Solar Powered Autonomous Multipurpose Agricultural Robot - Agrobot

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Abstract- *Around 42% of the people on the earth chose agriculture for their profession. It is also seen that agribusiness is called the "backbone of India" as more than 70% of the Indian population depends on horticulture. Horticulture is the preparation of plant development to create nutrition, fiber and other required items. The basic point of Agrobot is to apply advances in mechanical technology to the field of agribusiness. Agreeing with the later considerations, it was found that farmers are still using conventional strategies to carry out rural exercises, from which the labor force is expanded and the accuracy of the final result is reduced. Because of the need for information, every now and then the farmer falls to recognize leaf disease. This expands the points to understand the difficulties related to agriculture and increase the accuracy of the final result by creating a gardening robot that naturally performs rural tasks such as furrowing, leveling, seed sowing, water system along with locating leaf diseases to inform the farmer a reasonable pesticide.*

Keywords- Agriculture, Solar energy, Leaf disease, Digging, Seeding, Leveling, Watering.

I. INTRODUCTION

In India we have generally followed the traditional farming practice where all the processes are done by human power. Currently, speed, energy efficiency, guidance detectors, guidance fineness, and technologies resembling wireless connection are prioritized in the development of autonomous field robots. Technology was not as developed back then. They thus planted by hand. However, technology has advanced in recent years. Thus, it is no longer required to seed in the sun. By covering the robotic mixer, one can use robotic technology while lounging in a cool environment. In the breeding industry, robotics has recently emerged as a technology whose application is predicated on the idea of ideal management.

The primary motivation behind automating agricultural processes is to reduce the time and energy needed for routine husbandry chores and to boost production by handling each crop as a whole [1]. Similar robot designs are modelled using a particular methodology and specified factors pertaining to the agricultural land where it will be used. This article brings together these many approaches and considerations. Additionally, a working version of an autonomous breeding robot made just for seeding is displayed.

Robotic systems play a huge role in all parts of companies, associations and artificial units. The initial idea of this study is to develop a mechanized device to assist in field operations such as sowing/sowing seeds [1] at predetermined distances and depths [5] with all applicable sensors to control humidity and temperature. The system focuses on two things, a monitoring station and a control station, which are interconnected using Wi- Fi wireless communication technologies [2]. Both the control station and the robotic station have equipment that are soil moisture sensor, a seed dispenser and a seed container, a robotic system with motors, an Arduino microcontroller, and a power supply [9]. The brain of the system is a microcontroller that can devote the order of input designs to all networks with the sensible factors reused by their respective built-in programs.

The robotic medium works using its internal motors and motor controllers that rotates the motors in the desired directions. Bluetooth is wireless protocol that provides signal transmission and function entry. ADC is an approximate analog to digital motor and helps in processing analog factors in the microcontroller, also the bone will cover the robot and fire the signal. Based on the entered signal, the robot takes the commands [2] from the mobile phone and moves in the direction and places the seed on the field. The robot can be monitored from the smart phone through the help of Bluetooth using the help of the ZIGBEE.

II. LITERATURE SURVEY

In the current script utmost of us have come across the atomization in colorful fields as the advancement of technology has to a lead tremendous development in the artificial products that have made our lives a lot easier and helpful more than what our ancestors faced. The advancements especially in the field of husbandry have helped evolve a new period of development and growth of different

developing countries. Atomization in this field has been a trademark for the people who are fully dependent on husbandry for their survival and other requirements. Around ten papers reviewed who are worked under this area.

A. **Sunitha.M: Seeding robotics for the irrigation system.** The Indian agriculture system is facing problems due to the increase in the resources costs, lack of skilled labors, shortage of water supply and efficient monitoring of crops. To resolve all these problems, the robots are used that works on automation technology for agricultural work. The automation decreases the farmers effort in the field of agriculture.

