Smart Renewable Irrigation Model

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1. Abstract

Nowadays, the weather is changing very rapidly which adversely affects the farming, which as a result affects the growth of a farming-dependent nation like India. The basic principle of our project is to collect data from the various sensors to be placed in the field and then analyze the data to help the farmer. If the soil's moisture content is low then the water motor will irrigate the field. When the moisture content reaches a certain level, the water motor will automatically be turned off. The project's main aim is to reduce the physical work of a farmer as much as possible and increase productivity. In hilly areas, the sunlight is not evenly available to all fields, so artificial UV light could be used in the areas that are devoid of natural sunlight. In this work, the sensors are connected to a cloud server, which help the farmer to be aware of his farm through his mobile phone or any other digital means to receive data from the cloud. In addition to this, a pH-monitoring system is also added. The pH value of a field can affect the growth of the crop. To power all these sensors, we used solar panels. The solar panels are long-lasting and don't need frequent repairs whereas conventional methods, like using a battery will have to be changed regularly. The project utilizes an Arduino which can connect to all kinds of sensors which further increases the scope of our work.

Keywords: Node MCU, Arduino, UV lights, Temperature, Smart Irrigation, Iot,

2. Introduction

If a farmer is happy, so is a nation. As we all know that around 50 percent of India's working population is depends upon farming and the rest is relies upon the other rest for survival. So directly or indirectly farming plays a vital role in everyone's life. To enhance our agricultural practices, we are integrating them with technology. In course of the pandemic, the outspread of coronavirus restricting us from stepping out of our houses, so we can take the help of technology right here and decrease the lot of manual work in agriculture using automation [1]. Did you know India ranks 2nd in farm output in the global? Currently, the farmers of India are using flood irrigation (anyplace electricity is free and groundwater is available). However, it is noticeably a waste system, and some crops like Rice and Sugarcane consume a lot of water. Presently we are using a conventional crop and intensive use of machinery and inputs in the farm. But this isn't always sustainable, it needs to be modified [2]. Agriculture needs to be smart to amplify and develop from what it is presently, to cope up with modern-day demand. As smart technologies already enhancing various industries, the agriculture sector cannot be ignored. This Smart Renewable Irrigation Model is a model that comprises

various electronic sensors which can be used to measure various physical factors like humidity, temperature and moisture, and water level without operator intervention. It also helps to give commands to other devices like the water motor to start when the moisture content of the soil is low or to do vice versa when the moisture content is high [3]. The ions present in the soil are sensed by the sensor and the output of the sensor is processed by the signal conditioning unit. Then the output of the signal conditioning unit is fed to the Microcontroller. The microcontroller compares these values with pre-stored values and displays them on the LCD. The values are then sent to the transceiver which further sends them to a remote location for further analysis [4].

3. Literature Review

There was numerous work has been carried out to enhance our agriculture system, shown below (1), (2) and they all collectively helped us writing this review. But there may be still one challenge left, since most of the villages are not having a proper electricity supply to power these systems, so we are using a completely traditional system. We can either use wind or solar for powering it. This way we can keep our earth safe and enjoy farming [5].

1. Smart agriculture: IoT-based precise and productive farming approach by Arunlal K. S. and Rajkiran S. N. This describes how smart and precision agriculture improves productivity, efficiency and reduces human intervention. IoT is a network of physical devices, home appliances, or any other embedded electronics. IoT brought a revolution by connecting everything to thing internet. The objective of the paper is to connect the farmers to a single platform where they can monitor everything from home.

Brief introduction of the paper: The paper brings insight into making a framework for the farmers to decrease the load on them. IoT is day by day evolving platform which has helped various industries and making away for IoT into farming will increase productivity. After connecting farms to the IoT platform comes field Automation. For automation a knowledge base is required that can be obtained by cloud computing [10].

2. Agriculture: IoT-based Smart Sensors agriculture by Anand Nayyar and Er. Vikram Puri The paper describes how IoT has brought change to every field of a common man's life by connecting everything to the internet and making them smart and intelligent. The development of smart farming is improving the face of agriculture production by not only enhancing it but also increasing production. The main aim is to install a novel smart IoT sensor device on the field which will assist the farmer by giving them live data of their farmland which enabled them to do smart farming and increase their production and make it cost-effective.

