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Arduino Uno Based Smart Farm Application

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Abstract: *In India, agriculture in villages plays a necessary role in developing the country. Agriculture is the backbone for our nation. Earlier, agriculture used to depend on the monsoons only, monsoons in India can be quite uncertain and unreliable as well. To beat this downside, the irrigation system was introduced and utilized within the field of agriculture. This system included irrigational practices like drip irrigation, sprinkler system, surface and subsurface irrigation etc. However, the above-mentioned practices have their own set of disadvantages like excess leakage and seepage of water turn the land marshy which in turn become a breeding ground for the mosquitoes. Apart from these disadvantages, there is another problem that the farmers face i.e. constant vigilance of the farm lands. Often farmers go the field and examine the soil to see how dry it is and then do the watering. But this type of vigilance is bound to cause human error leading to another serious problem like under-irrigation and over-irrigation. This project aims at saving time and avoiding issues like constant vigilance along with ensuring efficient water usage for irrigating the fields. For achieving optimum usage of water and obtaining maximum yield watering of the plants should be based on soil moisture content. Moreover, in a situation like the COVID-19 pandemic where social distancing is promoted, our smart irrigation prototype will irrigate the agricultural field without any hassles thereby providing efficient irrigation facilities along with following the norms issued during this global pandemic. It would be a win-win situation for our farmers.*

Keywords: IOT, irrigation, Arduino, cloud, sensors, Blynk, microcontroller

I. INTRODUCTION

The objective of this paper is to observe the wetness content of the soil by using sensors and thereby automating the irrigational farm activities to remodel irrigation-based activities from being manually operated to dynamic that results in higher yield with lesser human involvement. We aim to solve the problem of crop failure due to inefficient irrigation practices by measuring the soil moisture content using a moisture sensor and the ambient temperature using a temperature sensor and then based on these data automatically irrigates the field using the right quantity of water.

By using a Microcontroller ATMEGA328P on the Arduino Uno platform which helps the farmers to monitor the valve status of water sprinklers that have been used to irrigate the fields by recording the temperature and moisture sensor values. The ESP8266 NodeMCU is the most suitable device to be used for the project as it is light-weight, compact, easily programmable, and easily installable. Moisture and temperature data will be pushed to the cloud and will be available on a mobile application via NodeMCU. Continuous internet connection is required for monitoring and controlling using an android phone. The application is designed such that data from the sensors is frequently updated on the Blynk internet application by which a farmer will be able to conveniently check whether or not the valve status is OPEN/CLOSED at any given point of time. The application can be used to switch off the valve which in turn cuts the water connection to the crops after the moisture threshold is reached. The non-agricultural applications of smart irrigation include turf and landscape, golf courses. It can also find application in weather-based controller systems. Smart irrigation prototype can be used with sensor-based controller systems.

II. RELATED WORK

R. Subalakshmi (2016) proposed a paper to make the irrigation practices better by making use of PIC 16F877 core and GSM (Global System Monitoring) systems. A value is pre-programmed in the microcontroller which when exceeded gives a message to the user that the moisture content value has been exceeded.

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Archana and Priya (2016) proposed in their paper the idea of recording the moisture and humidity values from the sensors, using these values the farmers can monitor the water that needs to be given to irrigate the fields, but this paper doesn't update the farmer with regards to the current status of the field.

In the paper by B.A. Sarath and Reshma in 2016, they suggested the use of an IoT concept i.e. WSN (wireless sensor networks) along with an interface so as to monitor the status of the field so that the farmer can take well informed decisions while irrigating the farm land remotely.

S. Darshna, T.Sangavi , Sheena Mohan, A.Soundharya, Sukanya Desikan in their paper proposed that they used a servo motor and rotating platform to uniformly distribute the water thereby ensuring maximum absorption of water by the crops which ultimately leads to minimum wastage of water