B. **M.Priyadarshini: Command Based Self - Guided Digging and Seed Sowing Rover**. A self-guiding digging and seeding rover that operates on command. The robot that conducts tasks including evaluating the moisture content of the soil, planting seeds, applying pesticides, and removing compost from the field, which also conducts metal detecting in the path and obstacle avoidance operations. Using the DTMF technology, a cell phone is used to operate the robot. The usage of DTMF technology eliminates the range or distance issue associated with Bluetooth or RF modules, which have a restricted operating range. An integrated system called Agribot makes use of WiFi to facilitate communication between two robots that carry out tasks including fertilizer and pesticide spraying, weeding, and seeding. The robust Raspberry Pi minicomputer and Arduino Atmega2560 controller are used to monitor and control the robot's operations. It has an underbody sensor system to detect that and an ultrasonic proximity sensor to avoid obstructions in its path. It can excavate a hole in the ground, plant seeds there, fill it again with soil and any necessary pre-emergence nutrients, and continue moving forward while utilizing Wi-Fi to communicate with another robot nearby. Rover for three purposes—precise digging, accurate seed placement, and sowing—have been proposed.

C. **Agribot: An Agriculture Robot:** Ankit Singh concentrated on how the positioning system – enhanced remote guiding devices navigate the rover. To avoid obstacles, it makes use of an ultrasonic radar sensor and an Arduino Atmega2560 controller. It is operated by a wireless module that is controlled by a mobile device, PC or tab. The farmer receives a massage indicating whether the seed tank is full or empty. The agrobot only does two tasks: it excavates a hole in the field while it is being ploughed, plants a seed at regular intervals and then covers the soil- filled hole with dirt. Stepper motors are used to drop the seed and spike wheels are utilized to dig a hole.

D. **N. Firthous Begum: Design, and Implementation of Pick and Place Robot with Wireless Charging Application.** This research focuses on decreasing the harvesting cost and increasing the crop productivity. The harvesting needs more labor usually and it takes a lot of time and money. So to overcome this robots provide partial solution by machine harvesting method that picks up crops and fruits in the field efficiently. Thus 35-45% of the harvesting cost reduced out of total production cost

E. **Buniyamin N: A Simple Local Path Planning Algorithm For Autonomous Mobile Robots.** A few key characteristics of the Mobile Robot Planning 2 depend on the kind of surroundings, both completeness and algorithm. Its features include whether it is complete or heuristic, dynamic, local, or global. Dynamic path planning is an environment with dynamically moving and changing items, such as moving obstacles, while static path planning isan environment with only a navigation robot and no other moving objects or obstacles.

III. EXISTING SYSTEM

In India generally the traditional procedure is followed for agriculture. The existing robots use the battery for power supply which has to be replaced if it loses its power. The different robots or devices are required for all every operation; they are not integrated [1]. The crop disease is not identified with proper information. Which may damage the whole crops. Seed sowing styles includes the use of beast drawn channel and pipes drillmaster or tractors used for the drilling. Before system required many laborers and they consume a lot of time and energy. Whereas the tractor ground drilling drivers of similar power units produce high amount of noise and the vibrations, which are mischievous for health and also work performance.

IV. PROPOSED ARCHITECTURE

System Conditions specifications specify the system factors in detail, both attack and software, that are the reasons for the system performance, along with functional conditions, as expected from the system. The battery is used for the working of the entire system. The 12V battery is necessary for the working of the robot. The four machines are required to four arms and the back two wheels are connected to the dc motors. The front end of the frame has the dc motor that is used for the digging the soil[2]. The Shaft is fixed which is drilled to make a hole so that the seed can pass through it, it is

also connected by one dc motor to rotate conveniently. A democrat makes the seeds to close[1], the sprinkler is used for the water pumping to spray the water. The robot operations digging, levelling, seeding, watering are controlled through the smart phone using the Bluetooth technology. microcontroller is the heart of the robot, DC motors relays are connived with the microcontroller to give colorful operations such as ploughing, sowing, leveling, digging, water and pesticide spraying. Bluetooth module controls the complete medium of the robot from Android smart phone [3]. Bluetooth technology is wireless communication that provides robot to move in all the directions like moving right, left, front and back[5]. For the movement of robots forward, reverse, stop, left, and right the respective commands are given.

