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Developing a model of solar powered Multi-tasking Agribot

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***Abstract*—An agricultural robot, often referred to as agribot, is a type of robot designed specifically for use in agriculture. It performs various tasks to assist farmers and improve efficiency in agricultural operations. This paper deals with development of robot for agricultural applications such as digging, ploughing, leveling and seeding. It also helps in identifying plant health and sprinkling pesticides. The main component used to develop the agribot here is the microcontroller that supervises the entire process. Arduino Uno board is used to design this system along with motors, sensors and a camera. Solar panel is used to power the system. This automated system helps former to be protected from pests and pesticides, allows working with reduced labour intensity. The robot will have full route planning and navigation systems, as well as driving control, which will help in moving around the field.**

Keywords—agribot, agriculture, microcontroller, Arduino Uno, Solar panel, labour

I. INTRODUCTION

Farmers these days spend a lot of money on machines that help them decrease labour work and increase yield of crops. There are various machines that are available for ploughing, harvesting, spraying pesticides etc., however these machines have to be manually operated to perform the required operations and moreover separate machines are used for every functions. The yield and profit returns from employing these equipments are very less as compared to the investment.
With the growing demands of the world's population, automation has become the ideal solution.
In the current generation, man power shortage is a major problem specifically in agricultural sector and it affects the growth of developing countries. In India at most 70% of people are dependent on agriculture. The revolutionary invention in agriculture system is becoming an important task because of rising demand on quality of agriculture products and lack of labour availability in rural farming areas.

The specific working of an agribot can vary depending on its design and purpose, but here are some common functionalities and tasks that agri-robots can perform:

- Crop Monitoring: Agribots equipped with sensors and cameras can monitor crops for various parameters such as plant health, growth rate, moisture content, and nutrient levels. They can capture images or use spectral analysis to identify diseases, pests, and nutrient deficiencies.
- Precision Farming: Agribots can perform precise tasks such as planting seeds, applying fertilizers and pesticides, and watering crops. They use GPS and advanced navigation systems to ensure accurate positioning and minimize wastage of resources.
- Weed Control: Agribots can autonomously identify and remove weeds from fields. They can use vision systems or AI algorithms to differentiate between crops and weeds, and then employ mechanical or chemical methods to eradicate the weeds without harming the crops.
- Harvesting: Agribots can be designed for automated harvesting of crops such as fruits, vegetables, and grains. They use specialized grippers, vision systems, and AI algorithms to detect and pick ripe crops, improving efficiency and reducing labor requirements.
- Soil Sampling and Analysis: Agribots can collect soil samples from different locations within a field and analyze them for fertility, pH levels, and nutrient content. This data can help farmers make informed decisions regarding fertilization and soil management.
- Data Collection and Analysis: Agribots are capable of gathering vast amounts of data related to crop health, soil conditions, and environmental parameters. They can transmit this data to a central system for analysis,

enabling farmers to make data-driven decisions and optimize their farming practices.

- Autonomous Navigation: Agribots are equipped with advanced navigation systems that allow them to operate autonomously in the fields. They can navigate around obstacles, follow pre-defined paths, and avoid damaging crops or equipment.

Overall, agribots aim to enhance productivity, reduce labor costs, minimize chemical usage, and improve resource efficiency in agriculture. Their abilities to monitor crops, perform precise tasks, and collect data contribute to more sustainable and efficient farming practices..

II. LITERATURE REVIEW

In the current scenario most of us have come across the atomization in various fields as the advancement of technology has to a lead tremendous development in the industrial products that have made our lives a lot easier and helpful than what our ancestors faced. The advancements especially in the field of agriculture have helped evolve a new era of development and growth of different developing countries. The atomization in this field has been a trademark for the people who are completely dependent on agriculture for their survival and other needs. Few recent papers dealing with the automation in agricultural field are reviewed in this section.

