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Multi-Tasking Robot for Smart Agriculture Monitoring

Ramani. R

Department of Electrical and Electronics Engineering, Dr MGR Educational and Research Institute, Chennai, Tamil Nadu, India. ramanikamal123@gmail.com

ABSTRACT

The development of agriculture must keep pace with the introduction of new technology. Smart agriculture greatly benefits from the Internet of Things. Crop yield cannot entirely be increased by monitoring environmental conditions. The smart irrigation system proposed in this project is IOT-based, affordable and suitable for usage in farm fields by middle class farmers. With the intention of irrigating fields only when there is a need for water and to offer information, which demonstrate in this article the job completed by dependable and cost effective technology. Blynk app, a cloud based website, is used to send information to the farmers. Farmers may easily check on their farm's fields by exploring Blynk app's channel links. For measuring soil moisture, temperature and humidity. The Wi-Fi module incorporated inside the microcontroller uploads all data to a cloud database of a blynk app. The grasses are chopped with an IoT based grass cutter. Farmers may apply fertilizer using IOT based smart agriculture system. To precisely track the movement of a human hand, an accelerometer is used.

Keywords: IOT, Agriculture, Technology, Farmers.

1 Introduction

The need for innovative agricultural systems and products is rising along with the ongoing expansion in the world's population [1]. For many people across the world, agriculture is their primary means of subsistence. Due to improper irrigation practices, insect pests and plant disease attacks, the overuse of herbicides and insecticides, erroneous weather forecasts and insect pests, farmers experience significant financial losses [2]. Several industries, including manufacturing, education, healthcare, personal technology and others are being impacted by robotics. Because agriculture is so vital to the Indian economy and because farmers today may gain from technology improvements, robotics is also having an influence on the agricultural sector and may have a significant impact on farm products [3]. Internet of Things (IoT) and Artificial intelligence (AI) are two main building blocks of a smart agricultural system [4]. By boosting efficiency, enhancing productivity, lowering production costs, reducing need for manual labour and other human resources, among other things, agricultural robotics enabled several advantages and benefits in relevant business and industry [5]. An increasing interest in the study of intelligent robots is being shown worldwide, but particularly in Korea due to the ageing of the rural population [6]. Robotics technology is one of the most rapidly expanding fields in smart agriculture and it is being used in a variety of agricultural situations, including outdoor cultivation and culture [7]. Robots are sensitive robots that can be taught to carry out particular jobs, make judgments and act in real time [8]. The German BoniRob was among the first robots to be created. This robot was first created by AMAZONEN-WERKE in collaboration with the Osnabrück University of Applied Sciences, Robert Bosch GmbH and other partners. It is currently used by Deep field Robotics, a Bosch start-up firm [9]. Because the traditional methods are no longer effective in the face of rising food demand, good agricultural and farming apps have grown in significance and popularity [10].

2 Recent Works

Muhammad Ayaz et al [2019] [11] created a smart agricultural system based on internet of things (IoT) with a goal of making fields interact. This article explores potential of wireless sensors and Internet of Things (IoT) in agriculture, as well as the challenges that will unavoidably come up when attempting to integrate this technology with more traditional agricultural practices. The Internet of Things (IoT) and the linked wireless sensors utilized in agriculture applications are carefully explored. The list of available sensors for various agricultural uses, such as crop status, irrigation, insect and pest detection and soil preparation, is organized into groups. It is explained in detail how this technology supports farmers at every stage of agricultural production, from planting to harvesting, packaging and shipping. There are several instances when cutting edge technologies are enhancing general effectiveness at different stages. Yet using eco-friendly IoT-based communication and sensor technology is not a choice; it is required if we are to deal with every inch in a right way.