The commands entered through the smart phones provides different functions in the field that are provided through the microcontroller. By using the CNN algorithm, the diseases present in the leaf can be detected and the remedies [8] for the perticular disease is suggested, based on that the pesticides can be sprayed [7]. Agriculture robots are suitable of performing operations like automatic furrowing, seed sowing, and water smattering. The qualitative development of this design is to provide digging and all other tasks to decrease the working cost and the time, all the tasks are performed using the battery source also we can borrow solar energy system [6]. The development end of the proposed system is that this bias can atomically conduct on agrarian operations. Nowadays farmers pay a lot of plutocrats for machines that help them to drop labor and increase income of crops but effectiveness and profit are less. Hence robotization is the ideal result to drop all the failings by development of machines that performs one operation and automating to adding the income on a large value.

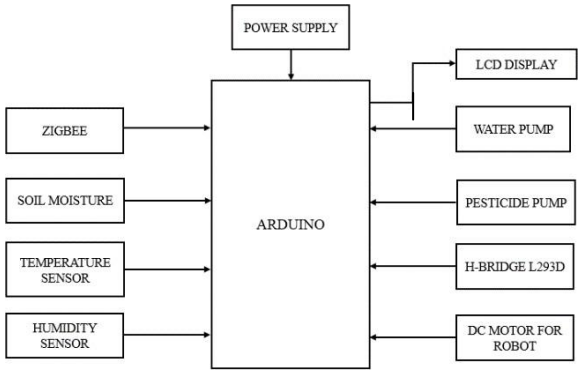

Fig:4.1**:** Architecture

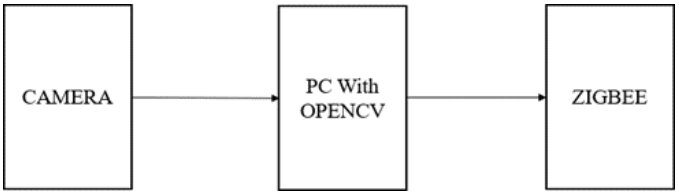

Fig: 4.2 Transmitter Unit

The image of the leaf is added to the dataset [8] and it is processed using the OPENCV and the image processing by CNN algorithm to provide the disease and remedies for the disease are displayed. The ZIGBEE provides the interface for the transferring the information between the robot and the laptop.

V. IMPLEMENTATION

The complete implementation of hardware and software is described in this paper.

SOFTWARE: Arduino IDE (Integrated Development Environment) is used to program the Arduino Uno board. Connect the board with computer using USB cable, load the code written in embedded C and upload it.

HARDWARE: Arduino[8] provides computer hardware and software which is an open-source platform that creates microcontroller kits and single-board microcontrollers for use in the construction of digital products. 17 and interactive items with the ability to perceive and manipulate both real-world and virtual elements. The 8-bit ATmega328P 14 microcontroller serves as its foundation. The Arduino Uno is equipped with six analog input pins, fourteen digital input/output pins, a USB port, a power barrel jack, an ICSP header, and a reset button. An Arduino board, another Arduino board, or additional microcontrollers can all be connected to it via communication.

The mechanical movement that can see around is caused by an AC or DC electric motor [9]. Here we need 5 DC motors that are for seeding, leveling, digging and 2 for the wheel rotation. All these are connected to microcontroller through the [9]H – bridge, where each H – bridge control 2 dc motors, so 3 H – bridges are used.
The sprinkler for spraying pesticide and water is connected using the voltage regulator to protect from the high voltage.

Solar Panel : A 7.5V/1.3W (BPL) solar panel converts solar power to electrical energy[6]. The solar panel has a maximum output power of 1.3W and maximum output voltage of 7.5V. The most prevalent solar cell technologies are monocrystalline, polycrystalline, and amorphous BPL

Sensors: FC-28 is soil moisture sensor it is a simple breakout to measure the moisture in a soil [6] and similar materials. The two sizable exposed pads serve as the sensor's probes and combine to create a variable resistor. The greater the amount of water within pads there will be less resistance and more outflow as a result of the pads.