In the paper[1] written by Mohd Najib Ahmad and others provides several research works and developments on automation and agribots from different scopes and field areas to expl ore recent agricultural practices. They conclude that agribots align with the IR 4.0 concept, whereby various smart technologies and robotics are being produced and practiced in the agriculture sector. An attempt has been made by P.Nithishetal [2] to develop an IoT based Agribot which performs seeding, watering, Humidity and temperature checking and grass cutter**.** Sunitha M **[3]** has carried out seeding robotics for the irrigation system. Some of the major problems in the Indian agricultural are rising of input costs, accessibility of skilled labors, lack of water resources and crop monitoring. To overcome these problems, the automation technologies with robots were used in agriculture. The automation in the agriculture could help farmers to reduce their efforts.The robot proposed by M. Priyadarshinihasetal [4] performsoperation like soil, moisture testing, seeding, spraying pesticides, removes compost from the field, and also performs obstacles avoidance operation and metal detection in the path. The robot is controlled using cell phone using DTMF technique. Because of using DTMF technique it overcomes the range or distance problem of using Bluetooth or RF module which having limited working range. Agribot integrated system which uses Wi-Fi to communicate between two robots which perform activities like seeding, weeding, spraying of fertilizers and insecticides is presented in [5] by Ankit Singhwasetal. They focused on rover's navigation and is performed by remote guiding devices fortified with the positioning system. It uses Arduino Atmega2560 controller and ultrasonic radar sensor for obstacle avoidance. It is controlled using wireless module that can be controlled by PC/TAB/Mobile. It gives acknowledgement massage of seed tank empty or full to the farmer. Paper [6] by N. Firthous Begum etal, develops an agribot which perform only two operations like digging hole in field and then planting a seed at a regular interval and cover the plough area with soil. To drop the seed, stepper motor is used and to dig a hole, spike wheel is used. The motivation of this research is to decrease harvesting cost and increase the productivity. Conventional harvesting method is highly labor intensive and inefficient in terms of both economy and time. Machine harvesting systems by robot are a partial solution to overcome these issues by removing fruits from the trees efficiently. This reduce the harvesting cost to about 35-45% of total production cost. An agribot is designed to reduce harvesting cost [7] by Buniyamin N. They state that Mobile robot path planning has a few main properties according to type of environment, algorithm and completeness. The properties are whether it is static are dynamic local or global and complete or heuristic. The static path planning refer to environment which contains no moving objects or obstacles other than a navigating robot and dynamic path planning refers to environment which contains dynamic moving and changing object such as moving obstacle.

The new inventions happening in agribot development is tremendous and farming is becoming more mechanized and automatic.

III. PROPOSED AGRIBOT WORKING PRINCIPLE

The proposed smart multipurpose agricultural robot is made to move in all directions like forward, reverse, left, and right. These can be controlled by specifying corresponding commands to the microcontroller with the help of a Zigbee module. The microcontroller then makes the driver circuit to move the robot. In addition to these movements many operations like ploughing, watering, spraying pesticides by identifying the disease, etc. are performed by this robot. Each operation performed by the farmer is done by agribot and farmer can control and monitor with the help of Bluetooth module and IoT technology. Power generation for the entire system is done with the help of Solar panel. Overall block diagram of the agribot is shown in fig(1). Fig(2) shows the actual connections made between microcontroller board and other devices.

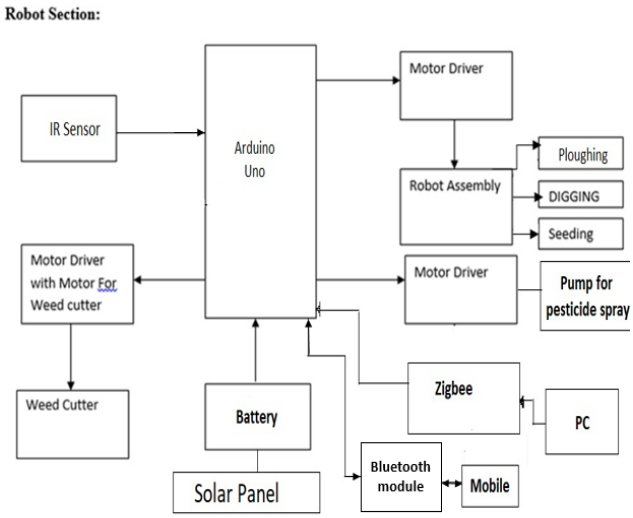

Fig 1. Block Diagram

Fig. 2: Actual Circuit connection

IV. ALGORITHM

The general algorithm used to make the robot work:

STEP1. – At first declare the variables as global variables with initializing the pin numbers.

STEP2. – In setup section identify few pins as output.

STEP3. –Supplied low values in the stating phase.

STEP4. – In void loop section, four functions are called which are explained below:

1. – First robot move function for the movement of the robot.
2. – Second robot stop function for stopping the robot.
3. – Third digging for digging action.
4. – Fourth robot seeding for seeding action.

All These functions will repeat in a loop.

V. WHEAT LEAF DISEASE DETECTION ALGORITHM USING MACHINE LEARNING

Machine learning is a branch of artificial intelligence that enables computers to learn and make predictions or decisions without being explicitly programmed. It involves training algorithms on large amounts of data to recognize patterns and extract meaningful insights. Through the use of statistical techniques, models are created that can generalize from past experiences to make accurate predictions on new, unseen data. Machine learning algorithms encompass a wide range of methods, including supervised learning, unsupervised learning, and reinforcement learning. These algorithms have applications in various fields, such as image and speech recognition, natural language processing, fraud detection, and personalized recommendations.

The process of leaf disease detection using machine learning typically involves the following steps:

Data Collection: Gather a dataset of labeled leaf images that represent various diseases and healthy conditions. It's important to ensure the dataset is diverse and representative of different plant species and disease severities.

Data Preprocessing: Clean and preprocess the collected data to ensure uniformity and remove any noise or irrelevant information. This step may involve resizing images, normalizing pixel values, and applying filters or transformations for better feature extraction.

Feature Extraction: Extract relevant features from the preprocessed leaf images. This can involve techniques like color-based features, texture analysis, or shape descriptors. The goal is to capture important visual characteristics that can differentiate between healthy and diseased leaves.

