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# Cost Effective Implementation of IoT Based Solar Powered Agriculture Robot

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**ABSTRACT:** Agriculture is the main source of livelihood for many in India, but recent years sees farmers are finding difficult in making agriculture is a profitable one, mainly because of shortage of labour for farming activity. Recent advances in technology such as Internet of Thing (IOT), cellular communication comes to make life of farmers easy by providing low-cost solutions for various farming operations. This paper proposes design and implementation of a low-cost IOT based agriculture robot for automating ploughing, sowing and watering the agriculture land. The design of the proposed system minimizes the labour dependency of farmers for many farming activities and also reduce the time and improve accuracy of the work. The proposed system uses Arduino microcontroller to control the farming operations and develops a mobile application for android phone to give command for robot from remote.

**KEYWORDS:** Agriculture Robot, IOT Application, Smart Farming.

## I. INTRODUCTION

Recent statistics [1] shows, farmers in India are giving up the agriculture and converting the farming land for some other use. Mainly due to loss they incurred by various environmental and climate change and also due to shortage of labours for farming activities. The land used for crop cultivation in India is decreasing at alarming level. Hence, low-cost technological solutions for agriculture operations are the need of the hour. So, the smart agriculturing is require to deliver high operational efficiency and high yield. Smart agriculture and food production with a focus on environment monitoring, precision agriculture, machine and process control automation and traceability are the focus areas of current development in the field of agriculture. In particular, precision agriculture that simplifies irrigation mechanisms by reducing water wastage are very essential [2].

Driven by electric power, recent years sees the developments of technological solutions for irrigation and agricultural task automation are high. India receives solar radiation on an average 3000 hours throughout a year [3]. Hence solar powered technological solutions for agriculture task automation can be used to yield more benefits in the Indian conditions. Many such technological solutions have been addressed in the literature in the field of agriculture task automation and remote monitoring the farm land are discussed in the following section.

This paper is organized as follows. Section 2 related works discusses the previous works in the field. Section 3 discusses about the proposed design and implementation of agricultural robot. In Section 4 prototype and results of the work are given. Section 5 concludes our work.

## II. RELATED WORK

In[4], A smart irrigation controller that transmit the data using xbee technology to a remote server is developed using PIC16F876A microcontroller. But system proposed can monitor moisture only at a single point. Considering for large farm area, this will not be viable solution to deploy because this ultimately increases the cost involved. Xbee is short range communication technology also put limit on the remote application of the system. Proposed system also not perform any signal processing operations to obtain useful statistics relevant for farming operations.

In [5], automation of the process of seed sowing is discussed for many crop varieties, high-precision pneumatic planting with a wide range of seed sizes and uniform seed distribution in seed spacing along the travel path. Wifi is used as receiver and main disadvantage of the system is robot moves in only one direction. A two cell overhead crane system proposed in[6] perform tasks such as spraying fertilizer, irrigation, planting seeds by a solar driven crane



system. However, these systems incur more cost and also need to monitor the farm land using multiple sets of sensors from various geographical points.

Authors in [7] proposed an agricultural solution for the farmer based on Wireless Sensor Networks and GPRS technology. Using ARM processor, a smart GSM controlled weather based irrigation system is developed in [8] to sense the soil moisture at a given geographical position and irrigates the farm based on prediction of rain. Because multiple sensors are to be placed and monitored over a geographically separated and large farm area, the system proposed in [7] and [8] incur more cost.

The Agricultural Robot for Automatic Ploughing and Seeding proposed in [9] uses Bluetooth to control device and helps in the navigation of the robot outside the field. Authors in [10] proposed a solar powered agricultural robot that uses IOT for controlling and storing the data for predicting the best way of farming that yields good profit for the farmers.

### III. METHODOLOGY

The proposed based IOT based solar powered agriculture robot is controlled using ATmega2560 micro controller programmed on Arduino platform. The robot can be controlled using mobile phones through IOT communication, so that the robot will move in all directions inside the field. We can give command to control the seed spreader valve and water tank valve using mobile. Along with that, we can measure the seed & water level with the help of IR & water level sensor. If any problem occurs like (low seed & water level), a buzzer will be alarmed. Solar panels are used to convert solar energy into usable electrical energy using boost converter and charge the battery connected with the robot.

The YL-69 moisture sensors collect the data from the field, is processed in Arduino micro controller and take decision irrigates the soil near the sensing point uniformly. Further, the data collected from Arduino is transferred to cloud using IoT device. This information of soil.

Relays are used to drive the necessary current required for ploughing blade adjustment, open and close the seed spreader valve and water tank valve. Robo Relays are used to provide required current for DC motors attached to the wheels. The block diagram in figure 1 below shows the proposed low-cost solar powered agriculture robot. Infra-red sensors are used for taking decision on the robot's movements.

The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a computer, is used to connect the IOT device for the interaction with cloud to receive the command for robot based on the data received from various sensors connected with Arduino mega 2560 micro controller.

