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Research Paper on Agribot Using Swarm Intelligence

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Abstract - *This robotic vehicle is a very powerful and high-yield agricultural machine that uses swarm intelligence to perform tasks. Swarm Intelligence (SI) is an artificial intelligence technology based on the study of collective behavior in decentralized and self-organizing systems. Based on this, multiple robots or devices can be grouped and perform required tasks. Swarm Robotics is a new method of coordinating a system with multiple robots, which consists of a large number of mostly simple physical robots. The multifunctional system provides an advanced method of planting, cultivating, watering and mowing crops, thus requires very little labor and is very convenient. The machine processes fields based on specific rows and specific columns at regular intervals according to the cultivation. In addition, an Android smartphone can be used to control the vehicle via WI-FI. The entire process of calculation, processing and monitoring is performed by the motors and components in front of the microcontroller.*

Key Words: Swarm Intelligence, Robots, Agriculture, Multipurpose, Cultivation, Decentralized

1. INTRODUCTION

Agriculture is rapidly becoming a high-tech industry, attracting new professionals, new companies and new investors. Technology is quickly advancing, not only in improving farmers' productive skills but also in developing robotic and automated technologies as we know them. At the heart of this trend is the need to be more productive. And with the growing population, the world will need more food, and farmers will face greater pressure to comply. Agricultural robots increase productivity for farmers in a variety of ways. From drones to independent tractors to the arms of a robot, technology is used in creative and innovative systems. Agricultural robots perform slow, repetitive and dull tasks for farmers, allowing them to focus more on improving overall productivity.

We use the concept of swarm intelligence technology in agriculture. In swarm robotics, many robots collectively solve problems by building beneficial structures and behaviors similar to those seen in natural systems, such as swarms of bees, birds, or fish. Swarms traditionally co-operate without central control, and act in accordance with simple and local ethics. Only their interactions emerge in a way that can solve complex tasks. These factors lead to the main advantages: flexibility, durability, and durability. Swarms can be considered a type of quasi-organism that can adjust to changes in the environment by following certain behavioral patterns. With the implementation of swarm robotics, many robots - homogeneous or heterogeneous - are connected, forming a host of robots. Since individual robots have the ability to process, communicate and hear in an environment where on board they are able to communicate with others, and respond to the environment independently. In recent times, agricultural growth has slowed down day by day largely due to staff shortages.

Although the lack of rainfall, the failure of the weather, the long summers and the effect of extreme heat contribute to the destruction of agricultural growth, a shortage of workers is a major reason for slowing down agricultural growth. To overcome this shortage of workers in the agricultural sector and the challenges facing Indian farmers, it led us to work on innovation "Agribot using Swarm Intelligence - AUSI" to reduce this problem. It can use power sources efficiently and communicate via Wi-Fi. And is capable of monitoring over the entire field of cultivation throughout day and night. This multi-purpose program provides a breakthrough method for sowing, cultivating, irrigating and cutting crops with minimal human effort and performance that makes it an efficient vehicle. The machine will plough the farm by looking at certain rows and certain columns at a certain distance depending on the yield. In this method, it would have sufficient intelligence embedded within to behave well orderly for a long time, on its own, in a semi-natural environment, while carrying out a useful task. The whole design is automated with the help of a Wi-Fi module and signals done through the Blynk application over a phone. The whole process of calculation, processing, monitoring is built with motors & sensor connected to the microcontroller.

2. PROPOSED METHODOLOGY

The basic aim of this paper is to develop a multipurpose machine that will be able to plough the land, sow the seeds, water the crops, level the land and carry out harvesting. This whole system of the robot works with the battery and over Wi-Fi communication. We will be using an android smart phone application i.e., Blynk app to control the vehicle to respond to the control signal. This type of vehicle should

help farmers as a low investment option, and ease of use and ease of use for the user. Instead of buying multiple machines to perform the different functionalities, the farmer can get the respective work done by using our single productive multipurpose agribot - AUSI.