Brief introduction of the paper: This paper brings insight into how IoT is helping farmers to decrease their work in the field. IoT devices are evolving day by day and making our life smarter and taking agriculture towards automation.

Agriculture is the most crucial sector for global food security as most food industries are dependent on agriculture. Indian farmers are in a down position in terms of the size of their farm, trade, technology, government policies, etc. The climate in India is changing drastically which can't be changed [8].

4. Methodology and Experimentation

Embedded system

We are stepping into an era of automation and the things which used to be carried out physically are now easily handled by the embedded systems, which is having a microprocessor that can be easily programmed to perform a certain set of instructions. The processor, which is the heart of the embedded system, takes the input and produces output. And in this project we are using a nodeMCU ESP8266, a development board having a 32-bit processor which works at 80-160 Hz controlling in real-time, and having a memory unit that stores a certain set of instructions. The nodeMCU is a superpower saver device because of its deep sleep operating feature, and for getting live feed of data it consists of ESP8266 SOC Wi-Fi [6].

Non-conventional Power source

For powering the device a non-conventional energy source solar panel for daytime a battery is installed which charges using the solar panel extra power at daytime and use that charge at night to power the device.

I. Objectives

o Grouping of soil into classes based on nutrient level, moisture content, pH, and other physical factors.
o To provide a solution to problems faced by farmers over the misuse or overuse of fertilizers on a certain type of field by governing the soil quality whenever required.
o To create a device that can be modified based on the requirements of the agricultural field and the farmer using the device.
o To create a database for the farmer which they can use whenever they face problems and solutions used by other farmers or experts in similar situations.
o To create a device with a very low or zero carbon footprint by utilizing solar panels or other renewable resources.
o To create a network between the farmer and market by predicting the production of crops and making that data public for the use of merchants so that no crops go to waste.
o To create a portable device that can be used anywhere.

II. Components used:

(a) Relay, (b) UV LED, (c) Soil sensor electrodes REES52, (d) Battery, (e) Node MCU, DHT11 sensor, Resistor, (f) Water Pump
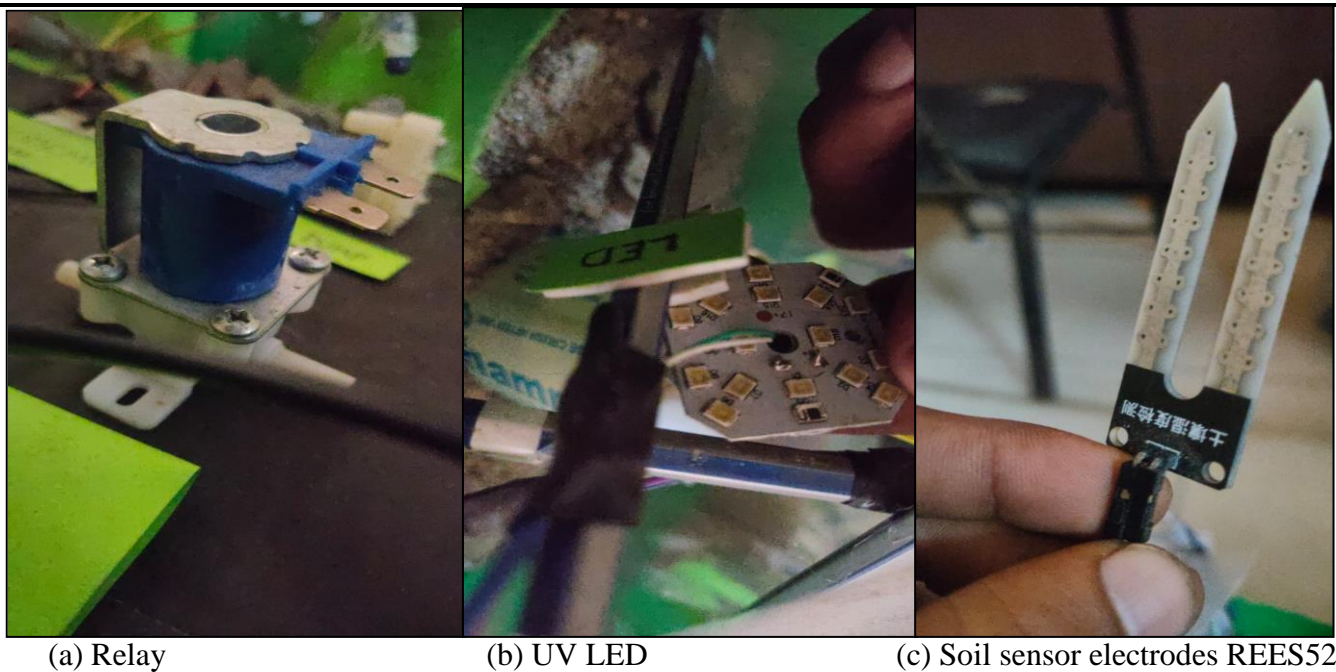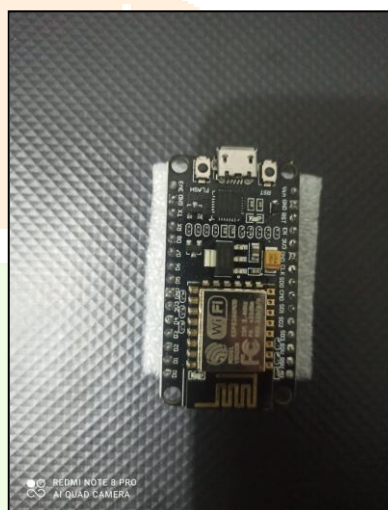
(a) Relay (b) UV LED (c) Soil sensor electrodes REES52