III. Proposed Work

A. System Architecture

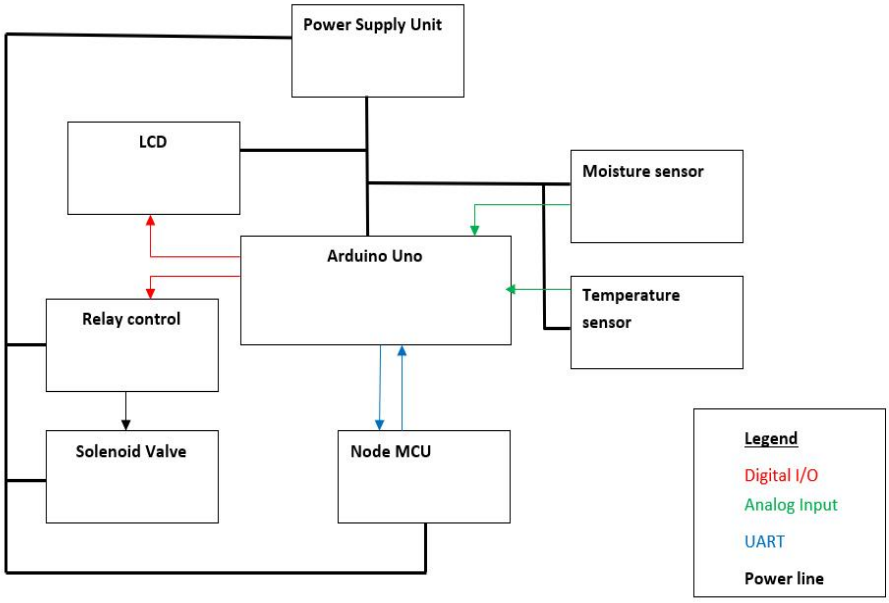

Figure 1: System Architecture of the Prototype

Arduino Uno board is the brain of the system and controls all the other peripherals. NodeMCU provides Wi-Fi connectivity and is used to send and receive the recorded data values to and from the cloud respectively. The connection between NodeMCU and the microcontroller is established via UART link. Moisture sensor is provided analog voltage value as per the moisture content of the soil. This is connected to the analog pins of the Arduino which in turn gets connected to the ADC (Analog to Digital Converter) module of the microcontroller, ATMega128p. Temperature sensor provided analog voltage value as per the moisture ambient temperature. This is connected to the analog pins of the Arduino. Solenoid valve requires ON/OFF control and a relay is used for this. This relay is driven by a transistor and the transistor is connected to the Digital I/O pin of Arduino which is connected to GPIO (General Purpose Input Output) pin of the micro controller. LCD display is connected to Digital I/O pins of the Arduino.

B. Cloud Platform and Protocol Involved

Blynk will be used as the IoT platform. It uses HTTP protocol which is built on top of TCP/IP for communication. It helps the us to make user-friendly interfaces for running numerous hardware projects. By making use of the widget function we can record numerous values obtained from the sensors, in case of our project we have obtained the readings of temperature and moisture sensors using the Blynk application for Android. Blynk is also easily compatible with Arduino Uno making our prototype feasible to remotely access the field without the physical presence of the farmer on-site.

