IOT Based Solar Powered Agribot for Irrigation and Farm Monitoring

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Abstract: Agriculture is an important sector in India. It is indispensable for the sustenance and growth of the Indian economy. In Indian economy Agriculture Contributes 22% to the country's GDP and more than 70% of Indians live in rural areas, and agriculture is the major livelihood for the majority of the rural population. The two major issues in agriculture are water scarcity, high labour cost and unnecessary flow of water during irrigation. These can be resolved by using agricultural robot. By considering Renewable energy resources sector, growth in India has been significant and in this paper solar power is used as the only source of power to control overall system. Agribot is developed using Arduino microcontrollers. It harvests solar power when not performing irrigation. While executing the task of irrigation, it moves along a pre-defined path and senses soil moisture content and temperature at distinct points. Raw data is transmitted to the irrigation part of Arduino via Bluetooth module and compared with threshold value. As per the comparison agribot starts smart irrigation.

Keywords*-Solar energy,Agribot, Arduino IDE, Bluetooth Module.*

INTRODUCTION

Irrigation is defined as the artificial application of water on an agricultural land for the assured growth of plants life. For the development of country, agriculture plays vital role. Most of the land in world are cultivated land but they are not able to utilize properly due to lack of knowledge or due to scarcity of water. If a crop is raised on rain water falling directly on a land on which the crop stands, we say that the crop has not been irrigated. On the other hand, water from its source of supply is guided to the land and is applied on it to raise a crop, that crop is said to have been irrigated. Such water as is applied artificially is called irrigation. India's current irrigation coverage of 48.7% of total sown area means two-quarters of the population engaged in farming are dependent on monsoon rainfall, which often exacerbates agrarian distress even during a partial drought. Nowadays the availability of water and power is insufficient to fulfill the farmer's needs, hence irrigation is one of the efficient method that saves water and fertilizer by allowing sufficient water to the roots of plants.

Why Irrigation is necessary? It is important to increase the area under irrigation because, It is necessary to reduce the dependency on rainfall and stabilize the cropping pattern. For example in South India without perennial rainfall, water supply replenishment is dependent on a cycle of dry seasons alternating with monsoon seasons. Monsoons are not certain in nature. So, farming cannot entirely depend upon rain. Irrigation allows farmers to grow more crops in one year on the same land. The constant availability of water for Irrigation provides a sense of stability to the farmer, and also encourages him to practice newer farming methods with updated technologies.

Technological solutions for irrigation and agricultural task automation are driven by electric power. Throughout a year India receives solar radiation on an average 3000 Hours of sunshine (i.e. 4-7kWh of solar radiation per sq. Meters).Hence solar driven technological solutions for irrigation task automation can yields better benefits for Indian environmental conditions.

Many such technological solutions have been addressed in the literature that achieve agriculture task automation and help in wireless farm monitoring. Some of them are discussed as follows. "Smart Irrigation system using IOT".It will work with a soil moisture sensor, ESP_8266 Wi-Fi module and an Arduino board to develop a smart irrigation system project that detects the changes in moisture level in the soil and controls the flow of water accordingly.

"Wireless remote motors starter with acknowledgement using solar energy for agricultural application", here the wireless remote has been used to ON and OFF the motor for irrigation. "Solar based automatic Irrigation Using Soil Moisture Sensor", this paper gives the embedded system for automatic irrigation using the soil moisture sensors installed at various points, based on solar power with GSM module.

On contrast to the systems discussed above, Nowadays IOT is changing the way we live.IOT is also changing the way trees and plants live. This project helps us to understand how to implement IOT in very important areas like agriculture and irrigation. Hence, agricultural robots can also be used for irrigation and agricultural task automation using Internet of Things. In this paper, we developed an agribot, capable of irrigating the form, harvesting solar power while not irrigating and also monitoring the farm from a distant node. The benefits of the developed agribot are better efficiency in water usage compared to manual irrigation, achieved via direct soil moisture and temperature measurements at particular nodes.it is worth noting that the developed Agribot irrigates the farm not based on a single point data like in the automated systems, but irrigates based on the averaged data obtained at each point. As the agribot can move around the farm, there is no necessity of installing multiple sensors at various geographical points in the farm. The data collected at various nodes is transmitted to the Arduino via Bluetooth module and compares with given threshold value. After comparison depend on raw data Agribot start irrigating the land.