Training and Validation: Split the dataset into training and validation subsets. Use the training subset to train a machine learning model, such as a convolutional neural network (CNN), using the labeled images and their corresponding disease classes. The validation subset is used to fine-tune the model and evaluate its performance during training.

Model Evaluation: Assess the performance of the trained model using evaluation metrics such as accuracy, precision, recall, and F1 score. This step helps determine the effectiveness of the model in accurately classifying leaf diseases.

Testing and Deployment: Apply the trained model on unseen or test leaf images to predict their disease classes. This step allows for real-time detection and can be integrated into a user-friendly application or system.

Iteration and Improvement: Continuously refine and improve the model by incorporating feedback, retraining with new data, and adjusting parameters to enhance its accuracy and generalization capabilities.

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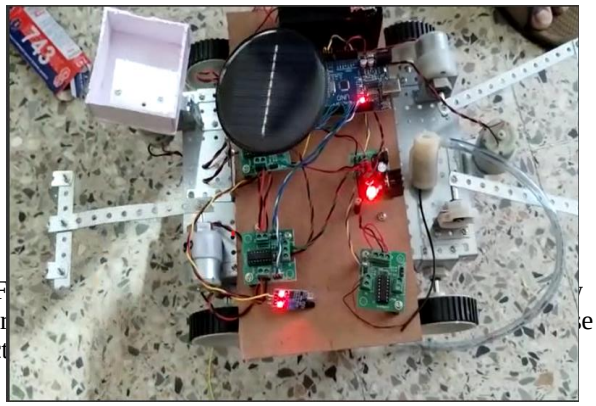

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- HEALTHY: A healthy leaf is typically green in color, with a smooth and intact surface, supporting photosynthesis and optimal plant growth as shown in fig.4.
- SEPTORIA: Septoria is a fungal disease affecting plants, particularly crops like wheat and tomato, causing leaf spots, reduced yield, and economic losses as shown in fig.5.
- STRIPE RUST: Stripe rust, caused by the fungus Puccinia striiformis, is a common disease in wheat and barley, characterized by yellowish-orange stripes on leaves, affecting crop productivity as shown in fig.6.

Fig. 4: Healthy leaf

Fig. 5: Septoria leaf

Fig. 6: Stripe Rust leaf

VI. SOFTWARE USED

The software tool used for the project work is IDLE, and Arduino IDE.

A. IDLE

IDLE is an integrated development environment for Python, which has been bundled with the default implementation of the language since 1.5.2b1.

It is packaged as an optional part of the Python packaging with many Linux distributions. It is completely written in Python and the Tkinter GUI toolkit.

B. Arduino IDE

Arduino IDE where IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Controller with open source that has a working voltage of 5.5 volts, inexpensive and less power taken. C / C ++ codes were comfortable for this progress. Arduino can interface with PC using Extended Serial Bus (USB) strategies. The Arduino could be an organized microcontroller placed on a board that feasibly connects to major PCs. It allows the customer to program the featured at mega chip to do a variety of tasks with the programming dialect on wanders called graphics.

VII. RESULTS AND DISCUSSIONS

A. SimulationResults

The results or the outcome of the project work is done in machine learning with the help of python language and output result are summarized as shown in below figure. First image (fig.7) tells about the wheat is healthy leaf second image (fig. 8) tells about that wheat leaf is septoria disease and third image (fig.9) tells wheat leaf is of stripe rust.

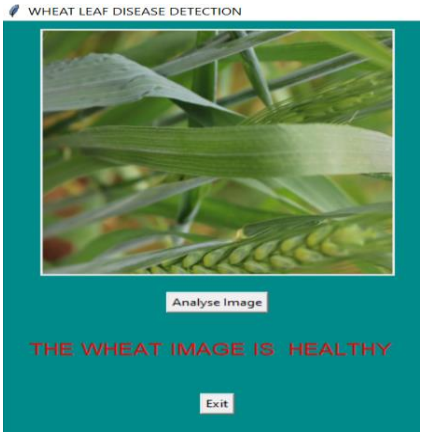

Fig. 7: Healthy leaf simulated output

Fig. 8: Septoria leaf simulated output

Fig. 9: Stripe rust leaf simulated output

B. Experimental Results

- Movement of Robot in forward and backward direction.
- Digging action.
- Seed Sowing action.
- Pesticides action.
- Leaf disease detection.

VIII. CONCLUSION

This paper introduces wireless technology in the field of agriculture. Exploits features of Arduino platform to help Farmers Significantly. Provide a flexible user interface to farmer to control the machine effectively. It reduces manual labor requirement which is a boon to the farmers as finding laborers is a very difficult job today. The Agribot can work in any sort of climatic condition as well as can work nonstop unlike humans. The time required to carry out the five functionalities reduces considerably in comparison with carrying out the same activities manually. It is a onetime investment which reduces the overall farming cost considerably. This Agribot acts as a gateway to automated smart farming.

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