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Monitoring and Controlling of Drip Irrigation using IOT with Embedded Linux Board

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Abstract: This paper presents automation in farming system in terms of remote monitoring and controlling of drip irrigation using Embedded Linux board. Our system takes into consideration the soil moisture, temperature and humidity of environment. We are also considering the water level of tank using ultra-sonic sensor. This system provides a web interface to the user so that the user can monitor the system remotely. In order to control drip irrigation system, we propose an approach for collecting environment data and sending control command to turn on/off irrigation system. Monitoring valves and switches operation, and remote area control will efficiently improve the productivity of crops in all season. In this paper, Arduino-Uno is used as an embedded Linux board which makes the communication with the soil moisture sensor and ultra sonic sensor. The Node MCU is used to monitor the environmental parameters of temperature and humidity using DHT11 sensor. Based on these, the water is supplied to crops as per requirement. Thus, the water consumption will be reduced giving uniform water to the crop resulting in increased yield.

Keyword: Internet of Things, Drip Irrigation, Sensor Network, Embedded Systems, Web-Service.

I. INTRODUCTION

Agriculture plays a vital role in world-wide economy. It is the main source of sustenance for people. It is necessary to make economical utilization of resources as per the environmental conditions, to fulfill the fundamental needs of the crops [1].

With the assistance of contemporary technology, the environmental factors can be gathered and analyzed in an exceedingly precise manner. This data will facilitate the farmers to take concerned decisions which might facilitate reduction of nutrient action and conjointly save resources [2].

Technological headways inside the zone of farming will affirm to increment in profitability and decreased manual work. The vital inconvenience faced in numerous horticultural zones is that absence of motorization in agrarian exercises. In agriculture scheme, sharp following of soil parameters like moisture and water system control frameworks can be measured utilizing sensors with exactness. Sensors are utilized for collecting the certainties about the natural qualities while actuators are procured to respond on the input to have controls over the conditions [3].

The context acquisition through sensors provides a precious contribution in modeling conditions of domains which have form of time variation attributes.

Drip irrigation system is a type of water system that spares water and compost by enabling water to dribble gradually to the roots of various plants, either onto the soil surface or specifically onto the root zone, through a system of valves, channels, tubing, and emitters. Slender tubes convey water specifically to the base of the plant which can make productive utilization of water.

Soil moisture, temperature and humidity sensors are placed in the field for collecting the environmental parameters. This collected data is send to server where the comparison with threshold values is done. Accordingly, the controlling system will take appropriate actions to water the plants.

The principle goal of our proposed system is:
a) Efficient and dependable utilization of water resources in agriculture.
b) Handles the water system consequently.
c) Monitoring the distant fields.

This paper will elaborate the proposed technique for the remote monitoring and controlling of drip irrigation system. Section II gives the survey on the already existing methodologies for irrigation system based on WSN and IOT. Section III presents the proposed architecture and its operation. Section IV concludes with the benefits of our system.