Agribot is deployed on a metal chassis which is the base frame with 4 wheels connected and driven the rear wheel is dc motor. The front end of the chassis is given both the harvesting feature and seed sowing while water pump used to water the crops will be added at the cultivator end. We use one motor to administer the forward, backward, left and right movement and another motor is used to control harvesting, seed sowing and watering the crops. The functioning begins when the farmer opens the application and selects the options provided on the display screen. This android application is developed using an open-source software Blynk Application that works well with the hardware. Wireless communication will be established between the phone system and Agribot by Wi-Fi which will send the RF signals serially, on the other hand the robot will take actions according to the instructions given by the Farmer. We use Embedded C and Arduino Software (IDE) compiler to write programs and upload them to the board. The Interfacing is done using Node MCU which runs on which runs on the ESP8266 Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability. It acts as master controller decodes all the commands received from the transmitter and is responsible for executing all the commands received from the remote and also generating pwm pulses for the speed control. We have also added LD293 motor driver IC which is an integrated circuit chip and is used to control motors. When the L293D IC receives signals from the microprocessor, it transmits the relative signal to the motors which drives two motors i.e vehicle driver motors and also runs the motors for all other operations of Agribot.

2.1 CHALLENGES

We have designed AUSI to be an efficient bot for farmers and making a significant change in the agroindustry. As all ways any machine will have its acceptances and challenges, we have also doted few challenges which we feel can be corrected in the near future with the growing technology. The main challenges we came across is as follows;

- AUSI is a multipurpose system that gives an advance method to farming, reducing man power. The considerable downside of the machine is the manual power required for ploughing and leveling the farm.
- So far in the market we have agricultural machines for separate purposes which are overpriced while AUSI is a multifunctional system which will provide 5 functionalities hence will be economically priced and since it is a one-time investment it will be worth the cost.
- The maintenance is something to be taken care off. Not only AUSI any machine in this case needs maintenance to keep them running for long term use.
- For using AUSI minimal knowledge on using a phone to be precisely using an app is required this can be a little challenging for farmers who lack the knowledge of using a phone since AUSI is completely operated using a phone.
- Finally, AUSI is designed using Swarm intelligence which will take over the traditional farming environment with new technologies reducing man power and this is very beneficial for a farmer as farm owner which will reduce his wages for workers where as for the employers working under these farmers can lose their jobs.

3. ARCHITECTURE

In this project, we will be looking at the use of a multipurpose irrigation robot called AUSI that will be able to plough the soil, sow seeds, irrigation and cropping after the harvest is ready. This will help the farmers in minimizing the use of multiple equipment's in farming. This Agribot works with an android application named Blynk. This app controls the Bot in performing various desired tasks as per the farmer's requirement.

3.1 Project Requirements:

Components Used:

- DC Motors
- L293D Motor Driver
- Relay
- ESP8266 Node MCU
- Water Pump
- Battery
- Cutter
- Seed Dispenser

Software Requirements

- Embedded C (Open Source)
- Eclipse

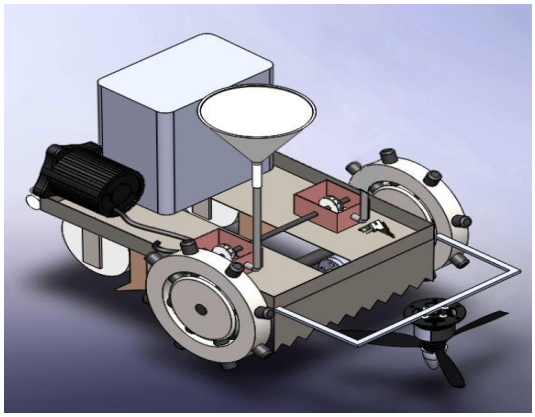

Fig -1: Agribot

3.2 Usage of Components

The Agribot consists of a Cutter which is attached to a DC Motor at the front which helps in cutting of the crops. The Seed Dispenser is also attached to a DC Motor which will help in sowing the seeds. There is a plougher mounted at the front of the chassis and a soil leveler at the back which perform the ploughing function.
Two L293D IC boards, ESP8266 Node MCU, Relay for the water pump is used for controlling the Agribot. Two additional DC motors is used for movement of the wheels.