Madhurima Bhattacharya et al [2021] [12] suggests a smart irrigation system that employs a soil sensor to collect a sizable quantity of real time data from agricultural regions. With the use of a soil sensor, this study proposed a technique for acquiring a sizable amount of real time data from agricultural fields. The sensors talk to one another when connected to the Internet. The Web server obtained the sensor data by means of a wireless sensor network. With the help of an IoT framework, the observed data is analysed and processed. Periodically, notifications are sent to the farmer's smartphone application. The farmer may keep an eye on the moisture level of soil. By using this method, water consumption is greatly decreased and harvest production is increased. The way the system works and the locations where it is used must be improved.

Anushree Math et al [2018] [13] A suggested irrigation system makes use of an Arduino as a central controller and a number of sensors, including a soil moisture sensor, a temperature sensor and a water flow sensor. The system used to gather field data utilizing several sensors is illustrated in this article. The microcontroller and the sensor can communicate wirelessly via zig bee. The farmers and a distant server can communicate with a microcontroller using GSM. Building a smart drip irrigation system using IoT is feasible and affordable. Pipe leaks are located by the controller's analysis of flow rate data and the same information is updated on a website. To identify pest and disease in the field, deep learning and AI may be employed. This study has the drawback that sensor measurements and field video recordings might both be stored in a database.

Rajesh et al [2020] [14] recommends an IOT and smart agricultural system designing an IOT-based system for monitoring agriculture is a major objective of this essay. The fields are safeguarded by this method from a variety of issues. The farmers who are in need are helped greatly by the projected smart agricultural monitoring. The farmer then takes the appropriate safety measures in the field. For the safety of drivers, the flood alarm information might be shown at key areas on LED display boards.

Anjali Deore et al [2019] [15] presented a farthest first traversing algorithms are proposed to find clusters of soil. This effort entails a number of different elements, including IoT-based soil monitoring, humidity sensing, moisture temperature, crop recommendation and appropriate irrigation facilities. It uses wireless sensor networks to continually receive information about the soil's characteristics and the surroundings. Several sensor nodes are positioned across the farm at various points. Field surveillance through wireless technology boosts agricultural output while using less labour. Both the price and the energy consumption are lower. Solar energy and many modern watering systems might be included as future improvements to this system.

3 Proposed Work

The sensor unit and the Arduino microcontroller unit make up the two components of the suggested method. A Wi-Fi module called NODEMCU is in-built with microcontroller unit to enhance data processing in the cloud storage system. Farmers may spray fertilizer with the help of a multitasking robot for smart agricultural monitoring system on IOT with pump. The suggested system is interfaced with a controller unit and uses a 12V lawn cutter motor. The controller unit and grass cutter motor are connected by a 12 volt relay for control and cutting purposes. Relay works and cuts off the motor supply when everything is normal. BLYNK app, a cloud based website, keeps track of and updates the user's information. The proposed system's block diagram is presented in figure 1.

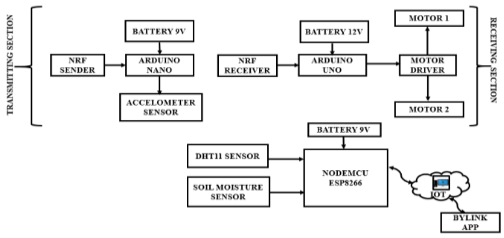

Figure 1: *Block diagram for proposed system*

3.1 Arduino Nano

Arduino is an easy to use both in terms of hardware and software and it is an open source electronics platform. It is a microcontroller board which provides a digital platforms to the users. The ATmega328 IC utilized in this study contains a reset button, a power connector that requires a 5 volt power source, 6 analogue inputs, a USB connection, 14 digital input/output pins, an ICSP header and a 16 MHz ceramic resonator. Figure 2 represents Arduino Nano.

Figure 2: *Arduino Nano*

3.2 Accelerometer Sensor

Devices that monitor acceleration of any body or object when they are at rest are called accelerometer sensors, which doesn't depict an acceleration along a coordinate line. With a basic piece of equipment called an accelerometer, mechanical motion may be converted into an electrical signal. The acceleration force, whether brought on by motion or gravity, is measured using this electromechanical apparatus. Buildings, equipment, autos, process control systems and other structures may all be found using accelerometers to measure vibration. They may also be used to determine seismic activity, tilt, machine vibration, dynamic distance and speed with or without gravity. Accelerometer Sensor is represented in Figure 3.