(d) Battery (e) Node MCU (f) Water Pump

Figure 1: Components used

Node MCU is a microcontroller-based device that can be used to give instructions through Wi-Fi which can be used to store and retrieve data from the database. It uses less power as compared to Arduino and esp-10. It also has an integrated Wi-Fi service which is very useful in making the system automated. It's also cheaper and small in size thus increasing the portability of the final product. The storage space is also higher compared to other boards.

Soil Sensor Electrodes are to be placed in the soil and keeping these electrodes in soil for long periods may destroy them due to corrosion as the electrodes are made of metal.

DHT11 sensor is used to capture the humidity and moisture content of the soil. It is portable and can be fitted in a very small space.

Relay is the signal conditioning system. It has more than a function as it also acts as a protection device. It works on the principle of electromagnetic induction.

III. Software used:
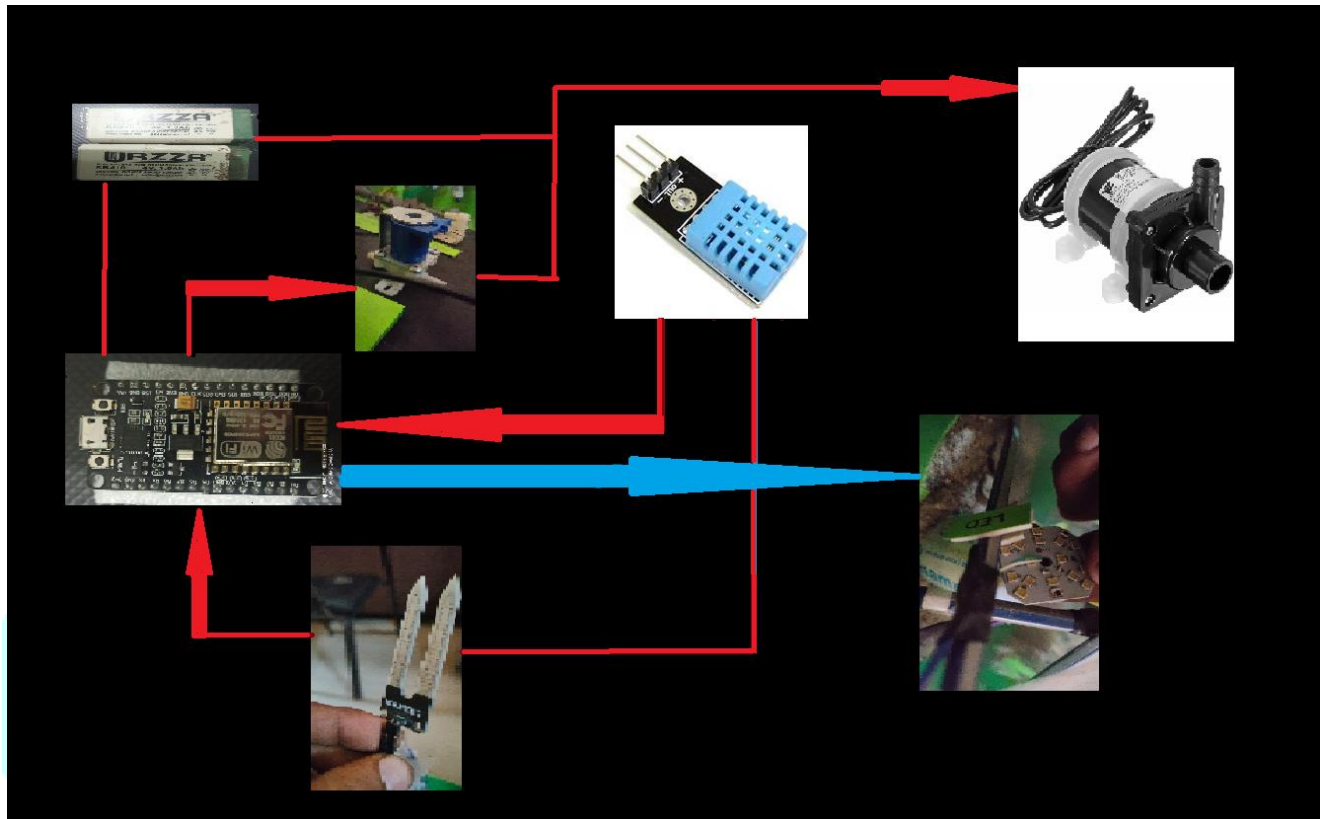   Fritzing.

IV.   Working Principle/Design

Figure 2: Flow Chart showing Smart Renewable Irrigation Model

Whenever the measurement of the sample or the field is to be taken the electrodes (Figure 1(c)) are to be dipped in the soil sample. The electrodes are connected to the Node MCU (Figure 1(e)), which sends a digital signal from the ADC to the electrodes to take the measurement. The output is then passed through a signal conditioning system which amplifies the output. The output is then given back to the Node MCU which compares it with predefined values on the systems and generates the output. If the output value is deviating too much then the warning will be given through the LED (Figure 1(b). The values are then transferred to the transmitter and then to a remote server (the user's smartphone). The user then can check what is needed to be done to improve soil quality.

