

Smart Multipurpose Agricultural Robot

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Abstract— The proposed system is a boom to farmers which combines robotics with agriculture and capable of moving around the field like a farmer and plough the field, sow the seed in the pre-determined row and irrigate the field along the rows autonomously as well as in a manual way by Bluetooth and IoT application. During the seeding process, it sows the seeds and then levels the mud after seeding. In the irrigation process, the soil sensor monitors the water condition. It checks this level and alerts the farmers, then slowly applies a small amount of water to the planted seeds in all the rows of the farming plot. The fertilization process is the same as the irrigation process but some crops need fertilizers when the seed germinates and the plant begins to grow. It also sprays pesticides to the crops. In addition to this, harvesting of crops and removal of weeds are also done using image processing techniques. When weeds or fruit is detected, a message will be sent to the mobile and then a corresponding motor will be made to run manually to remove weeds and to pluck the fruits that are ready to harvest. It monitors environmental conditions and also protects the crop from animal attack using a PIR sensor and if any animal enters into the field alarm sounds and messages will be sent to the mobile IoT. The soil and climatic conditions are continuously transmitted to the mobile using IoT so that farmers can see the conditions frequently.

Keywords: Agriculture Robot, Bluetooth, IoT, Seeding, Irrigation, Weeding

I. INTRODUCTION

Agriculture is an art and science of cultivating the soil, growing crops, protecting crops from pests, and raising livestock. For the development of the economic condition of the country, the agriculture sector is necessary. Requirements in the field of agriculture are growing constantly. It helps agriculture to smart by automation and Bluetooth technologies. An advanced idea of our paper is to automate the procedure of planting, cultivating, pesticide, spraying, tunneling, and increase the harvest. To overcome most of the challenges in agriculture, modernization is required. Farming of seeds is robotically done by dc motor.

II. LITERATURE SURVEY

Maheshwari R, Azath H, Sharmila P, Sheeba Rani Gnanamalar S. The proposed system makes it easier to collect all appropriate facts about the enhancement in fertilization of soil and farming by sending the information about the changes in the environmental condition using IoT devices. Restriction of the paper is during the rainy season, there is no advantage of the solar panel, 2019[1]. Gokul, R. Diksith, M. Gopinath, S. AjithSundaresh. In this project, the system is elaborated to remove unwanted plants using the robot which is controlled by Bluetooth. It only allows short-range communication between devices. In the future Bluetooth wireless technology has the skill to have simultaneous

handling between both data and voice transmissions, 2019[2]. Y Nikhil Kumar, M Koteswarrao, Khushwant, Rahul raj, Promaananya chakrobarty, M Himakiran, Dr. Gopi Krishna Saramekala. This system accomplishes the actions of functioning the digging and seed sowing using the components such as dc shunt motor, Arduino, Solar panel. The commands are given to cultivating robots by using android applications. Inaccurate sprinkling may not fulfill the tasks of the driller and the opposite force which acts on the motor might result in the crumbling of the driller. In the time ahead, industrial application purpose is more useful, 2019[3].

K Durga Sowjanya, R Sindhu, M Parijatham, K Srikant, P. Bhargav. The expected paper works towards designing the agricultural robotic vehicle which can be controlled through Bluetooth for cultivating, sowing, and sprinkling systems. Bluetooth works in a short-range. In the future, it can be expanded to hold something with the help of UV sensors along with cameras, 2017[4]. Sourabhumarkar, Anil Karwankar. This paper will finish off the installation of the agribot including the hardware and software facet. It is estimated that farmers find it difficult to buy expensive robots. It helps the farmers to lift the corps efficiency and also reduces the need for manual labor to the farmer, 2016[5]. Amirta, Sneha A, Abirami E, Ankita A, R Praveena, R Srimeena. This sheet of paper deals with a robot accomplishing the operations like seed distribution, fruit detaching, and pesticide spraying automatically. Failed to successfully bring out the accuracy of specific tasks. Additional activities like yielding, irrigation can be performed by using a single multitasking robot, 2015[6].

