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Aurdino Based Automaticagricultural Support System

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Abstract:

Almost centuries Indian farmers follow a set of prescribed manuals for cultivation. Water scarcity, patchy power supply and nonavailability of skilled labor have consistently led the backbone of the farmer which directly affects the economic growth of the country. This paper highlights the three major problems(skill, labor, water) in the agriculture field and presents an automated multipurpose Robot for the agricultural system to reduce manpower, cost and time. For this automation the solar power backup is provided to the robot, to make it eco-friendly. Concerning this concept, additional smart irrigation is added to reduce water losses. We also provide sufficient delay to the robot for maintaining digging, dropping of seed and water supplying accurately. A combination of electronic circuits and mechanical arrangement enhances the power of the system in the automated platform. All the operations are monitored and controlled by Arduino-Uno using L298N motor drivers. The ultimate objective of the proposed model is to support farming in the direction of automation with a step ahead to words next generation.

Keywords: *Agricultural automation, Arduino-Uno, servo motor, motor driver, robot.*

I. INTRODUCTION

India is an agriculture-based country, where a major chunk around 60% of India's population is engaged in agriculture and more than 70% of the population is directly or indirectly dependent on it, which is the main source of income**.** Agriculture plays a very significant role in the growth of the Indian economy**,** which has an 18% contribution to India's gross domestic product (GDP) and creates 50% of the employment. Many farmers are still following the older agricultural systems because of factors like lack of education and awareness which does not allow them to shift to other methods. Till now the natural food demand of society is fulfilled by direct agriculture.

Most of the lands in India are not suitable for agriculture because of water scarcity. It is due to the nonavailability of surface and groundwater for irrigation and unpredictable natural cycle that maintains stable water availability. Systems are developed in different ways to manipulate nature for producing higher yield, more nutritious and bigger crops that withstand different environmental changes. When development in the world is at its peak, the agricultural technologies fall behind and come to the scope of research[1-4]. Modern farms and agricultural operations are using sophisticated technologies such as robots, aerial images, GPS technology, and temperature and moisture sensors[5]. These advanced and automated devices allow farming to be safer, efficient, profitable and eco-friendly. Though there are many existing techniques to carry out agricultural activities, the need for the hour is to provide an efficient and inexpensive solution to the farmer for their ease in their agricultural activities. Many researchers have proposed many models such as home automation using the boat, smart monitoring, smart irrigation, etc[6-9].

The proposed solution is an automated seed plantation robot that is solar-powered and is controlled by an Arduino. It manages to do (i) digging of an assigned land with specified distance, (ii) planting the seed and (iii) watering (irrigation)the particular place where it is required without wasting the water. The user can define the sequence of work as per the specified job like plantation of the tree in a large land where only digging is required with a specific size. The amount of seed required for farming can be controlled with the help of a mechanical arrangement and servomotor to reduce the wastage of seed. The traditional farmland requires the use of a

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conventional method which thereby increases the need for manpower, time and money. But by the use of the above-mentioned solutions, these interventions can be minimized. This system (i) Reduces the manual work, (ii) Consumes less time, (iii) requires less effort, (iv) is economic and beneficial (v)Improves work quality and productivity.

The paper is organized as follows: The prototype requirements of the proposed model are described in Section II and Section III highlighted the detailed architecture. The component descriptions, hardware implementation with software details are given in Section IV, V and VI. Section VII summarizes the results obtained and Section VIII concludes the paper.

II. PROTOTYPE REQUIREMENTS

Automated Plantation system consists of an integration of the mechanical and electronic components which have their specification and a set of distinctive properties. The system is developed with the latest technology and can be easily upgraded from time to time as per requirement. The cost involved in the system is the lowest as possible while ensuring adequate efficiency and quality. The system can prove its robustness for a long period without any major defects. The system is more reliable and thus it will plant the seeds precisely. The configuration of the system is time-efficient and easy to install, the additional modules can be easily introduced to increase the feature. All the components of the model are connected smoothly by merging various technologies. As the robot does all the three vital parts of agriculture automatically so wastage of manpower, time, and water are not required. No technical skill is required for its operation.

III. PROPOSED ARCHITECTURE

Fig. 1 shows the block diagram of the proposed model. It consists of Arduino UNO for decision making which is operated by a dc battery with solar backup. For the movement of the system, two dc motors are used. The output of Arduino is not sufficient to drive the motors which have a high torque to support the load of the total system. The Motor driver system (L298N) is used to drive the dc motor. The same system is also driving the water pump for irrigation purposes. The working process of the proposed model can be understood in the following process.