Humidity sensor DHT11 is required for sensing the vapors in the air. The change in RH (Relative Humidity) of the surroundings would result in display of values.
IR sensor [10] is used to detect any objects that are blocking the way of the robot.

Voltage Regulator: Three-terminal positive regulators of the LM78XX/LM78XXA series are offered in the TO-220/D-PAK package and with a variety of fixed output voltages. Protection Against Thermal Overload. Protection from Short Circuits. Protection of Safe Operating Areas for Output Transistors

Leaf Disease Detection:

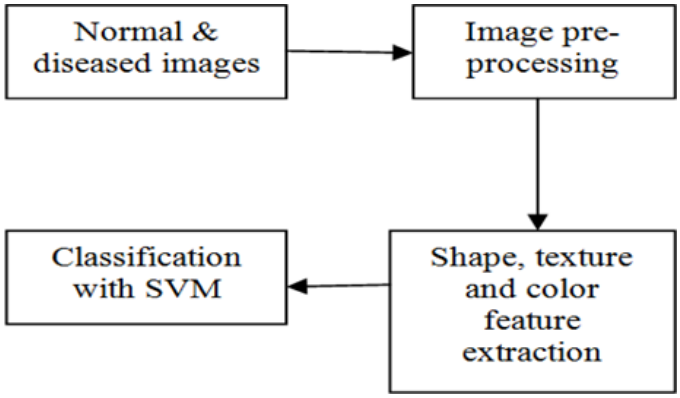

Fig: 5.1 Leaf Disease Detection

Convolutional neural network is the special type of feed forward artificial neural network in which the connectivity between the layers are inspired by the visual cortex. Convolutional Neural Network - CNN is a class of Deep Neural Networks(DNN) which is applied for analyzing visual imagery. Each leaf images are given as input that will be passed through a series of convolution layers with filters (kernels) to produce output feature maps. The 4 layers of the CNN algorithm is described.

A. **Convolution Layer:** In a convolutional layer, the computer analyzes an image using small patches called filters. These filters are compared to different parts of the image, multiplying and adding up pixel values to create a feature map. By matching these features with the input image, the convolutional layer can identify similarities and classify images accurately. This process involves sliding the filter across the image, computing the dot product at each position, and generating a matrix as the output.

B. **ReLU Layer:** ReLU layer is nothing but the rectified linear unit, Every negative value from the filtered photos is eliminated in this layer and replaced with zero. This is carried out to prevent from adding up to zeros in the values. This transform function removes all negative values from the matrix and only activates a node if the input value is greater than a certain threshold. If the input value is less than zero, the output will also be zero.

C. **Pooling Layer:** Pooling layer reduces or shrink the image size. Here first we select a window size, then mention the required stride, then walk selected window across the filtered images. Then take maximum values from every window. This will pool the layers and shrink the image size as well as the matrix. The reduced size matrix is given as the input to the fully connected layer.

D. **Fully Connected Layer:** We need to accumulate all the layers after passing it through the convolutional layer, ReLU layer and pooling layer. The fully connected layer is used for the classification of the input leaf image. These layers has to be repeated if needed unless you get a 2x2 matrix. Then at the end final classification takes place in the fully connected layer.

The leaf disease detection [8] helps formers to suggest the suitable pesticide for the diseased leaf efficiently. Here the CNN algorithm is implemented to identify the leaf detection by analyzing the image of the leaf.

V. RESULT & DISCUSSION

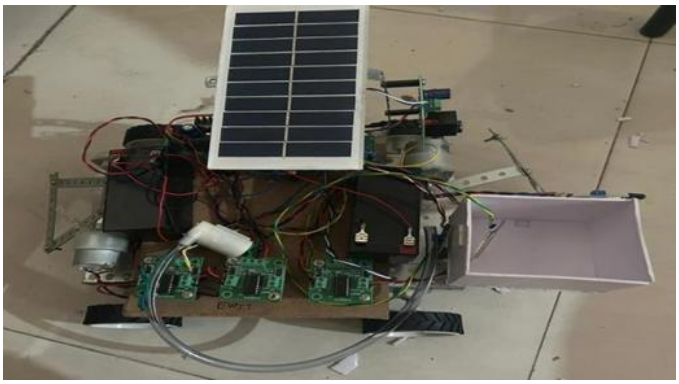

Fig 6.1: Model

The agricultural robot will have four motors and a chassis that it will use to connect and assemble everything on it. Toy motors make up two of them, and gear motors make up the other. The robot is able to perform three different tasks.