III. EXISTING SYSTEM

The existing system combines robotics with agriculture and capable of moving around the field like a farmer and plough the field and sow the seed in the predetermined row and irrigate the field along the rows autonomously. In addition to this, harvesting of crops, spraying fertilizers, and clearance are also done. All these operations are controlled via Bluetooth application. Today we are facing a lot of problems in agriculture due to pandemic diseases, natural disasters, etc. So there are lots of chances for the unavailability of laborers. At that time, this project will help the farmers to reduce the burden of their work and also helps to manage time. This project will also help the farmers to reduce the labor cost. This system to be developed must have an advantage over traditional methods and tractors in terms of cost, speed, accuracy in operation for which it is designed, fuel consumption, and physical energy required by a human for it. By targeting these issues and consideration properly, this product will be the real help for farmers.

IV. PROPOSED SYSTEM

Various methods aim only at surveillance which is mainly for human intruders, but we tend to forget that the main enemies

of such farmers are the animals that destroy the crops. This leads to the poor yield of crops and significant financial loss to the owners of the farmland. This problem sometimes makes the farmers leave the areas barren. This system helps us to away such wild animals from the farmlands as well as provides surveillance functionality.

A. Requirements

1) Hardware Requirements

- Microcontroller Atmega-28P
- PIR Sensor
- Temperature Sensor LM35
- Moisture Sensor
- UART
- NodeMCU
- Bluetooth Module
- Driver motor L293D
- Driver motor L298N
- DC motors
- Water Pump
- Relay

2) Software Requirements

- MATLAB
- Arduino IDE
- Bluetooth Terminal Application

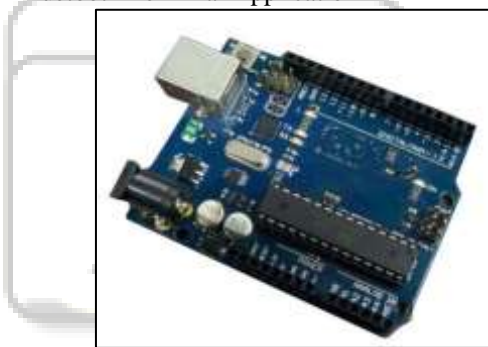
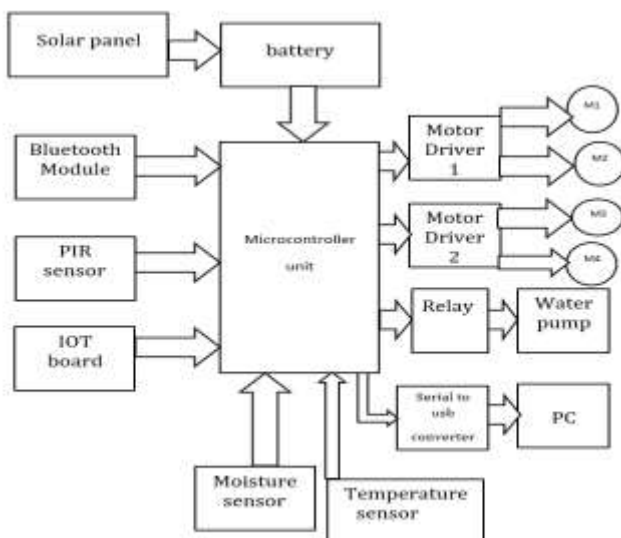


Fig. 1: ATMEGA328P Microcontroller

B. Block Diagram



C. Interfacing

1) Interfacing moisture sensor with Arduino

The moisture sensor measures the soil moisture using two conducting plates that act as a probe. It can measure the moisture content based on the resistance between the two plates. The resistance varies inversely with the amount of moisture present in the soil.

2) Interfacing temperature sensor with Arduino

LM35 is a temperature sensor which can measure temperature in the range of -55 degree to 150 degree Celsius. It is a three-terminal device that provides an analog voltage proportional to the temperature. The output of LM35 is given to the analog pin of the microcontroller. This analog voltage is converted to its digital form and processed to get a temperature reading.

3) Interfacing PIR Sensor with Arduino

PIR sensor is used for detecting infrared heat radiations emitted from the objects. This makes them useful in applications involving the detection of moving living objects that emit infrared heat radiations.

4) Interfacing Bluetooth module with Arduino

HC-05 is a Bluetooth device used for wireless communication with Bluetooth-enabled devices (like a smartphone). It communicates with microcontrollers using serial communication (USART). Data is sent from the smartphone using the Bluetooth Terminal application.

5) Interfacing NodeMCU with Arduino

On the Arduino side, we will take samples periodically and send JSON messages over soft serial to NodeMCU. On the NodeMCU side, we need to receive the messages sent by Arduino over serial, Arduino will send the messages in JSON format. We will not be doing any processing on NodeMCU.

