Raspberry Pi 3 Model B for detecting the animals and alerting the vehicles. The camera is configured for use in Raspberry Pi to take shoot images and movement of animals. It also employs IOT based image detection system using display or sound alert system

VI CONCLUSION

The Smart Agricultural Drone with Pesticide Spraying and Rat Detection Using Image Processing stands as a groundbreaking solution poised to transform modern agriculture. Through meticulous design and implementation, the drone successfully integrates cutting-edge technologies, offering precise pesticide spraying capabilities and real-time rat detection powered by advanced image processing algorithms. The robust drone platform, featuring an efficient propulsion system and autonomous navigation, demonstrates its potential to revolutionize crop protection and management. The system's ability to optimize pesticide distribution, reduce environmental impact, and provide early detection of rat infestations positions it as a crucial tool for farmers seeking sustainable and efficient farming practices. As evidenced by rigorous testing and validation, the drone showcases promising results in enhancing crop yields while addressing key challenges in precision agriculture. The project's success opens doors to a future where technology and agriculture synergize, offering scalable, data-driven solutions for farmers worldwide. With considerations for regulatory compliance, ethical use, and potential collaborations for further advancements, the Advanced Agricultural Drone project sets a strong foundation for the future of smart and sustainable farming practices

VII REFERRENCE

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[2] "Design and Development of an autonomous pesticides spraying agricultural drone" by Kazi Mahmud Hasan, S.H Shah Newaz, Md. Shamim Ahsan, Md. Tariq Hasan, Abdullah-Al-Nahid, IEEE journal of engineering,2020

[3] "Development of an Aircraft type portable autonomous drone for agricultural applications" by Kazi Mahmud Hasan, Wida Susanty Suhaili, S.H Shah Newaz, Md. Shamim Ahsan.

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[5] "AgrOne: An Agricultural drone using Internet of Things, Data Analytics and Clod Computing Features" by M V Suhas, S Tejas, Snigdha, Sitaram Yaji, Sanket Salvi.

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[10] "Application of Drone Technology for Mapping and Monitoring of Corn Agricultural Land"

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