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II. EXISTING METHODOLOGIES

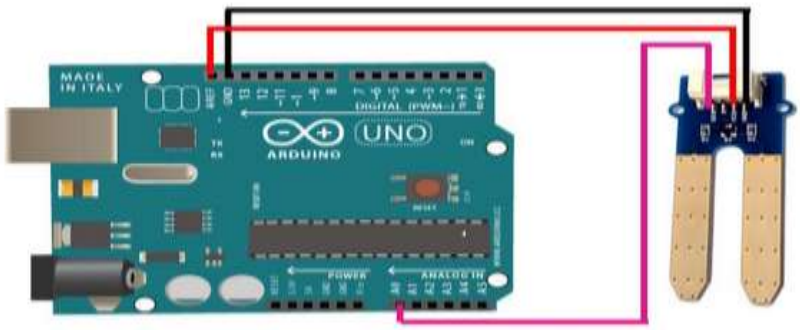
TABLE I Literature Survey

Papers Referred	Technologies used
[1], [2], [3], [4], [5], [6]	• Automation introduced in irrigation using WSN • Responds in a timely manner to changes in soil parameter results. • Reduction of freshwater consumption and cost
[7], [8], [9], [10], [11]	• ZigBee-based network is used which guarantees long battery life and low maintenance a hybrid of wired and wireless technology • Using WSN and GPRS Networks it accomplishes the remote observing and support of greenhouses on the premise of WSN GPRS innovation • Web Server-Master-Slaves design is utilized as a part of this framework
[12], [13]	• System is making an irrigation automatic and also giving an option to control it manually via smart phones from anywhere. • Data transmission takes place via XBEE which transmits signals as the characters through small chip. • Limitation is that the failure of any particular part is not informed and must be tested manually
[14], [15]	• The decision support system (DSS) is utilized which contains various agricultural models. • Analyzes the database and provides the relevant guidance to the user. • The guidance is provided in aspects of management, irrigation and disastrous climate warnings, which are intimated to user via SMS.
[16]	• Emphasizes the use of IOT in agriculture. • When the land is dry it is also able to remove excess water from the land when in excess. • GSM, power source ultimate hybrid solar cell is used.
[17]	• Wireless Sensor and Actuator System for Smart Irrigation on the Cloud ,a cloud-based solution is developed for a smart irrigation system organized as a Wireless Sensor and Actuator Network (WSAN).

III. AUTOMATED DRIP IRRIGATION SYSTEM

A. Components Used

1) Arduino with Soil Moisture Sensor:



It basically consists of Arduino Uno, soil moisture sensor and a analog sensor cable(3 pin). This sensor consists of two probes. When the current passes in the soil via these two probes, resistance is given as output to measure the moisture level of the soil. Increase in amount of water in soil increases the electric conductivity. This results in decrease in resistance value. Using the sensor was designed to measure the moisture level. The sensor basically measures the resistance and coverts it into voltage as output. The supply and output voltage is 3.3v-5v and 0-4.2v respectively. Current required is just 35mA i.e. consumes low power consumption.

2) Arduino with Ultra-Sonic Sensor:
It measures the distance between the first object in its way from itself. It has a transmitter and a receiver to transmit and receive the signals. The sensor consists of Vcc(+5V), GND, trigger and echo.

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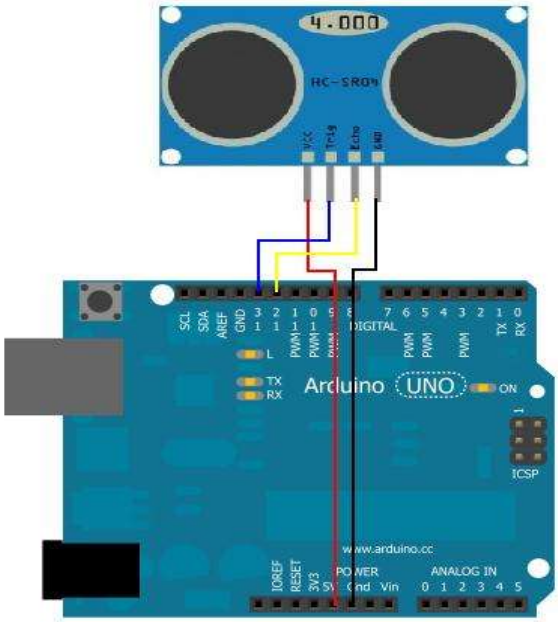
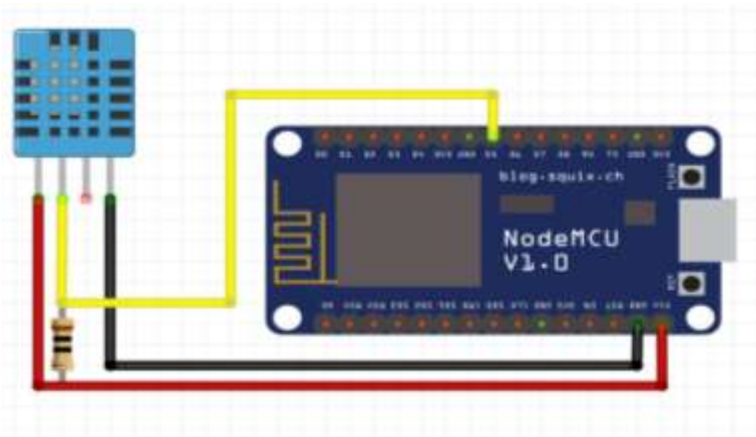


It sends a 5V signal to the trigger pin for approximately 10 microseconds. This 5V signal triggers the sensor to emit ultrasonic signal from the transmitter. Receiver captures the reflected ultrasonic sensor. This automatically makes the echo pin high. We need to read how long the echo pin remains high to calculate the distance.

3) Node MCU with DHT11 Sensor:



This sensor calculated the presence of water vapor by measuring electric resistance between 2 electrodes. It consists of a substrate which absorbs water vapor. This substrate then releases ions to increase the conductivity between the electrodes. The change in resistance between the two electrodes is inversely proportional to relative humidity. The range for humidity is 20% to 90% RH and in case of temperature is 0 to 50. The accuracy of humidity and temperature is 5.0% RH and 2.0 C respectively. It has ultra-small size, low power consumption and high reliability.

