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# IoT Based Approach to Automation of Farming Irrigation System

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**ABSTRACT**

In India, much of the economy relies on agriculture. Farmers, however, do not get the proper equipment for farming. They face problems such as lack of soil fertility, no adequate water treatment for soil moisture, and many more. IoT is a shared network of objects where these objects communicate through the Internet. Through the use of IoT, a Farming Automation System can be built that can reduce the waste of water, herbicides, and pesticides and increase crop yields. In this job, With the use of accurate soil humidity sensors that support pain alleviation and monitor soil moisture changes. The temperature is measured and recorded using the Raspberry Pi 3 Module and Arduino Mega microcontroller with a Light-Dependent Resistor sensor, a moisture sensor, and a temperature sensor. The soil contains details on the soil moisture status over a certain period. The Raspberry Pi 3 collects and processes the data received from the Sensors. When the soil's threshold moisture level is reached, the water will be supplied accordingly. This is important because the plant needs to have water at a specific time for a good yield. We can also track the humidity and temperature of the crops at the time of their yield.

**Keywords**
Smart Agriculture system, Wi-Fi, Sensors, IOT, automation, Arduino Mega Microcontroller, Raspberry Pi 3, Light-Dependent Resistor Sensor, Temperature sensor, and Moisture sensor.

## Introduction

The Internet of Things (IoT) is a modern technology that enables heterogeneous systems to exploit a smart ecosystem. IoT systems are usually connected to the Internet through RFID-equipped physical devices, actuators, wireless sensors, and/or wireless networking devices. These developments are directly used in the framework to build an intelligent environment, ranging from cellular networks to machine-to-machine (M2M) connectivity, vehicle networks, wireless sensors, and embedded devices, etc. A broad variety of IoT technologies is being developed in an attempt to restructure the intelligent universe and introduce new technological paradigms to connect physical objects. A wider array of IoT applications are provided to restructure the intelligent universe and construct new computing paradigms for the interaction of physical objects. A layered architecture containing three main layers is preceded by IoT; a layer of vision: consisting of physical structures and sensing devices; a layer of network: responsible for transmitting data. Physical objects to the network gateway/edge, and the System layer: manage application/service requests. IoT's myriad launch extends Internet access to billions of people.

Currently, 6.4 billion computers are being connected to the Internet, which will grow to 50 billion by 2020, according to the Cisco IoT Growth Report. These linked computers generate a huge amount of data, such as data generated in the current year (6.2 Exabyte), which is expected to increase by 478 percent (30.6 Exabyte) in 2020. The expected increase in embedded devices by 781 percent and data generation by 478 percent in 2020 is expected to result in a smart network access and management solution. In an attempt to remedy the current issues in the IoT model, many proposals have been examined.

In the context of SDN, the control plane is separated from the transmission plane and the API. The SDN has three layers of architecture (1). Project of data (2). Plane/Controller Control, and 3. Layer for operation. The data plane is mainly composed of irrelevant forwarding devices, namely routers and switches, that send information only on the orders of the controller. The controller functions as a brain and controls the network from a global vision of the network. The specifications of clients are abstract from the implementation layer that the Northbound APIs e.g. the RESTful API send to the dispatcher. The entire network has a global network view and is managed by the dispatcher. The control is above all programs/applications. Inputs from the data plane are governed by the SDN controller.

## Literature Review

Below is the literature review of various papers/ articles used to make the project IoT Based Approach to Automation of Farming Irrigation System.

**Table 1.** Lorem ipsum dolor sit amet

| Authors | Paper Title | Description |
|---|---|---|
| ***Peter Bull, Ron Austin, Evgenii Popov, Mak Sharma, & Richard Watson*** | Flow Based Security for IoT Devices using an SDN Gateway | The SDN Gateway to the future is used as an IoT system gateway to an SDN-based switch that offers packet inspection opportunities and traffic pattern analysis at the local (i.e. distributed) and worldwide (i.e. centrally controlled) level. |
| ***Olivier FLAUZAC and Carlos GONZALEZ and Abdelhak HACHANI and Florent NOLOT*** | SDN based architecture for IoT and improvement of the security | To build and protect wired and wireless network infrastructure, and IoT SDN-based architecture and enhancement of security for the proposed security model have been planned. Extended the architecture proposed to incorporate the following things: sensors, laptops, mobile phones, etc. Networks and network objects. |
| ***Kshira Sagar Sahoo, Bibhudatta Sahoo, Abinas Panda*** | A secured SDN framework for IoT | The IoT Protected SDN System, stressing the main security concerns of SDN, as well as the SDN SDN Security Model. Incorporating ad hoc structures in the network equipment, considering the final target the planned building model has been incorporated. |
| ***Prathibha S R , Anupama Hongal , Jyothi M P*** | IOT BASED MONITORING SYSTEM IN SMART AGRICULTURE | IoT Sensors will provide information on their fields of agricultural production. IOT Dependent Tracking Device IN SMART AGRICULTURE. The paper seeks to use emerging technologies such as IoT and intelligent agriculture through automation. Environmental monitoring is a key factor in improving the production of productive crops. |
| ***S.Anitha, P. V. V. Hymavathi, E. Brumancia*** | Smart Irrigation Automation System Using IoT | Despite recent advances in water structure control and sprinkler process, best in class water structure systems do nothing to compensate for regions of turf with |