4. WORKING PRINCIPLE

The L293D IC boards takes low power voltage and gives sufficient power for the DC motors. Each IC board has 4 input pins such that only 2 DC motors can be connected. One of the IC is used for Cutter and Seed Dispenser, whereas the other one is used for the movement of the wheels. In the soil dispenser, when the motor is turned on, the flap will be rotated 90 degrees which will allow the seed to be dispensed. The ESP8266 will be connected to the internet and all the data and commands will be sent to this via app. The code will be stored in ESP8266 and when Blynk(app) is connected to the server we can be able to control and perform all the desired tasks. We are using a Relay for the Water pump which is connected to a reservoir. This will be controlled by the app. When the plougher is pushed down, it will plough the soil and seed dispenser will be turned on simultaneously from the app. Once the seed is dispensed the soil leveler will level the soil above the seeds.

5. FUTURE SCOPE

Agricultural robots or Agribots are already widely used to increase productivity in all aspects of the industry. However, Agribots can do more than just do repetitive tasks. Because of the technology of wireless communication and communication, they can do their job selectively, for example by irrigating, cutting, plowing and fertilizing only the plants they need, and only the fertilizer or water needed, so that nothing can be used. Factors that have hindered the adoption of robots in the agricultural sector include: the availability of cheap agricultural labor, complex processes involved in agriculture (making duplication of robots a real technical challenge), lack of research funding, low prices, and other complex relationships and risks affecting agricultural communities. Robots and drones can have a profound effect on farming performance. From drones that monitor and analyze plants, automatic robots like AUSI can sow seeds, fertilize and harvest, the development of agricultural robots all means that human performance can now be devoted to more complex tasks.

Agribots may require significant investment in the future but provide long-term results by working 24/7 and protecting themselves from fatigue, stress and illness in an area divided by chronic unemployment, which is why these robots can be legitimate for farmers. With the help of technology, agribot can also be used for a variety of farming applications. For example, it can be used to test the soil and determine which plants will grow better, or which nutrients should be combined to allow existing plants to produce more yields.

5.1 ADVANTAGES

• Farmers are now free from busy activities such as farming, sowing, feeding and monitoring animals, etc.
• Agribots like AUSI are not as sick or tired as human beings and no breaks are required so efficiency and productivity increase.
• With high speed and low tolerance, efficiency is high
• The robotics industry offers us the opportunity to reimburse the labor for a good investment profit by providing practical solutions.
• We can use cameras and sensors to monitor farms and detect weeds and identify pests, insects or diseases.
• Since robots are designed for a specific purpose then there is no chance of a major error.
• Using a variety of sensors and technologies we can also get data on seeds, plants, climate, soil etc. and we can predict the best outcome.
• As we use Robots and various processes so it creates job opportunities for people who are interested in working for new or hobbies.
• Non-agricultural people can also successfully farm with new technologies and robots.

Our Agribot uses Swarm Intelligence- AUSI empowers the farmer to do agricultural work without going to the field and allows simple robots to work together to perform complex tasks. In the future, Agribot could be made independent by doing various agricultural activities. It is evident from research that there is great potential for implementing an independent system in various agricultural processes, where it is possible to enforce an adequate management and security system at a reasonable cost. With the development of robots in the agricultural sector, the agricultural system,

food production could increase dramatically and economically.

6. LITERATURE SURVEY

These papers have helped us in delineating and contriving AUSI bot with exceptional ideas and success are the following. We are indeed grateful for these papers which has succored us in presenting our project AUSI.

