

# Effective Utilization of Water in Agriculture Using WSN in IOT Environment

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**ABSTRACT:** Crop irrigation uses more than 70% of the world's water, and thus there is an intense demand in improving irrigation efficiency. To facilitate the irrigation, monitoring of field parameters is very much required. In the existing system, Arduino microcontroller is used to monitor the values of the soil moisture and temperature respectively. For the remote monitoring of the field from the farmer's premises, a MATLAB GUI is developed on a PC which receives the data through the Wi-Fi module ESP8266. In the proposed system, soil parameters needed for agricultural irrigation are remotely monitored using a microcontroller-based gateway as a coordinator node, which makes the communication with all the distributed sensor nodes placed in the field through ZigBee protocol. The goal of coordinator node is to collect the parameters like soil moisture and soil temperature wirelessly. The coordinator collects the data over ZigBee wireless communication protocol and allows the user to control and monitor the data remotely from a MATLAB GUI created in the PC/laptop via Wi-Fi. So the user can make the irrigation system ON or OFF remotely on the basis of the recorded values using the MATLAB GUI interface.

**KEYWORDS:** MATLAB, Wi-Fi, Zigbee, 8.2.11 b/g/n, Arduino, Microcontroller-based gateway, communication.

## I. INTRODUCTION

Agriculture is the worldwide prime occupation of human being, 64% of total available land is occupied by the agriculture, and it consumes 85% of available fresh water. This figure of water consumption increases every year due to globalization and population growth. There is a challenge in front of every country to sustain the fresh food requirement and reducing the farm water consumption. Irrigation is the process of watering the soil. The requirement of water to the soil depends on soil properties like soil moisture and soil temperature. It also depends upon the crop which grows in the soil.

In the existing system Arduino is used to monitor the values of the soil moisture and temperature respectively. For the remote monitoring of the field from the farmer's office a MATLAB GUI is developed on a PC which receives the data through the Wi-Fi module ESP8266 which uses 802.11 b/g/n protocol. Farmer can monitor the temperature and soil moisture values through the PC by enabling a Wi-Fi hotspot which acts as a mediator for connecting both the PC and the ESP8266 module.

In this system the Arduino can read only the single sensor value at a time and displays the values simultaneously. This method is only for monitoring purpose, there is no automation or control of irrigation. It requires more human intervention and is time consuming.

So we require modern technology to resolve this problem and support better irrigation management. For that purpose, Effective utilization of water in agriculture using wireless sensor network in IOT environment has been proposed. The wireless sensor network creates the networks of multiple devices having capable of computation, communication and sensing. It provides a bridge between the real physical world and virtual worlds and having a wide range of potential applications of Agriculture, home automation, science, civil infrastructure and security.

In this system WSN consists of two nodes, coordinator node and Router/End device node. Each node mainly consists of memory, processor and an RF transceiver. The coordinator node is based on Raspberry Pi (Rpi) embedded Linux board and End device is based on Arduino UNO Atmega328 platform. The function of the coordinator node in the system is to initiate the communication with distributed End device nodes via the ZigBee wireless communication

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protocol and continuously collects the soil moisture, soil temperature and soil PH data and store collected data in the database. Farmer analyses the received data and decides the water required for the soil. If the analysed data shows that water is required, the farmer can remotely make Irrigation ON using the MATLAB GUI interface on his P.C.

Coordinator node manages the multiple Router/End device nodes. The system consists of three parts Coordinator node, Router/End device sensor node and MATLAB design. Coordinator node and End device sensor node is linked by radio transceiver. It will allow transmitting soil parameter data from End device sensor node to coordinator node and controlling signal from coordinator node to water pump node. The wireless communication is based on ZigBee protocol it uses 2.4 GHz wireless link. The MATLAB GUI is designed on PC for monitoring and control of the irrigation.