The developed prototype of the Agribot in this paper forms a low cost system due to the incorporation of a worm-rack mechanism and only a single set of sensors, the model developed is based upon master and slave methodology. The battery incorporated can be recharged using renewable solar energy using solar panels.

DESIGN AND IMPLEMENTATION OF AGRIBOT

The irrigation Agribot is controlled using two Arduino boards, Arduino ATmega 2560 for the locomotion and sensing and an Arduino uno for irrigation. The power is entirely supplied by the renewable solar energy. The Agribot is made to move on the pre-defined path that is programmed in the ATmega. The major criterion for the decision regarding the irrigation operation is taken using the sensor values. The sensors include soil moisture sensor (YL-69) and temperature sensor (LM35). These sensors collect the values from the nodes or sensing points that have been pre-defined.

The soil moisture sensor is connected to a worm and rack that will be pierced into the soil to sense the soil moisture content. Further the value will be sent to the ATmega which will then be compared with the threshold value and takes an action about the irrigation. If the irrigation has to take place, the master Bluetooth module (HC-05) will be intimidated. The master will send the signal to the slave Bluetooth module that will be interfaced with the Arduino UNO. If state 1 is sent from transmitter to receiver Irrigation is done, if state 0 is transmitted from transmitter to receiver irrigation is not done.

The locomotion operation of the Agribot will be initiated and controlled by the Arduino ATmega, there will be an H-Bridge that will control the working of 4 gear motors, which will act as wheels and helps the Agribot to move further. There will be another H-Bridge connected to the mega which will initiate the movement of the worm and rack, to go inside the soil and get back to the same position with a time delay of 5 seconds.

In the irrigation part the relay will be connected to the 5v supply of the Arduino uno, it will receive the signal from the slave configured Bluetooth and if the signal is low the relay gets turned on and if the signal is high the relay gets turned off. Turning on and off of the relay will initiate the pump to irrigate and to stop irrigation respectively.

The working of sensors and other components are discussed below

Soil moisture sensor (YL-69): YL-69 sensor is made of two electrodes, which enable the sensor to read the moisture content around it. A current is passed across the electrodes through the soil and the resistance to the current in the soil determines the soil moisture. If the soil has more water, resistance will be low and thus more current will pass through. The sensor has both digital and analog outputs and is available with a small PCB board fitted with LM393 comparator and a digital potentiometer.

Temperature Sensor (LM-35): The LM35 are precision IC based temperature sensing device with an output voltage linearly proportional to the Centigrade temperature. LM35 sensor has 3 pins namely Vcc which is given to supply, ground which is given to ground of the controller and output pin given to one of the analog pins of controller. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°Cat room temperature and ±¾°C, over a full −55°C to 150°C temperature range. The device is used with single power supply, or with dual supply.

Gear Motors and H bridge (L293D): Gear motors are used by the Agribot to move and also help the on board sensors to reach the soil while sensing measurements are being collected. A Gear motor in simple words is a device that converts direct current (electrical energy) into mechanical energy. The Gear motors are driven by L293D, which is a dual H-bridge motor driver IC. Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, four Gear motors can be driven simultaneously, both in forward and reverse direction.

Relay: A relay is used by the Agribot to carry out the task of irrigation. The relay module is an electrically operated switch that allows you to turn on or off a circuit using voltage and/or current much higher than a microcontroller could handle.

Bluetooth module (HC-05): Here we use two Bluetooth modules, to establish a communication between two Bluetooth modules, we have to configure one as master and other as slave. Bluetooth uses piconet protocol for communication. The master establishes connection with slave device found within its range and that process is done using AT commands, there is nothing to do for slave until the master creates the communication channel and sends signals. This signal from slave will be interpreted by the microcontroller.