- **"Agriculture Field Monitoring and Analysis using Wireless Sensor Networks for improving Crop Production."**

Paper Originators: B. Balaji Bhanu Department of CSE, KL Univ., Guntur, AP, INDIA, K. Raghava Rao Department of ECM, KL Univ., Guntur, AP, INDIA, J.V.N. Ramesh Department of ECM, KL Univ., Guntur, AP, INDIA, Mohammed Ali Hussain Department of ECM, KL Univ., Guntur, AP, INDIA
The motive of this is to design and create an agricultural monitoring system using wireless sensor network to rise the throughput and standard of farming without discerning it constantly and manually. Temperature, humidity and carbon dioxide volumes are the most prime aspects for the growth, productivity, and quality of plants in agriculture. So, this system periodically measures these parameters inside the fields, thus the farmers or the agriculture experts can observe the measurements from the web simultaneously. Moreover, when a critical change in one of the measurements occurs, then the farmer will be intimated via mobile text message and e-mail by an agriculture expert. With the continuous monitoring of many environmental parameters, the grower can analyze the optimal environmental conditions to achieve maximum crop productiveness, for the better productivity and to achieve remarkable energy savings.

- **"Intelligent agent greenhouse environment monitoring system based on IOT technology"**

Paper Originators: Liu Dan China University of Petroleum, Cao Xin Nanjing Agricultural University
This paper takes CC2530 chip as the core, presents the design and implementation of agriculture Greenhouse Environment monitoring system based on ZigBee technology, the wireless sensor and control nodes takes CC2530F256 as core to control the environment data. This system is made up of front-end data acquisition, data processing, data transmission and data reception. The ambient temperature is real-time processed by the temperature sensor of data terminal node. Processed data is sent to the intermediate node through a wireless network. Intermediate node aggregates all data, and then sends the data to the PC through a serial port, at the same time, staff may view, analysis and storage the data by the PC that provide real-time data for agricultural greenhouse, fans and other temperature control equipment, and achieve automatic temperature control.

- **"Wireless Sensor Network Based Automated Irrigation and Crop Field Monitoring System and scheduling systems"**

Paper Originators: G Nisha and J Megala.
Wireless sensor Network based automated irrigation system for optimize water use for agricultural purpose. The system consists of distributed wireless sensor network of soli-moisture, and temperature sensors placed in the crop field. To handle the sensor information Zigbee protocol used and control the water quantity programming using an algorithm with threshold values of the sensors to a microcontroller for irrigation system. The system has powered by solar panel and Cellular-internet interface for data inspection. A wireless camera is fixed in crop field to monitor the disease area using image processing technique. The system is low cost and energy autonomy useful in water limited geographically isolated areas.

7. CONCLUSIONS

The project introduces wireless technology and a swarm intelligence in the agricultural sector. It reduces manual labor and can work in any type of weather as well as work continuously unalike humans. The time required to perform five tasks is significantly reduced compared to performing the same tasks manually. It is designed to help farmers reduce their workload and increase productivity with its many functional features such as automatic planting system, automatic irrigation, automatic crop cutting etc.

This AUSI project is being implemented with simulation and computer hardware. It connects via Wi-Fi with the operator and a swarm of similar small robots. AgriBot has a limited working area of less than half an acre due to its shape and structure. We designed it under limited imagination and worked on it over each task. Different operating modes have been found to control its movement, transmitting signals using a Wi-Fi module and with the help of swarm intelligence, a large number of robots are assembled in a distributed and decentralized way. This basic design of autonomous robots can be transformed with few changes and can be built to cover a large area of land for efficient agricultural activities.

By building this robotic vehicle with its many agricultural features, it overcome the difficulties of farmers in cultivating their land at all times of the year no matter what the weather on that day. Considering all the circumstances, a robot integrated with different small modules can be used for rescue and agricultural purposes around the world especially countries like India where agriculture provides the main livelihoods of large Indian populations.

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