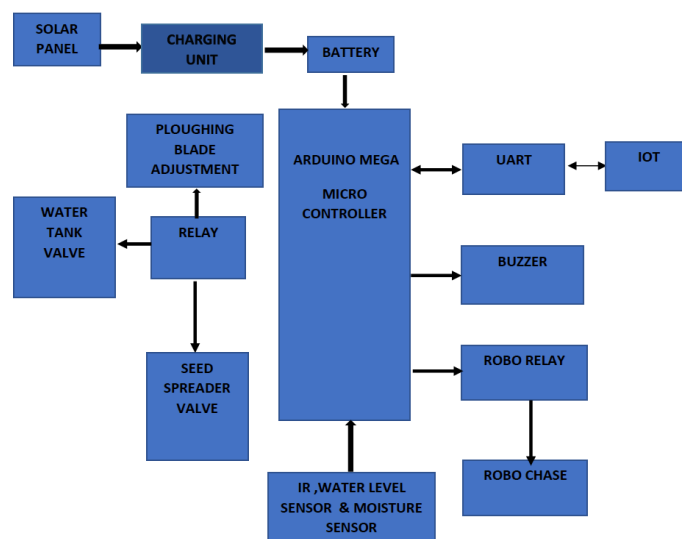


Fig 1: Block diagram of Proposed low-cost solar powered agriculture robot





#### IV. EXPERIMENTAL RESULTS

*Agricultural Mobile Robot:*

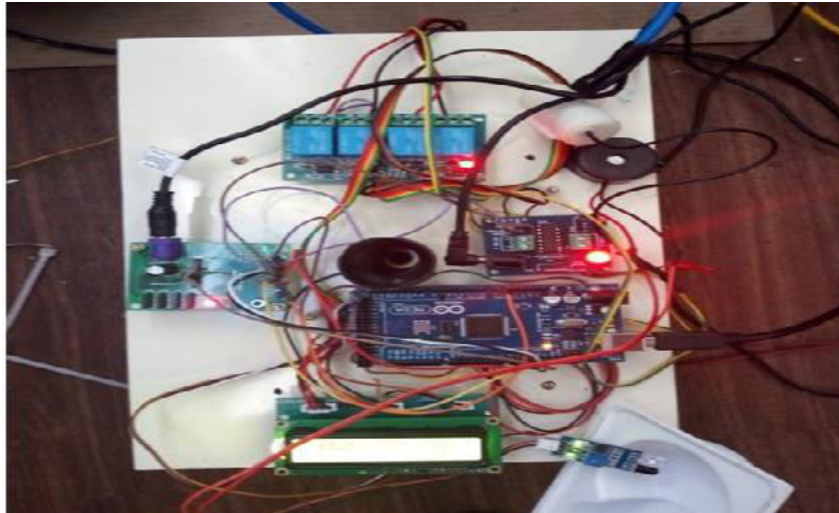


Fig 2: Prototype of Agriculture Robot

Figure 2 and 3 shows prototype of our low-cost IOT based solar powered agriculture Robot using the Arduino microcontroller and its solar power unit.



Fig 3: Solar panel and charging unit of the Agriculture Robot

*Webpage Output:*

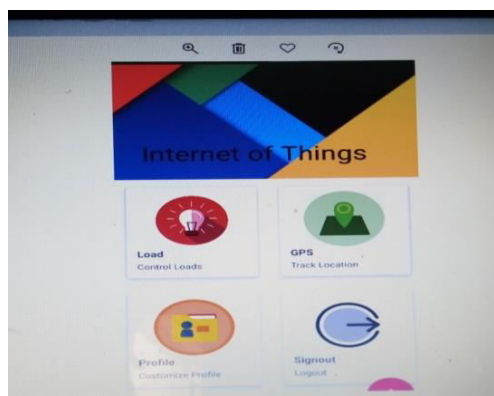


Fig 4: IoT Application

Figure 4 shows IOT Application is used to control the agriculture mobile robot and figure 5 shows Load condition controls the robotic directions to process in the agriculture land.

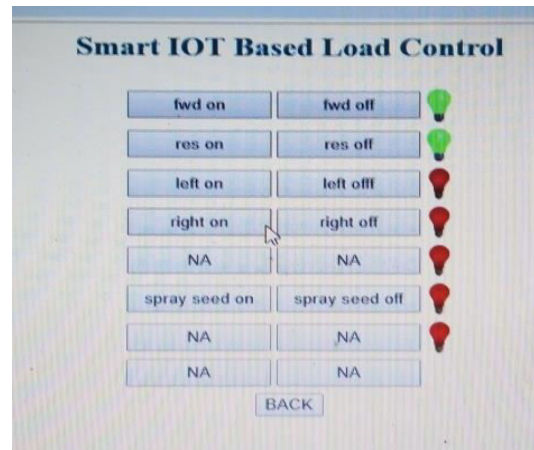


Fig 5: Snapshot of IoT based Load control model (on condition)

## V. CONCLUSION

This paper has discussed the IoT technology application in Agriculture and selected Android mobile wireless communication technology to achieve Agricultural site monitoring. The remote monitoring system with internet and wireless communication combined is proposed. According to the need, agriculture field is monitored and this system realizes the automatic control on the water level factor. This system has offered a good opportunity for the farmers, to operate and automatically identify the water level then water spraying, seed spreading and crop ploughing for the low-cost.

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