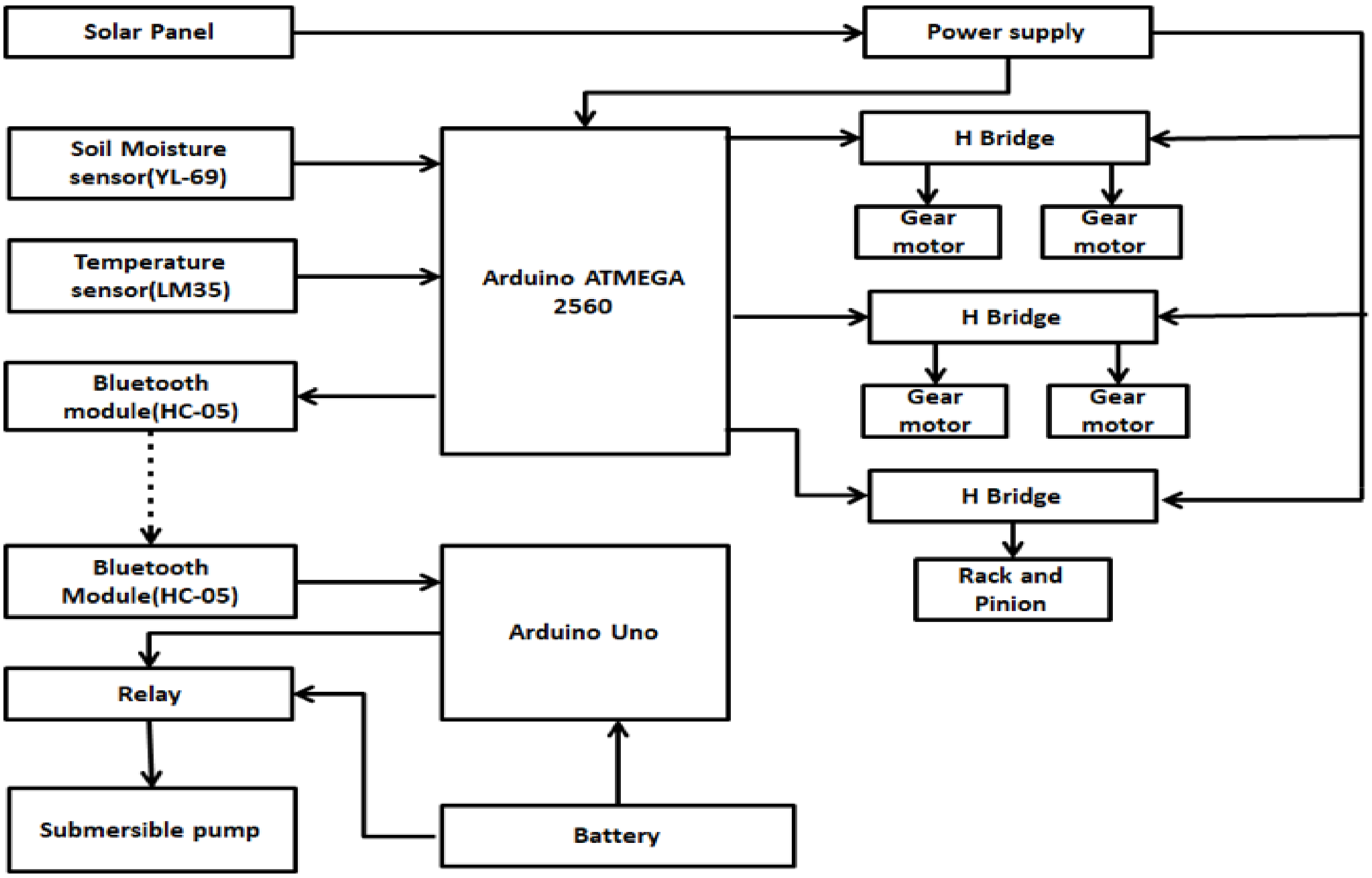

Figure 1: Block diagram of the Agribot

WORKING OF THE AGRIBOT

The solar energy will be harvested by the solar panel and will be stored in the battery. The current will be supplied to the Arduino mega from the battery. The Agribot is programmed to move forward for 10 seconds. It stops at the first sensing point. With the help of the worm and rack the soil moisture sensor is placed in the soil for 5 seconds and is stored in the micro controller and then the soil moisture sensor is returned to its initial position, and this procedure is iterated for 5 times .

The Arduino micro controller takes the average of the sensor reading. After completing a revolution around the field, the values from each sensing point are compared with the threshold value that is set based upon on the season and crop that is being cultivated and the duration for which the Agribot has to irrigate the plant is calculated.

Once the values are being calculated and taken an average, the Agribot initiates the irrigation system to irrigate sending a Bluetooth signal from master to slave. If the soil moisture value is greater than 750 and less than 1023, water will be supplied for 5 seconds, else, no water supply takes place along the nodes, the robot moves further for 5 seconds and the same process repeats for remaining sides. In short if the value of sensors is less than threshold, the pump is on the land is irrigated. If the sensor value is above the threshold the pump does not water that area.