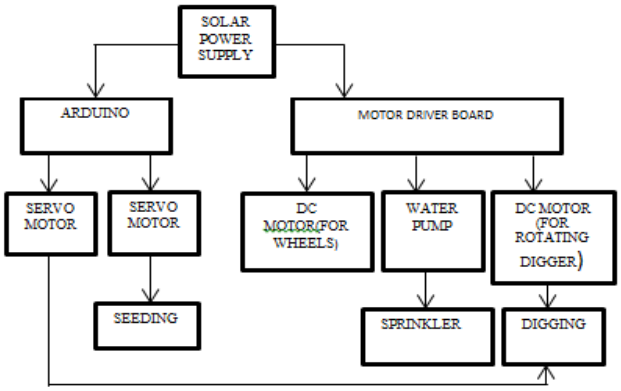

Fig.1. Proposed Architecture

(i)Initially, when switched on the power supply, the robot starts moving in the forward direction. The movement of the system is controlled by the program written in the microcontroller.
(ii)When the robot starts moving in the forward motion after a few distances it stops and starts drilling work. The distance between the two digging places is decided by the program which can be changed as per requirement.
(iii)The seeding system is controlled by a servo motor for dropping the required seed at a particular place.
(iv) As irrigation plays a major role in farming and it is the requirement that decides the quality of yield, a separate watering mechanism is used in the model. The sprinkler is supplying the desired amount of water to the seeding place. Unnecessary wastage of water can be minimized in this method. This method can help the cultivation where people are dependent on monsoon.

IV. MAJOR COMPONENTS

The proposed system accumulates several subsystems that help to carry out the process smoothly and efficiently. The components and modules required for the operation are mentioned below along with their functionalities

A. Arduino UNO

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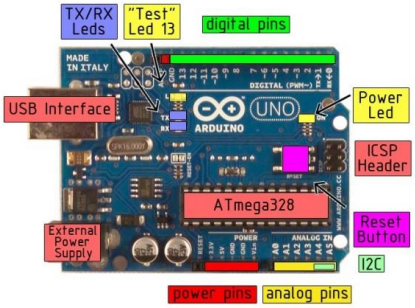
Arduino is an open-source electronics prototyping microcontroller-based board. In this section, the details of the Arduino board, as well as its applications, are described. The Arduino family has i) Arduino Lilypad ii) Arduino Mini iii) Arduino Mega iv) Arduino Nano v) Arduino members. Out of the above, the Arduino UNO board became more popular than the other microcontroller boards. As a result in electronic prototyping its adoption increased (Fig. 2).

The recommended input voltage of Arduino UNO varies from 7 volts to 12 volts, however the input voltage limits of an Arduino UNO from 6 volts to 20 volts. Arduino UNO can be powered-up using an AC-to-DC adapter or battery to get started. Each input pin or output pin uses a current of 40 mA. The Arduino UNO is programmed with the Arduino Software.



(IDE).

Fig.2. Arduino UNO

The recommended input voltage of Arduino UNO varies from 7 volts to 12 volts, however the input voltage limits of an Arduino UNO from 6 volts to 20 volts. Arduino UNO can be powered-up using an AC-to-DC adapter or battery to get started. Each input pin or output pin uses a current of 40 mA. The Arduino UNO is programmed with the Arduino Software (IDE).

B. Motor Driver IC

The L298N is a motor driver IC used as a current amplifier. The IC takes a low current signal from the Arduino board and amplifies it to high current. The direction of the motor is also controlled by the Driver. The L298N can driver any high voltage and high current load (Fig.3). The module has two separate blocks for the different motors with an onboard 5V regulator, which is done using a jumper to either enable or disable the output pin. The 5V pin can be used as an output pin for powering the Arduino board if the motor supply voltage is up to 12V. If the motor voltage is higher than 12V, the jumper must disconnect to protect the onboard 5V regulator. In the second case, the 5V pin will be used as input and need a connection to a 5V power supply.

C. DC Motor

A dc motor is a rotational device that converts energy(electrical to mechanical). The direction of the rotation is defined by Fleming's left-hand rule. Three dc motors are used out of which two for driving the wheels connected to the robot and one for digging system. The operating voltage of the dc motors is 12 volts. The maximum load current of dc motors is 330 mA and has a maximum torque of 1.5 kg-cm at 12 volts. L298N is the dc motor driver used for driving motors.

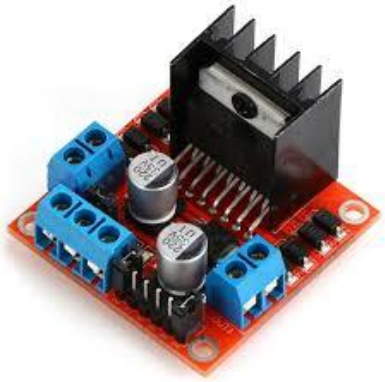


Fig.3. Motor Driver IC L298N

D. Servomotor

A servomotor is an electrical rotary device that is used for rotating a connected object with precise control. Servomotors are suitable for the control system. The major parts of the servo motor are DC motor, gear reduction part, position-sensor, and the control circuit. The motor is connected to the gear mechanism and the gear system provides feedback to the position sensor (potentiometer) for achieving the revolution cut off from 90° to 180°. The position sensing device is used to point out the rotational position of the shaft. In the proposed model SG90 servo motor is used (Fig.4.a).