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C. Hardware Analysis Module

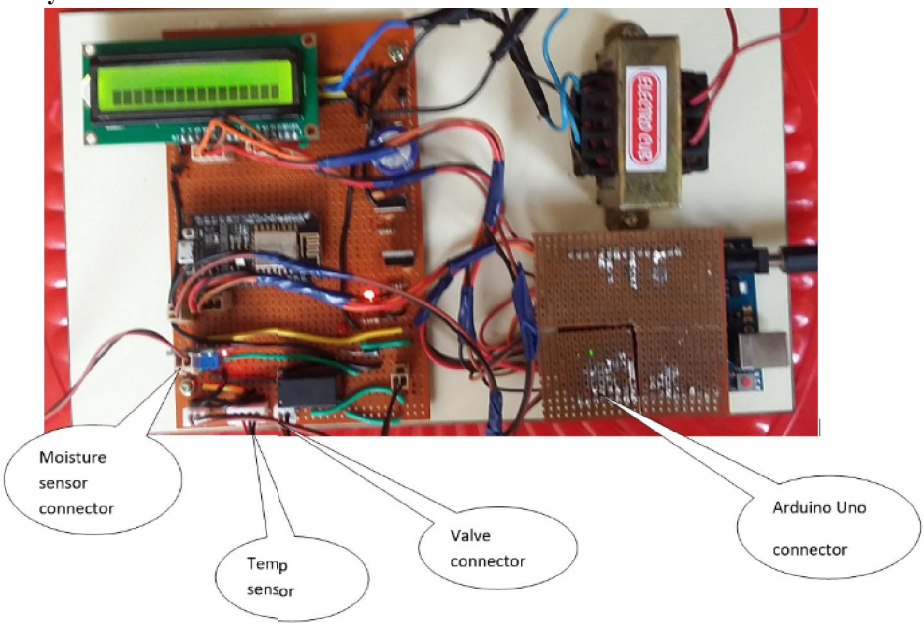

Figure 2: Connection of hardware components of the prototype

D. Software Analysis Module

1. Install Blynk App from google play store and login with the credentials.
2. App shows Moisture % and temperature in Celsius. It shows Valve status also.
3. Valve open means water will be flowing. When the Valve is open LED will be lit.
4. There are 2 operating modes for the smart farm application. Auto and Manual.
5. In the auto mode, the opening and closing of the valve is based on the moisture sensor value. If it is less than 10% valve will be open and when it reaches 45%, valve will be closed.
6. Override button in the app can be used to change the mode from Auto to Manual and Manual to Auto. In the Manual mode, pressing the valve switch will open and close the valve. Valve status will change accordingly.
7. There are 2 LEDs provided. One indicates power and other indicates valve status. When relay is active and valve is open, it will be lit.
8. There are 3 regulators, one 12V regulator for the Valve supply, one 5V regulator for the LCD and sensors and another 5V regulator for Arduino. Arduino provides power to NodeMCU.

E. Demo Module

1. For setting up the demo, a nearby electrical socket and a water pipe are required. Initially the bucket is to be empty and hence the moisture reading will be 0.
2. So, the Valve will be open and water will be flowing into the bucket. Once the water touches the sensor, moisture value will start increasing and when it reaches 45%, the valve will be closed and water flow into the bucket will be stopped. Make the setup similar to the above figure, but do not power on the board. Open Wi-Fi hotspot.
3. Open Blynk app. It will show previous values switch on the board.
4. Now water should start flowing into the bucket and Blynk app should display moisture and temperature value along with Valve status. You will also be able to switch to Manual mode and auto control.

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IV. CONCLUSION

The main objective of this Arduino uno based smart farm application is to create a user-friendly, innovative, feasible, cost-effective, and time-efficient system. Includes automatic on and off valve system for economical water measuring parameters like soil wetness, temperature values, and therefore the system also management, thanks to Blynk internet application updates farmers will understand crop field nature at anytime, anywhere. A prototype to observe and record wetness levels of the soil of a field so as to irrigate the crop fields optimally thereby reducing the risks posed by human error while carrying out irrigational activities. So, in case the moisture content crosses the threshold the water supply will automatically be cut-off preventing a scenario of over-irrigation or under-irrigation of the crops. This prototype can be easily set up in the farm lands for enabling remote and efficient irrigation without any hassles that can be caused by human error.

Figure 3: Circuit implementation and testing

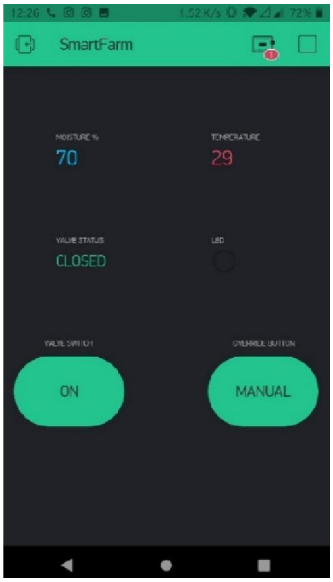

Figure 4: Blynk App platform code implementation

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The above screenshots show the temperature and moisture readings of the agricultural land where the prototype is installed. It also depicts the valve status which will be opened if the moisture percentage is less than 10% and will automatically close when the moisture percentage exceeds 45% when the over-ridden button is set to Auto whereas in a case where the farmer thinks that he wants to switch to the manual mode when he/she is physically present in the field. This prototype gives the user a lot of flexibility as far as remotely accessing the field is concerned. In addition to it, this unique method of irrigation will be the need of the hour during the global pandemic COVID-19. Farmers can be far away from their land and still open or close the water supply to their land to avoid under-irrigation or over-irrigation.

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