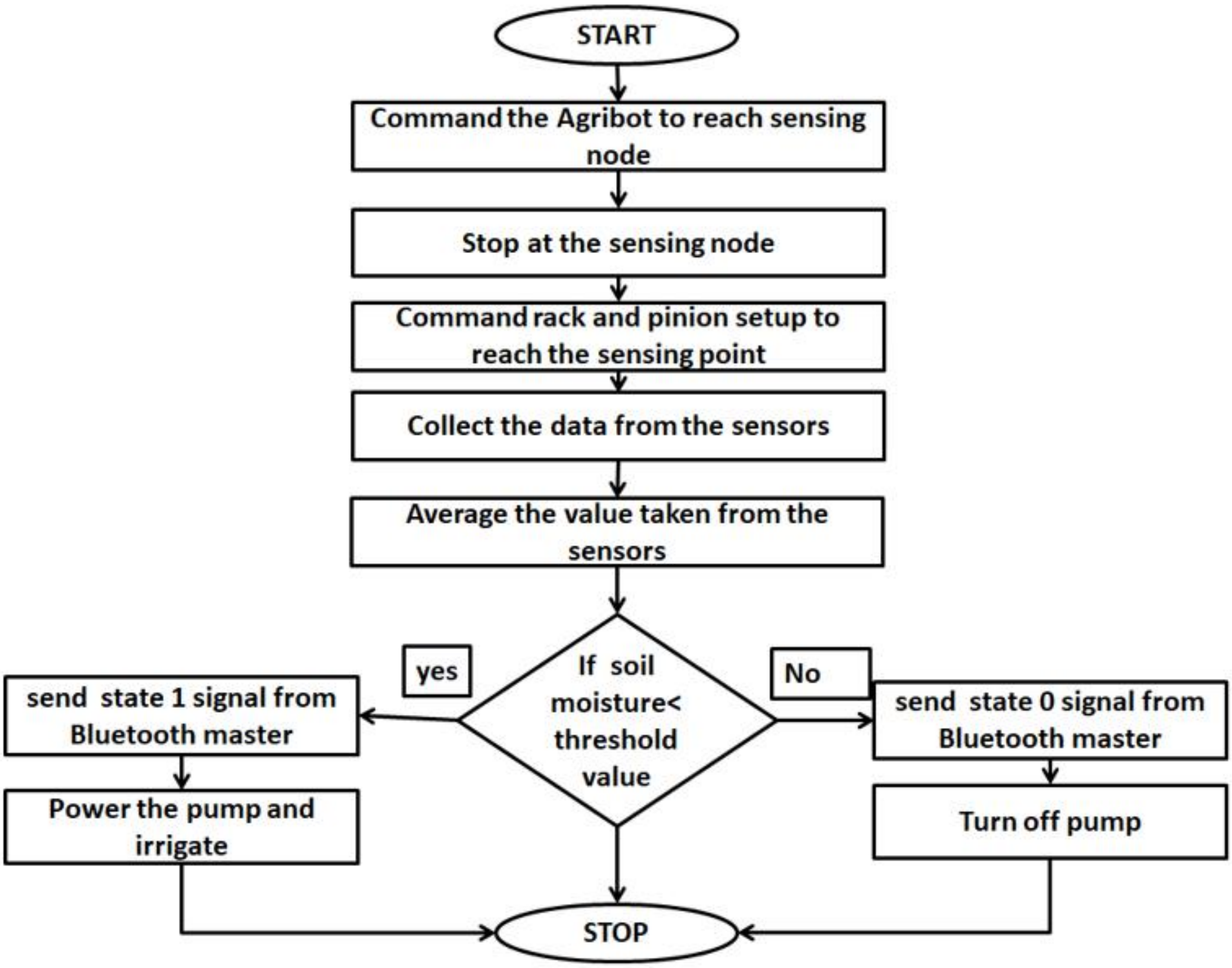

Figure 2: Flowchart of Agribot working

RESULT

An Agribot is built which tests the moisture content of the soil in the designated sensing nodes and takes an action on the irrigation. The sensing part will be a movable robot and the irrigation part will be a fixed system. The Agribot is tested for all its conditions from dry soil to wet soil to obtain unbiased results.

Figure 3: The prototype of the Agribot

CONCLUSION

The Agribot prototype is tested for its working on a small farming area for its operation, an Agribot, which acts as an IoT device is developed for irrigating the farm land. The developed Agribot is solar powered and hence it harvests solar energy when not irrigating. It is a better choice compared to fixed automation devices that help in farm monitoring and irrigation as it requires less hardware compared to a fixed system. The developed Agribot can irrigate the farm land after determining the physical condition.

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