D. Working Principle

The smart multipurpose agricultural robot can be 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 Bluetooth module. The microcontroller then makes the driver circuit to move the robot. In addition to these movements many operations like ploughing, watering, Spraying pesticides, and fertilizers, etc. Each operation performed by the farmer can be monitored both in Bluetooth and IoT.

1) Ploughing:

The main purpose of ploughing is to turn over the advanced layer of the mud, transferring superior nutrients to the exterior of the soil and making the soil nutritious for farming. This robot performs the ploughing operation by giving the command to the microcontroller. Once the required command is given for the ploughing operation, the motor runs.

2) Seeding:

By the process of seeding the seeds are sown into the mud. This can be done by giving the required command to the microcontroller via Bluetooth and when it receives the command for seeding, the motor turns ON.

3) Watering:

Watering is the process in which the seeds and crops are watered on regular basis. Soil moisture is the content of water present in the soil. The farmers can continuously monitor the moisture content in the soil through IoT as well as through Bluetooth by using a moisture sensor. When the water content

becomes low, the farmer can give the command to the robot and the water pump begins to water the crops.

4) *Weeding:*

Weeding is the process to remove unwanted plants in the field. This process is very important because weeds are competitive plants and they reduce the useful crop yield by acquiring nutrients, space, etc. This process also reduces the usage of herbicides and weedicides thus reducing harmful effects on crops. In this project, the weeds can be removed manually by giving commands as well as automatically by using the image processing technique. When the robot detects weeds, the weeding motor turns ON and the message is also sent to the farmer. After the removal of weeds, the weeding motor is turned OFF.

5) *Spraying fertilizers and pesticides:*

Fertilizers replace the nutrients that are removed from the soil. Without fertilizers, crop productivity will be reduced. Pesticides are used to remove the pests from the crops which is also a very important step in crop production. This robot performs both operations. By giving the required command the corresponding motor will be turned ON.

6) *Temperature Monitoring:*

For the cultivation of crops, temperature plays a major role. By knowing the temperature, the farmers can predict whether it will rain. It also helps to water plants frequently if the climate is too hot. The temperature in the field is continuously monitored by temperature sensor LM35 and the farmers can monitor the measured temperature frequently.

7) *Animal and Obstacle detection:*

Since this robot is operated by humans from distance it is necessary to detect the presence of obstacles such as animals, stones, etc. In this robot, we used a PIR sensor that detects the presence of obstacles. If any obstacle is detected the entire operation performed by the robot turns OFF and the message is also displayed to the farmers.

V. ADVANTAGES

- To reduce human effort in the agricultural field with the use of the small robot.
- To perform all four operations at a single time hence increases production and saves time.
- To complete a large amount of work in less time. Farmers can operate this robot through remote by sitting at one side and he can operate easily.
- The usage of solar can be utilized for battery charging. As the robot works in the field, the rays of the sun can be used for solar power generation.
- To increase efficiency, solar power can be used and the power output can be increased.
- Robotic cameras and sensors are capable of detecting weeds, identifying pests, parasites or diseases, and other stress.
- The robots can reduce the use of pesticides by up to eighty percent of the farm.