The power source for the project is rechargeable batteries (Figure 1(d)) which could be recharged through solar panels. The batteries connected to the Node MCU through a relay. The DHt11 and the Electrodes are also connected to the Node MCU. As shown in Figure 2, Node MCU is the brain of the project which tells other components what to do. The DHT11 and electrodes are to be placed in the soil. The Node MCU sends a signal to the sensors to analyze the given sample which generates an analog signal which is then received by the node MCU. Below (Figure 3) showing the simulation of this model using fritzing software and the virtual implementation of different components cited in 4(II). The received value is then processed and matched with the preprogrammed system's values.
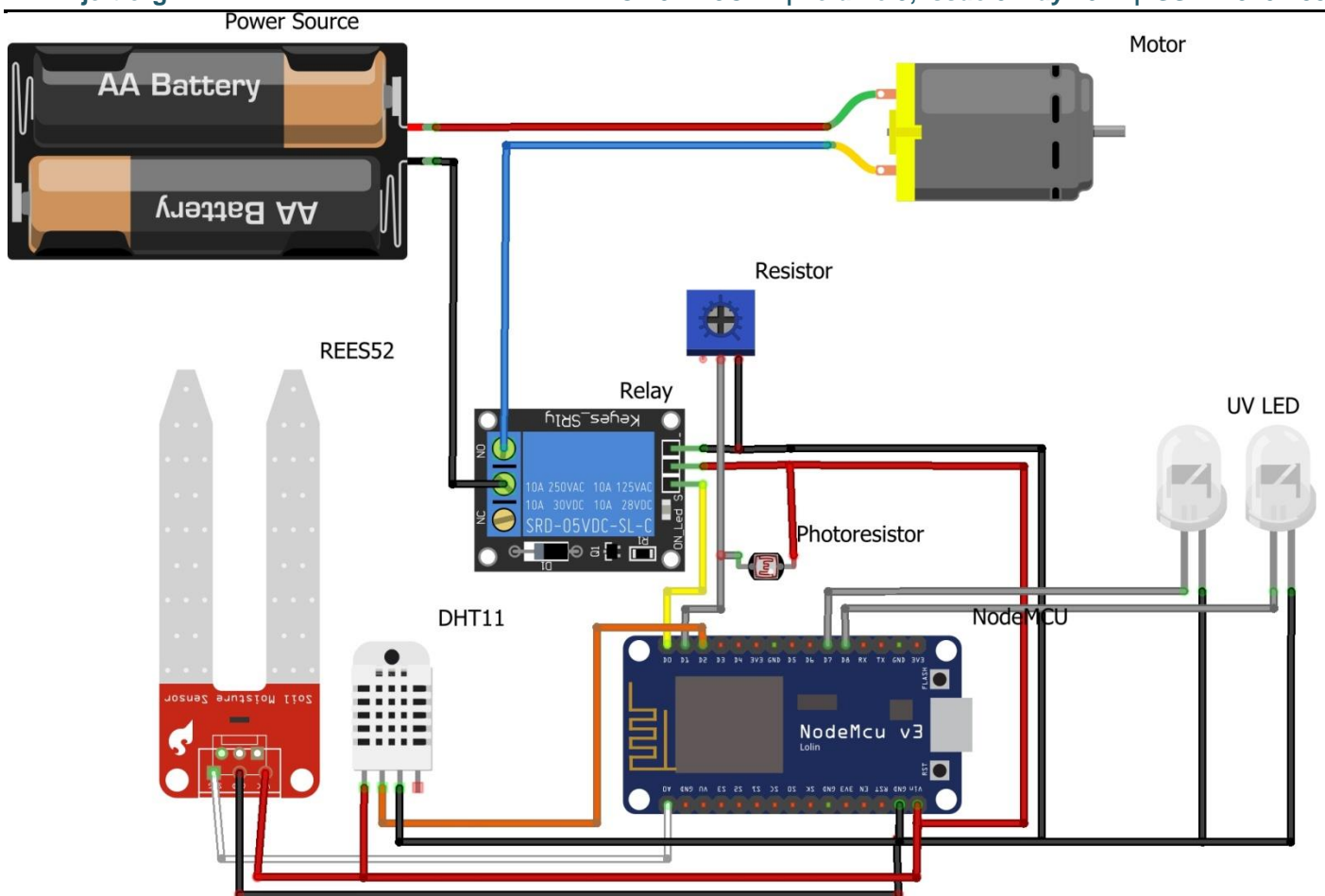
Figure 3. Simulation of the hardware components using fritzing software

5. Result and Discussion

From our studies, we observed out that many farmers use traditional techniques to irrigate their field i.e. irrigation based on availability rather than the quantity required [20]. The conventional methods of irrigation are detrimental to the crops as well as the field on a long-term basis as excess irrigation leads to an increase in the salinity of the soil. By enforcing the smart renewable irrigation model the farmer doesn't need to worry about the field as it is completely automated. Switching the IC from Arduino board (used in previous models) to Node MCU, now the data can be uploaded to the cloud/user from on-chip Wi-Fi ports of Node MCU. Adding the soil sensor also increases cost but it further improves the usage and implementation of the model in various fields.

6. Conclusions

The primary object of this project is to make our irrigation system efficient and minimize the physical work with help of Arduino Uno and various sensors. With the growth in the world population, food consumption also grows rapidly. To meet the demand-supply ratio, a change in the agriculture pattern is necessary. The smart Renewable Irrigation model is a portable model that can be used from anywhere and in all kinds of environments. It also reduces the work of farmers as they don't need to visit the soil testing laboratory every season, which is normally located in the district headquarters. It helps farmers in minimizing wastage and uplift productivity, the combination of various sensors and the smart decision can bring a change in modern Agriculture.

Future Scope: Agriculture is one of the fast-developing industries and by introducing Automation, production would improve by leaps and bounds. As this project is based to be an automated system it has a lot of possibilities to grow in the future. The aim is to make a device that is easy to upgrade.

7. References

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