TABLE II Sensor Specifications

Sensor Name	**Measurement Range**	**Humidity Accuracy**	**Temperature Accuracy**	**Package**
DHT11	20-90%RH 0-50 °C	±5%RH	±2°C	4 Pin Single Row
LM35	-55 to 150 °C	-	±5°C	SOIC
Soil Moisture Sensor	5-90%RH	±3%RH	-	2 probed device

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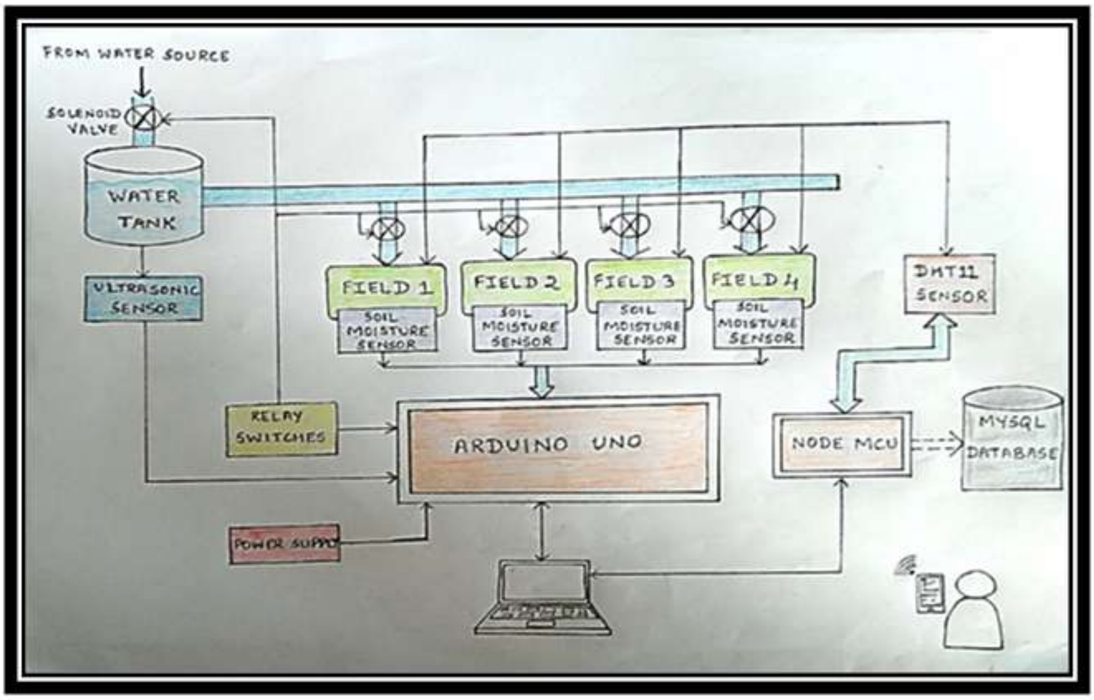
B. System Architecture

This system consists of Arduino Uno and NodeMCU as the main components. Arduino Uno is used for handling the controlling mechanism and NodeMCU is responsible for monitoring the field. Separate soil moisture sensors are deployed for different plants to provide the required amount of water to the crops. The sensed data is sent to Arduino which processes the acquired data. If the water-level goes below a pre-defined lower threshold value, the relay switch automatically turns on and water drips into that particular field through the solenoid valve. Now, if the moisture content crosses the upper threshold value, the relay switch turns off and the water stops flowing into the field. This ensures that the right amount of water is provided to the crops and water is not flooded.

The temperature and humidity sensor, DHT11, is used to monitor the environmental parameters. The DHT11 sends the collected data to NodeMCU. This data is stored in MySQL database. A web server is designed on the NodeMCU. It provides the web interface to the user to monitor the field remotely using any internet accessible device.

The ultra-sonic sensor is used to indicate the water-level in the tank. This indicator makes sure that enough water is always available in the tank. Water is automatically filled in the tank if it goes below a certain limit, and stopped after the water reaches the upper limit.