VI. EXPERIMENTAL RESULTS

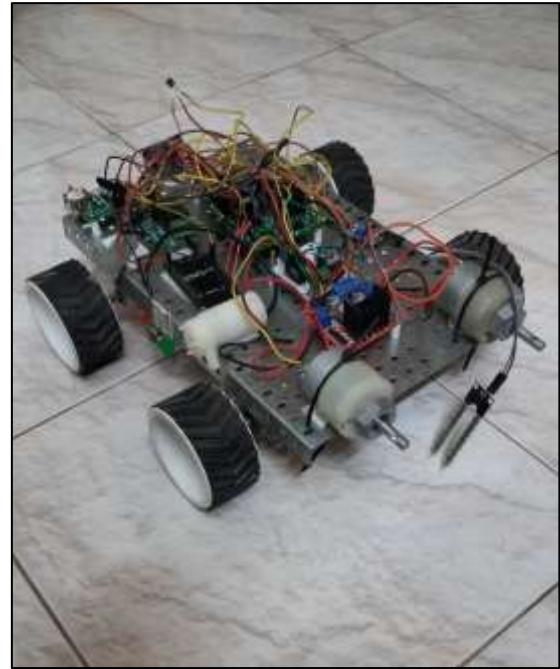


Fig. 2: Final Outcome- Smart Multipurpose Agricultural Robot

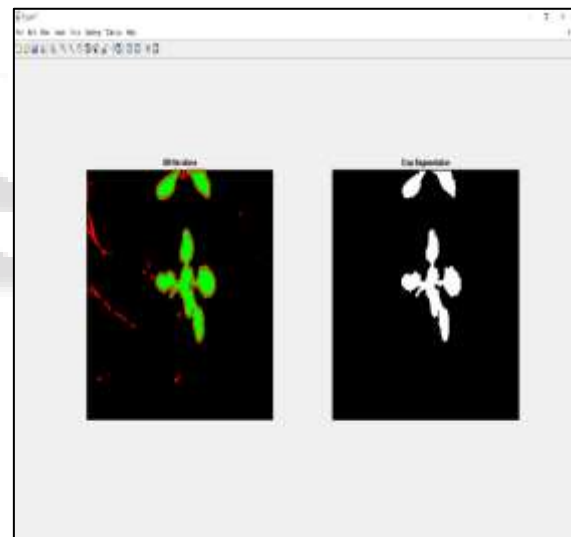


Fig. 3: Crop Segmentation- MATLAB result

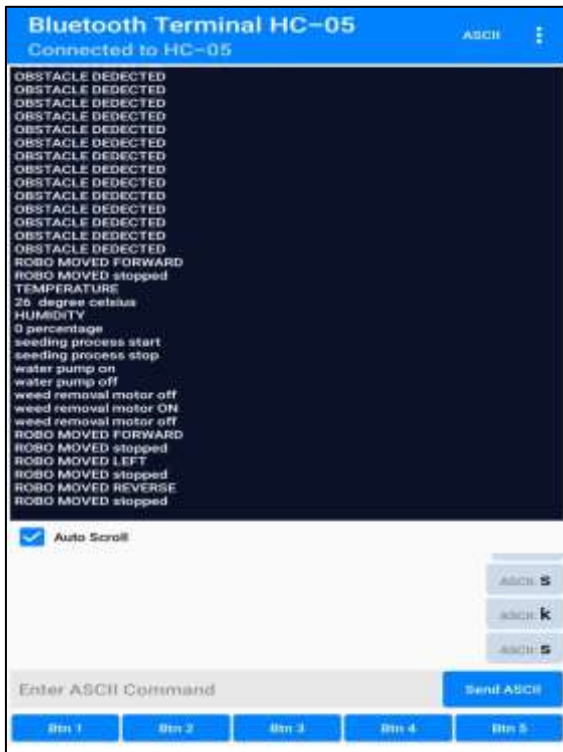


Fig. 4: Output displayed in Bluetooth Terminal application

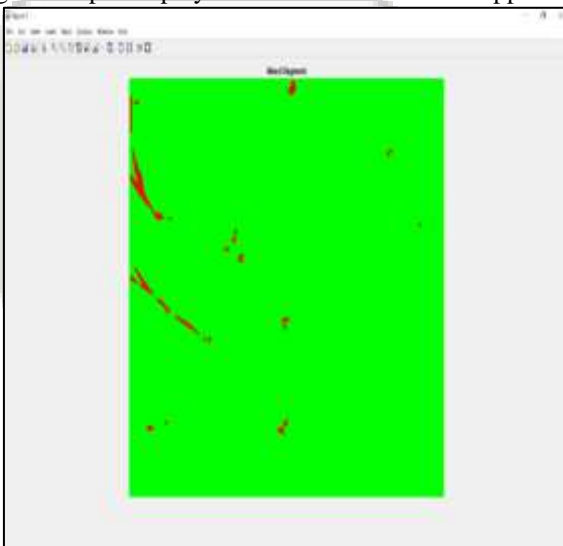


Fig. 5: Weed Segmentation- MATLAB result

VII. CONCLUSION

The solution for the problems in agriculture is given by designing an autonomous agricultural robot since farmers can't work alone for a long time and vehicles & tools used for farming cost high. This project helps the farmers in planting, cultivating, pesticide spraying, etc., This project helps in solving the problems of the farmers and reduces their work with smart automation and Bluetooth technologies. This system can be further developed by advanced technologies.

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