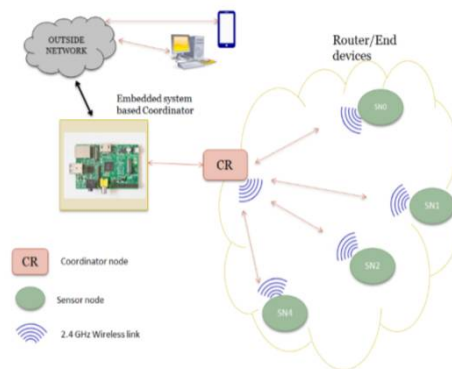
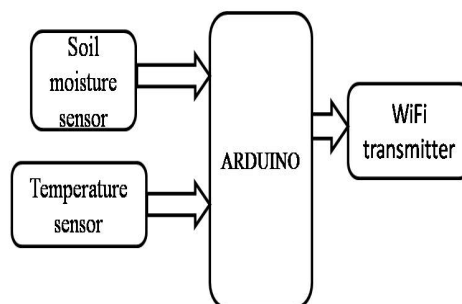


Fig 1 System Architecture

## II. EXISTING TECHNIQUE

### A. SENSORS

Spatially autonomous sensors such as temperature sensor and soil moisture sensor are used to monitor the environmental and physical conditions of the field and they cooperatively pass the data through the network to the main location.



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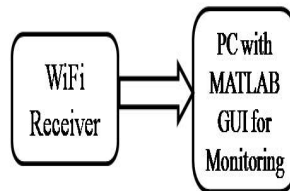


Fig 2 Existing technique block diagram

There are two sensors used in the existing system i.e., Soil Moisture and Temperature sensors.

The DS18B20 temperature sensor is used. It can be powered using either of the two modes i.e., Parasitic power mode and external power mode respectively. In parasitic power mode, the 1-Wire bus and parasitic power capacitor can provide sufficient current to the DS18B20 for most operations as long as the specified timing and voltage requirements are met. As the name suggests the External power mode needs an external power supply to the VDD pin.

### B. DISADVANTAGES OF EXISTING TECHNIQUE.

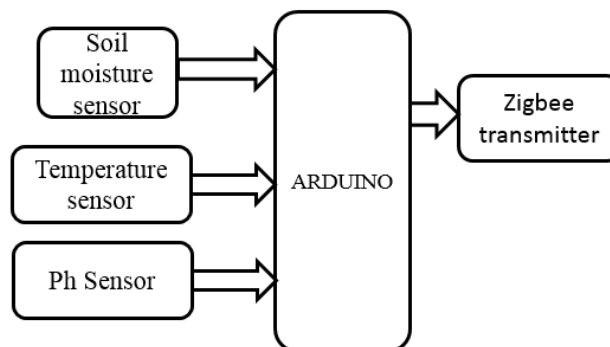
- The System is only meant for monitoring purpose
- It needs human intervention for watering the crop and is time consuming
- Arduino can read only one sensor value at a time and sends the values simultaneously

### III. PROPOSED SYSTEM

In the proposed system, Coordinator node manages the multiple Router/End device nodes. The system consists of three parts

- Coordinator node, Router
- End device sensor node
- MATLAB GUI for controlling.

Coordinator node and End device sensor node is linked by radio transceiver. It will allow transmitting soil parameter data from End device sensor node to coordinator node and controlling signal from coordinator node to the Farmer's P.C. The wireless communication is based on ZigBee protocol it uses 2.4 GHz wireless link. The MATLAB GUI is designed for monitoring and controlling the irrigation.



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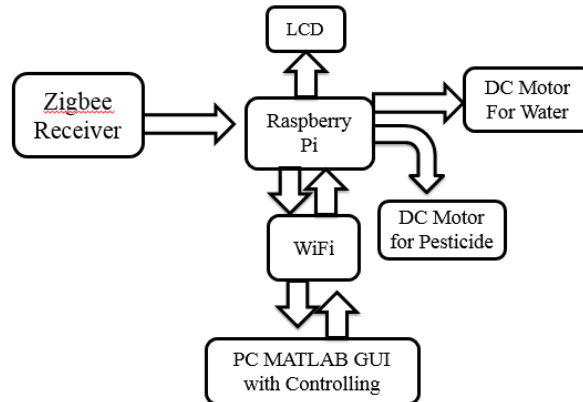


Fig 3 Proposed system block diagram

In this proposed system, we have used Raspberry Pi as the controller of coordinator node. Rpi is the small, inexpensive minicomputer. It continuously collects the information sent by sensor nodes via ZigBee, and processing large quantities of data timely and available for users to view. It is the core of the system.

Sensor node used here to sense the soil parameters. It is designed using Arduino UNO microcontroller board based on Atmega 328. It consists of the ZigBee protocol based radio transceiver, power supply unit, soil moisture, soil temperature (DS18B20) and Soil Ph Sensors. It will sense the soil parameter typically at one-minute intervals and send back to the coordinator node via the ZigBee wireless communication protocol.