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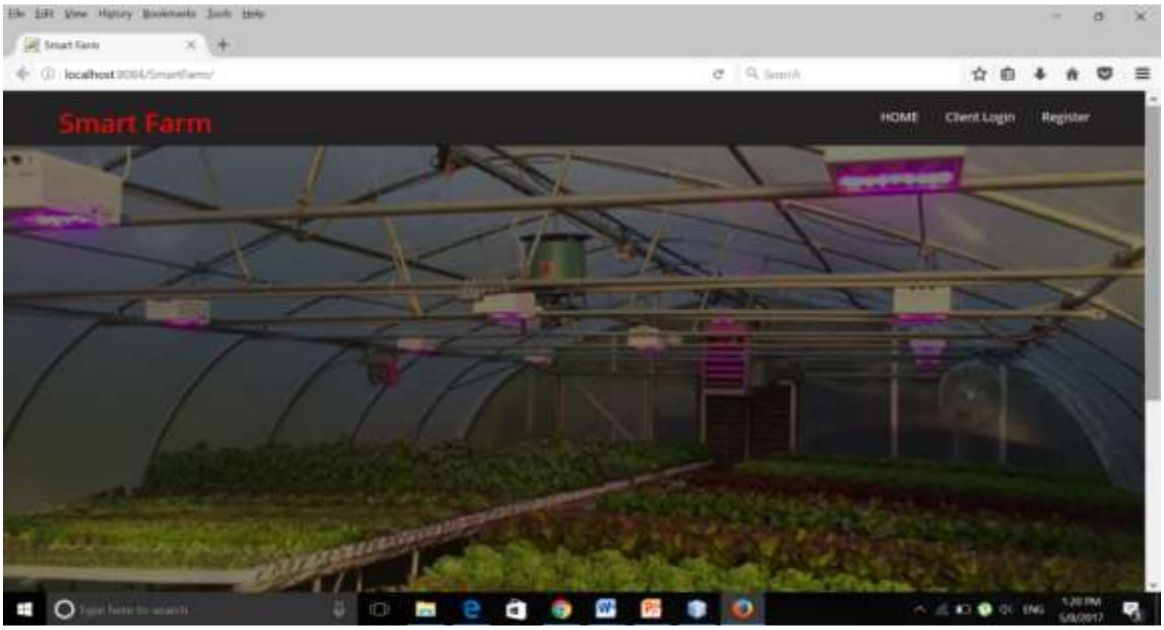

C. Work Flow Diagram
The below flowchart represents the working of our system

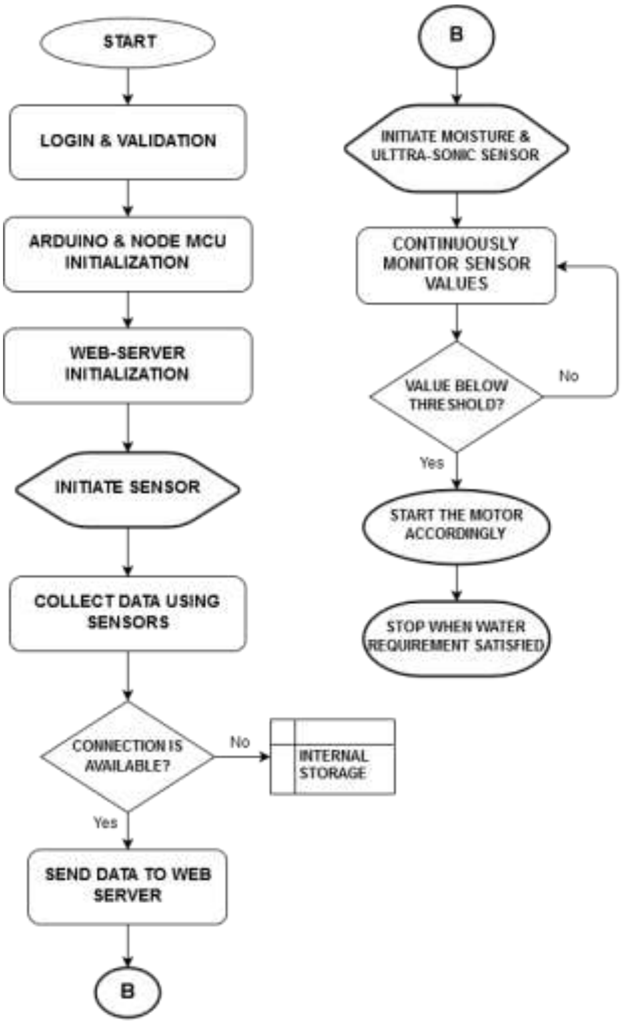

Fig.1. Work-Flow

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IV. CONCLUSION

We conclude that conservation of water sources and limiting wastage of it, done by this effective framework will help for better profitability of crops. In this present universe of expanding populace, the immense request of sustenance can be satisfied with this kind of technological advancement. By implementing such framework utilizing WSN and advanced innovation we can enhance farming development and Indian economy.

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