1. Digging
2. Seeding
3. Leveler
4. Sprinkler

These will be working in different modes. Programming of different modes will be done separately the different modes.

MODE 1: DIGGING

The DC motor is used to provide the movement while digging. The depth of the digging varies with respect to the crops we use so that the digging tool can be adjusted according to the crop that is sowing. In automatic mode the robot digs the land where a single seed in sowed while in the manual mode the robot keeps on digging and moves forward until the stop command is given.

MODE 2: SEEDING

Placement of seed (distance between two seed)	**Farm land**
Corn: Expected (6-8 cm)	7.2cm
Wheat: Expected (8-10 cm)	9 cm
Jowar: Expected (10-12 cm)	10cm
Soya bean: Expected (5-6 cm)	5.3 cm

Table 6.1: Placement of seeds

Hopper is used to carry seeds and to drop the seed at a particular hole [7] that is being dig by agrobot. The hole is available for the hopper through which the seed will be fallen down and the hole will be closed after the seed is put.

MODE 3: LEVELER

Leveler is fitted in the front end of the robot. The leveler will flatten the surface which is uneven. All this will require is for the front actuators to descend. The leveller will turn the entire area into a flat surface as soon as the robot moves forward on the uneven surface with ups and downs. This works great for filling up spaces, levelling gardens, and other tiny places.

MODE 4: SPRINKLER

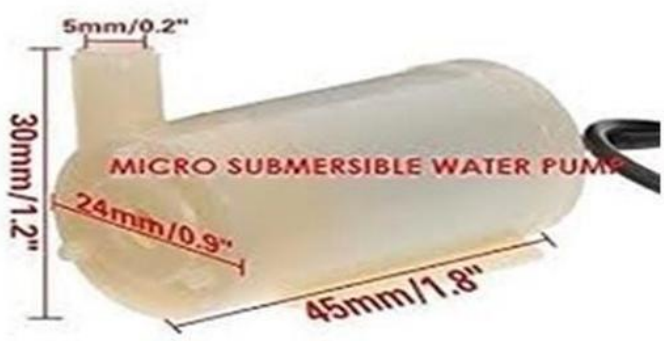

Fig 6.2: Micro submersible pump

The sprinkler is small in size, have the lightweight, efficiency is high, consumes less power consumption and noise produced is low. It has been used widely; in household include cooking, cleaning, bathing. Here the sprinkler helps to spray the pesticides to the plants and also for the watering the plants.

DATA SHEET FOR MOISTURE LEVEL REQUIRED

Crops	**Humidity (%)**	**Moisture level**
Corn	65	33
Yellow corn	65	15.3
Soybean	65	12.6
Wheat	65	13.8
Barley	65	19
Jute	65	13.7

Table 6.2: The data sheet of moisture level

VI. CONCLUSION

"Solar Powered Multipurpose autonomous agricultural robot" is efficiently implemented and tested to provide the operations of digging, seed sowing, levelling, watering and pesticide spraying. It is implemented with leaf disease detection and provides remedies for the disease. The embedded C programming is used to integrating agriculture robot. Utilizing affordable navigation sensors in the robot farming system makes the system environment-adaptable economically. Food output may be significantly and profitably boosted with the development of robot farming systems makes the system environmentally and economically versatile. The development of robot farming systems can significantly and profitably enhance food production.

With fully automated farms in the future, robots will perform all the tasks like mowing, fertilizing, monitoring of

leaf diseases, harvesting, tilling, etc. This also enables the farmers to just supervise the robots without the need to operate them. The project can be enhanced to any other kinds of crop. Hence, this robot can be applicable to the real time agricultural field.

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