## IV. SIMULATION RESULTS

### A. EXISTING TECHNIQUE RESULTS

The following figure shows the history of the temperature and moisture readings on the command window

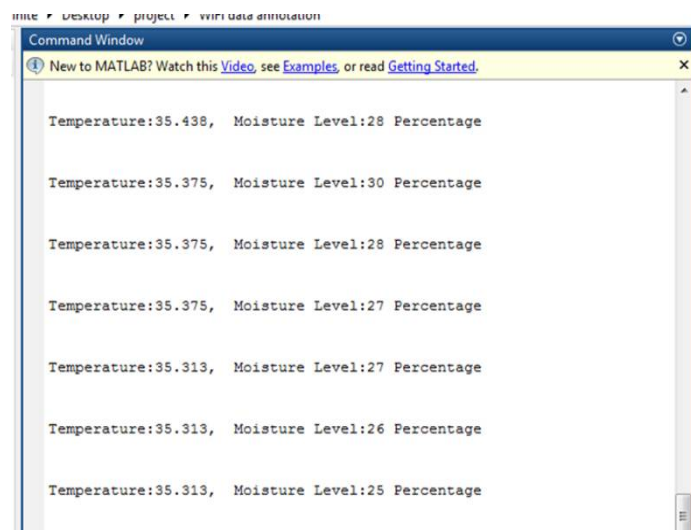


Fig 4 Values stored on command window

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The following figure displays the real time values of temperature and moisture displayed on the MATAB GUI

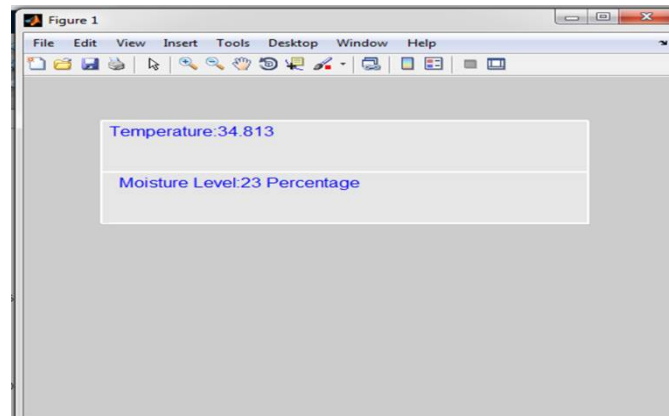


Fig 5 Real time values on MATLAB GUI

## B. PROPOSED TECHNIQUE RESULTS

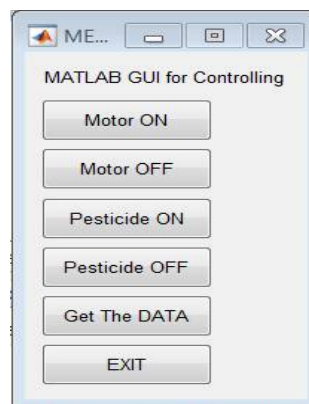


Fig 6 MATLAB GUI

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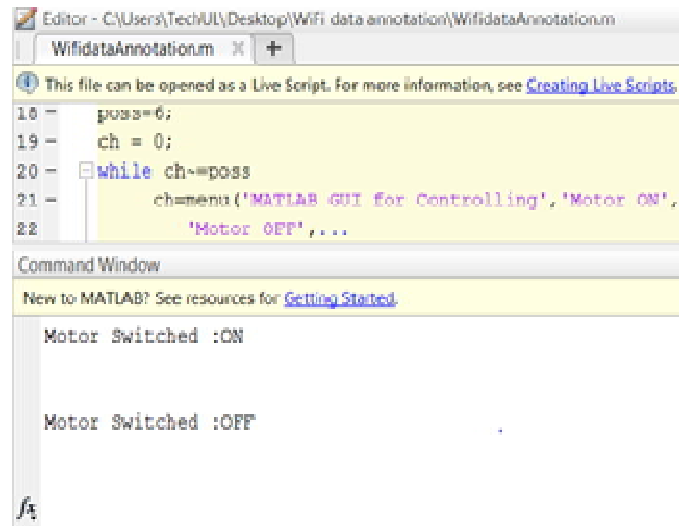