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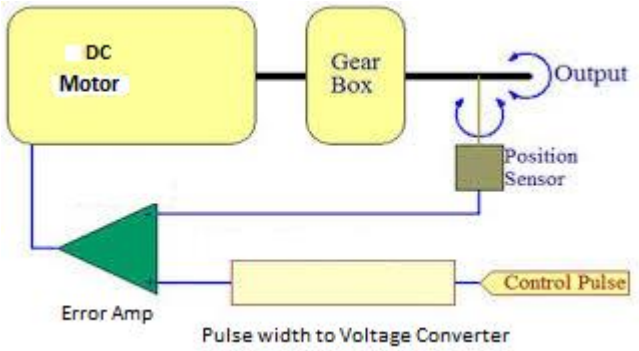


(a)

(b)

Fig.4. (a) Servomotor (b) Water pump

E. Water Pump

The drip irrigation system is highly appreciated, due to less water requirement and is used efficiently. In the proposed model we have used a 12-volt dc submersible water pump (Fig.4 (b)). Due to the Submersible water pump is placed inside the water major prevention is taken by sealing the motor hermetically. Sealing the motor prevents water to enter inside and avoids a short circuit. When the pressure switch of the pump is on, the impeller begins to spin as a result the pump draws water into it. Here the water pump is driven by the L298N motor driver.

F. Solar system

Solar power is the most reliable, renewable alternate source that derives clean and pure energy from the sun. It uses photovoltaic cells (PV) for the conversion of energy from sunlight into electricity by exciting electrons in silicon cells. This produced electricity is used to charge the battery using a dc-dc converter (Fig.5).

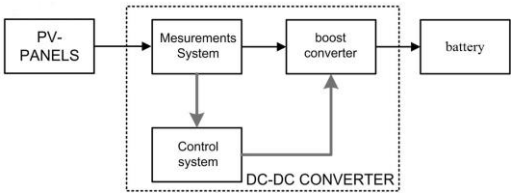
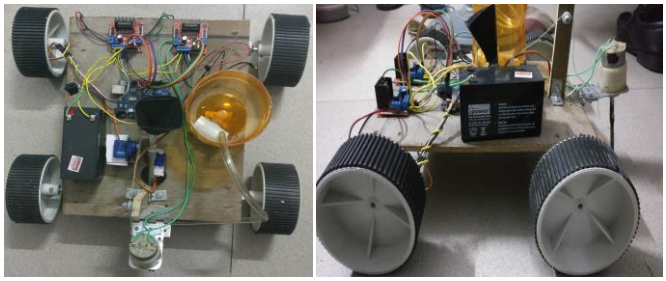


Fig.5. Solar power system

V. HARDWARE IMPLEMENTATION

The size of the entire prototype is 9inch × 7inch. The components are well mounted over a platform. The whole prototype is divided into four parts i.e. (i) movement of wheels, (ii)digging,(iii) seeding and (iv)watering(Fig.6). Four wheels are supporting the robot for forwarding movement. In our model, the two rear wheels are connected with 12V DC motor to drive the system. The motors are connected to the L298N driver IC and the Arduino. Now the data is transferred from Arduino to the driver IC and it functions accordingly. The major hardware part to be constructed in the prototype involves the formation of the digging and the seeding part. For digging the ground we have used a DC motor of 40 rpm with a sharp tool in front of it, which is connected in front of the robot with the support of a Hinge. So when the data is given to the servo motor it allows the hinge to go down and again pull it upward after the job is over. After that seed is planted with the help of a slider. The last part is irrigation. A water pump is fitted inside a water tank that pumps the water and pours it in the desired area.



(a) (b)

Fig.6.(a) and (b) are top view and side view of proposed model

VI. SOFTWARE IMPLEMENTATION STEPS

The microcontroller Arduino Uno was programmed and debugged using IDE(Arduino Uno software). The Arduino performs the following process as described in the algorithm.

Step1: Through pin Mode, the output pins of the Arduino are assigned.

Step2: The header file of servomotor was imported from the Arduino library.

Step3: The data is transferred to the motor used for digging.

Step4: A specified time delay is assigned for the work.

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Step5: The servo motors are instructed to pull the digger up and to pass the seed
Step6: The water pump is initiated for watering.
Step7: After this process is completed the motor of the wheels is instructed to move with a specific delay.
Step8: The above steps are automated as per user demand.

VII. RESULT AND CONCLUSIONS

The proposed model is implemented and tested under different environmental conditions for checking its effectiveness and robustness. It was observed that the model is working efficiently and maintaining the accuracy of the system. The watering system is modelled for drip irrigation to reduce the water requirement. As the farmers are suffering from the increased demand for the market this prototype will truly be opening a window to the future. This prototype will improve production reliably and efficiently. The automation in agriculture with less cost can improve the living of the farmer. The proposed prototype solution can be tested on an experimental basis and gradually can extend it to larger fields. There is an initial cost involvement, but in the long-term, the cost involved is very less as compared to the traditional systems.

A small modification of the system can help the farmer for preparing holes for plantation of the fruit plants. As per requirement only drip irrigation work can be done with the help of the bot. At every step, there is a scope for improvement. With the attachment of a GPS tracking system, the details of information can be collected from remote sensing. With the application of image processing, IoT and camera may be added for remote surveillance. The paper concludes that the application of technology for automation in agriculture used in farms around India will certainly increase the livelihood of the farmers.

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