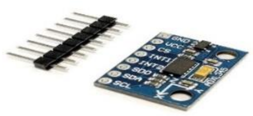

Figure 3: *Accelerometer Sensor*

3.3 DTH-11 Sensor

DHT-11 is a simple and affordable digital temperature and humidity sensor. After detecting the surrounding air with a thermistor and a capacitive humidity sensor, it provides a digital signal on a data pin. DHT11 is an affordable digital sensor that measures temperature and humidity. To measure humidity and temperature in real time, a micro-controller such an Arduino, Raspberry Pi or another may easily communicate with this sensor. The DHT11 humidity and temperature sensor is available as a sensor or a module. A DHT11 sensor, which consists of a capacitive humidity sensor and a thermistor to detect temperature, also measures humidity. The substrate that may serve as a dielectric storage for moisture is sandwiched between two electrodes to form humidity sensing capacitor. To get a greater resistance value even for a little change in temperature, this sensor frequently comprises of semiconductor ceramics or polymers. Figure 4 represents DTH-11 Sensor.

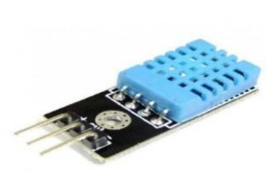

Figure 4: *DTH-11 Sensor*

3.4 Soil Moisture Sensor

The soil moisture sensor is one kind of sensor used to estimate the volumetric water content of soil. Drying, sample weighing and elimination of the straight gravimetric dimension of soil moisture are required. Other soil laws, such as dielectric constant, electrical resistance, neutron interaction and replacement of moisture content, are used by these sensors to infer the volumetric water content of soil. The reflected microwave emission can be influenced by wetness of a soil in addition to being largely used in agricultural and hydrological remote sensing. While another set of sensors estimates their water potential, a brand new way to assess soil moisture, these sensors are frequently used to measure volumetric water content. These sensors include gypsum blocks and tensiometers, which are also known as soil water potential sensors. This sensor starts working once it is placed into the ground and a percentage of the quantity of water in the soil will be noted. Soil Moisture Sensor is represented in Figure 5.

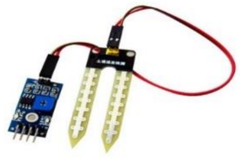

Figure 5: *Soil Moisture Sensor*

3.5 NodeMCU ESP8266

NodeMCU, an open source environment for creating both software and hardware, is built around ESP8266, a very inexpensive System on a Chip (SoC). An integrated WLAN 802.11 antenna is used. 11 b/g/n, regulators, power management units, a 10-bit A/D converter, a TR switch, a power amplifier, a matching network PLL and a 32-bit microcontroller unit. The 2.4 GHz band is used by Wi-Fi technology to enhance WLAN in a variety of operating modes. Figure 6 represents NodeMCU ESP8266.

Figure 6: *NodeMCU ESP8266*

3.6 Blynk App

Blynk, an Internet of Things (IoT) platform, enables Android and iOS mobile devices to control Arduino, Raspberry Pi and NodeMCU. By gathering information and supplying proper address on widgets that are easily accessible, this application may be used to construct a graphical user interface (GUI) or human machine interface (HMI). Without creating any code, the Blynk library enables direct control of Arduino or ESP32 pins from a phone. Also, sharing a project with friends or clients enables them to access the linked devices but prevents them from making changes to the project directly.

3.7 Motor Driver

Depending on the voltage's polarity when it is applied, a motor will revolve either forward or backward. With changes in voltage, rotating speed also changes directly. It consists of a permanent magnet stator, a rotor with a coil, a brush and a commutator. Motor drives for all electric motors are not readily available. For certain types of engines, several manufacturers create motor drivers. The makers, though, make things simpler by giving motor drivers a list of all compatible motors. Notably, most drivers work with both DC and stepper motors. When choosing a motor driver, a servo motor requires greater care. Motor Driver is represented in Figure 7.