Fig 7 Motor On/Off status

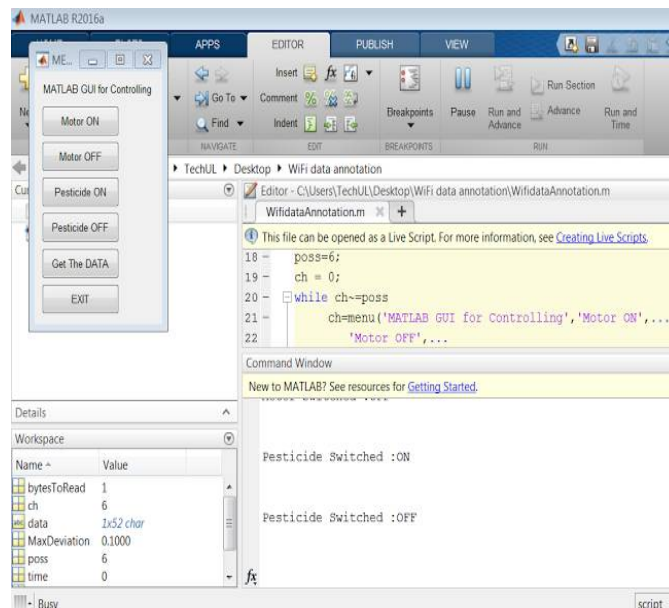


Fig 8 Pesticide ON/OFF

Figures 7 and 8 shows the Motors ON/OFF status of the motor used for irrigation and the motor used for pesticide respectively.

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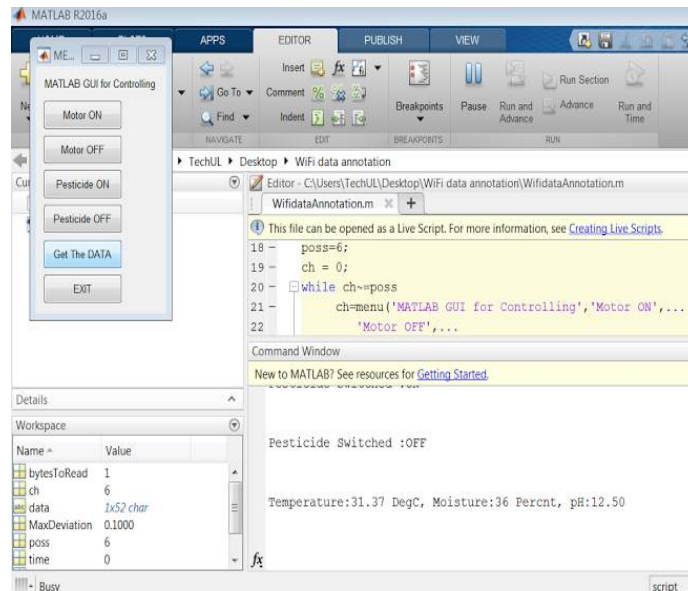