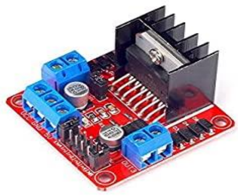

Figure 7: *Motor Driver*

3.8 NRF

For transmitting and receiving data at ISM operating frequency between 2.4 and 2.5 GHz, NRF is a radio transceiver module (SPI protocol). This transceiver module is made up of a frequency generator, beat controller, power amplifier, crystal oscillator modulator and demodulator.

3.9 12V Battery

Among all the battery varieties, a 12 volt battery is one that appears extremely different depending on its purpose. It is a peculiar battery that is used in specialised electrical applications. In some aspects, it is one of the most diverse batteries. It could be large, little, heavy, or light. One of the most common purposes for a 12 volt battery is transportation, since it is widely used in vehicles like cars and boats. While the car just needs electricity to start in these conditions, it is easy to replenish the battery. The alternator then takes over and keeps operating the electrical system if it is functioning correctly. The alternator also charges the battery. Based on the amp hours they are intended to produce, 12 volt batteries come in a huge range of sizes. These may be enormous and quite heavy, as those in automobiles. There are two types of 12 volt batteries: non-rechargeable alkaline batteries and rechargeable versions. Figure 8 represents12V Battery.

Figure 8: *12V Battery*

4 Result and Discussion

Plowing, seeding, digging and water sprinkling are among the tasks carried out by the robotic module. Sensors are used to carry out these operations. The sensors which include moisture and temperature sensors get information from the environment. The robotic module analyses the supplied data to decide how much water should be sprayed. Plowing is then done by the robot. The module is loaded with the seed that will be planted. The module has a pump for spraying insecticide.

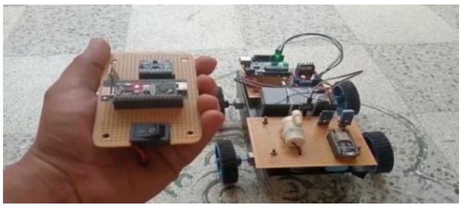

Figure 9: *Multi-tasking agriculture robot*

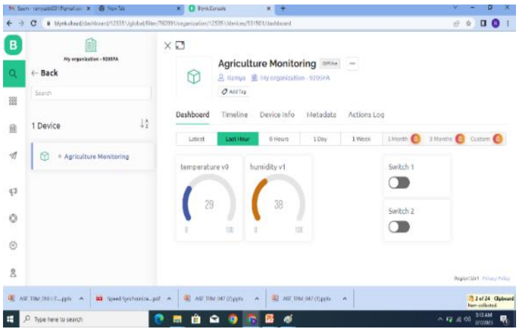

Figure 10: *Output using Blynk*

5 Conclusion

A multitasking robot for smart agricultural monitoring is employed in this project and it is affordable and practical for usage in farm fields by middle class farmers. Figure 9 represents Multi-tasking agriculture robot. The ARDUINO UNO microcontroller may manage the automobile by creating various threshold values based on the motions that are utilized to create a practical, fully working solution for the actual world that effectively converts a hand movement into electrical impulses that can control a vehicle. The temperature, soil moisture and humidity are measured by this system using a Node-MCU ESP8266, a soil moisture sensor and a DHT11. Using the microcontroller's integrated Wi-Fi module, all data is uploaded to the Blynk app's cloud database. A grass cutter powered by IoT is used to trim the lawn. The IOT smart agriculture system will help farmers when they apply fertilizer. The accelerometer manages the robot's motion. It is possible to measure the motion of human hands with great accuracy using accelerometers. Based on the location of the accelerometer linked to the hand, the transmitter will send the signal, which the receiver will then receive and use to move the robot in that direction.

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