Fig 9 PH value tested with lime water

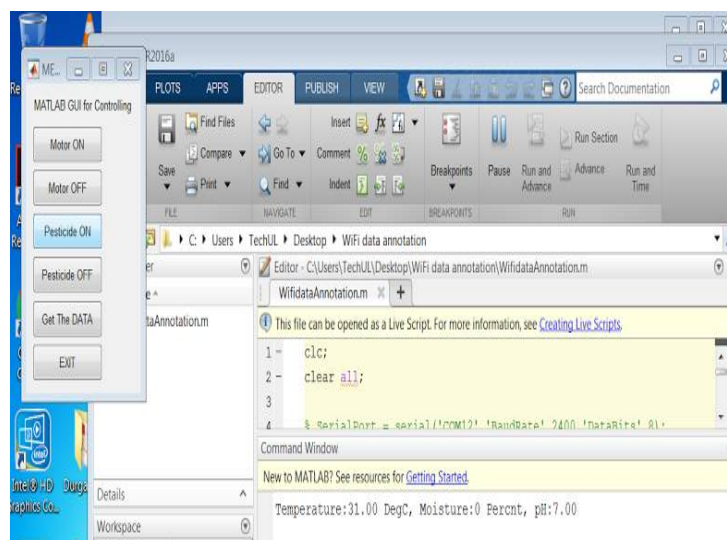


Fig 10 PH value in Normal water

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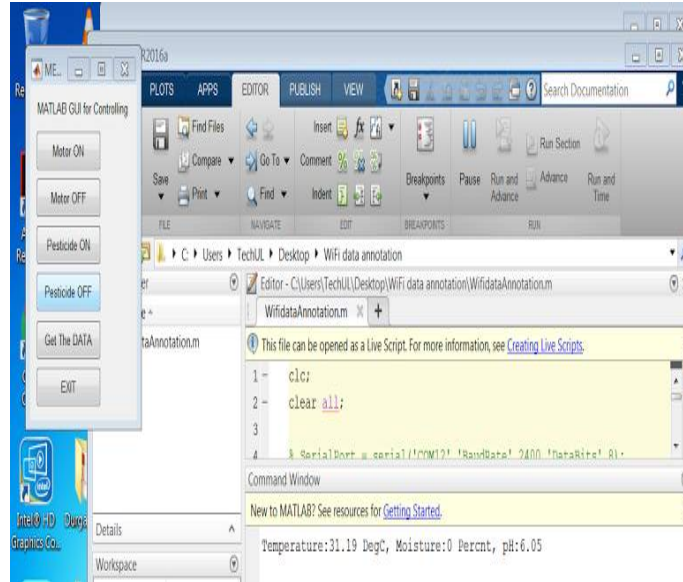


Fig 11 PH value in Salt water

The figures 9 10 and 11 are the PH levels tested using different samples of water that contains different levels of PH.

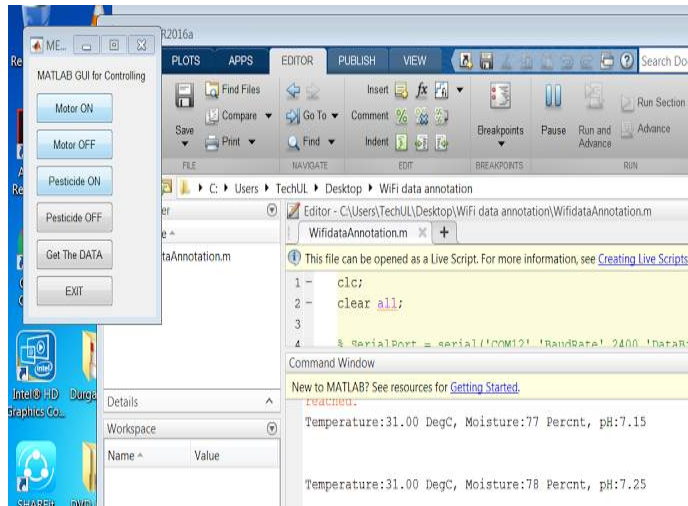


Fig 12 Soil moisture values



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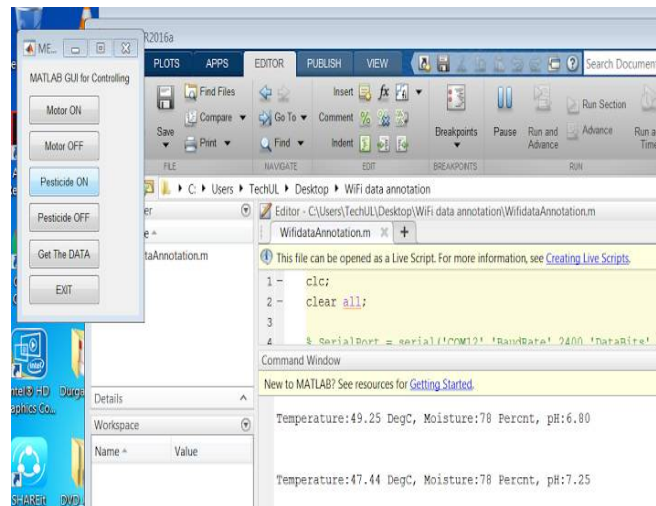


Fig 13 Temperature values

Figures 12 and 13 shows the real-time values of temperature and moisture tested in the field.

## V. CONCLUSION

The Existing system is designed for monitoring the soil parameters such as temperature and moisture values. Arduino is used for the collection of data from the sensors and at the receiver end MATLAB GUI is created for the monitoring of the values through Wi-Fi.

This enables the farmer to monitor the farm parameters and take the action accordingly. But, this requires human intervention for watering the field and farmer can only monitor the field. To overcome these drawbacks controlling capability is added in the proposed method. ZigBee communication is used to transmit the sensor data from the end device node to the coordinator node which is low power and reliable communication protocol.

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