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| | | heterogeneous water needs. We have eliminated the physical obstacles of traditional water frame structures in the light of a mostly ordered logbook by distinguishing them from the sprinkler center which can recognize the consistency drained by the area, offer remotely and impact their special sprinkler. |
| ***Dr. J. Jegathesh Amalraj, S. Banumathi, J. Jereena John*** | A Study On Smart Irrigation Systems For Agriculture Using Iot | The IoT system allows farmers to handle their jobs even simpler and helps decision-making even in the absence of farmers in the irrigation system automation. The technology IoT, sensors, and smart telephone systems help farmers understand their land status, water use, soil temperature, moisture, wind, and ph. levels. |
| ***R.Mythili, Meenakshi Kumari, Apoorv Tripathi, Neha Pal*** | IoT Based Smart Farm Monitoring System | IoT represents an autonomous component chain. The effective implementation allows agriculture to reduce human labor and to grow crops as well as self-discipline. This document promotes the agriculture stick, based on IoT, as a tool to assist farmers in gaining real-time field data awareness (temperature, soil moisture). These real-time readings assist farmers in practicing smart farming and increasing average crop yields as well as plant efficiency. Farmers can use Smart Agriculture with Arduino Technology to monitor live farm data and achieve the desired crop cultivation performance. |
| ***Ms. Swapnali B.Pawar, Prof. Priti Rajput, Prof. Asif Shaikh*** | Smart Irrigation System Using IOT And Raspberry Pi | Intelligent irrigation systems, as automaticity is one of the essential roles of human life today. The device offers not only convenience but also decreases electricity, productivity and saves time. Whenever the temperature, humidity, and current rain in the environment changes, certain sensors feel temperature and humidity changes and provide an |

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| | | |
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| | | interruptive signal to the pi. |
| ***M. E. Karar, M. F. Al-Rasheed , A. F. Al-Rasheed and Omar Reyad*** | IoT and Neural Network-Based Water Pumping Control System For Smart Irrigation | The goal of this paper is to store the wastewater irrigated through the Internet of Things (IoT) on the base of a series of sensors and neural Multi-Layer Perceptron (MLP) network for water irrigation. The system manages the sensor data through the Arduino board to automatically power the water pump. In addition to assessing the necessary time for water irrigation activity, the sensors monitor ambient variables, namely temperature, humidity, and soil moisture. In IoT technology, the water pump control mechanism includes software and hardware instruments including Arduino's Remote XY interface and electronic sensors. A significant role in supporting the decision to automatically monitor the water use of the IoT irrigation system is played by the MLP learning algorithm, for example, the neural network. |
| ***Mrs.T.Vineela, J. NagaHarini, Ch.Kiranmai, G.Harshitha, B.AdiLakshmi*** | IoT Based Agriculture Monitoring and Smart Irrigation System Using Raspberry Pi | Developed a Smart irrigation and control system of IoT-based agriculture The collected data provide details on the different environmental variables using Raspberry Pi. Environmental control is not the way to improve crop yield. Numerous other factors impair productivity. To overcome these problems, automation needs to be implemented in agriculture. To solve such challenges, an interconnected infrastructure needs to be developed that will increase efficiency at all stages. |
| ***Kshira Sagar Sahoo, Bibhudatta Sahoo, Abinas Panda*** | A secured SDN framework for IoT | The IoT Protected SDN System, stressing the main security concerns of SDN, as well as the SDN SDN Security Model. |

## Proposed Work

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Farmers will have suggestions of crops that will be best appropriate for cultivation in very specific farmland when the thought of the weather and atmospheric condition of that geo-location.

1. Besides, this project involves automated water control systems for the cost-effective treatment of water if soil conditions are constantly tracked during whole crop growing.

2. Below given is the architecture diagram for the proposed system. In this diagram, there is a Raspberry Pi and all sensors collaborate with it and there is one server that can be used to collect data and display it to the user so that he/she can take actions accordingly.

3. These embrace soil parameters like temperature and wetness, soil wet content, soil water level, etc... Arduino UNO or a custom MEGA is employed to gather these detector values and transmit them to the Raspberry Pi that we will use the net UI services.

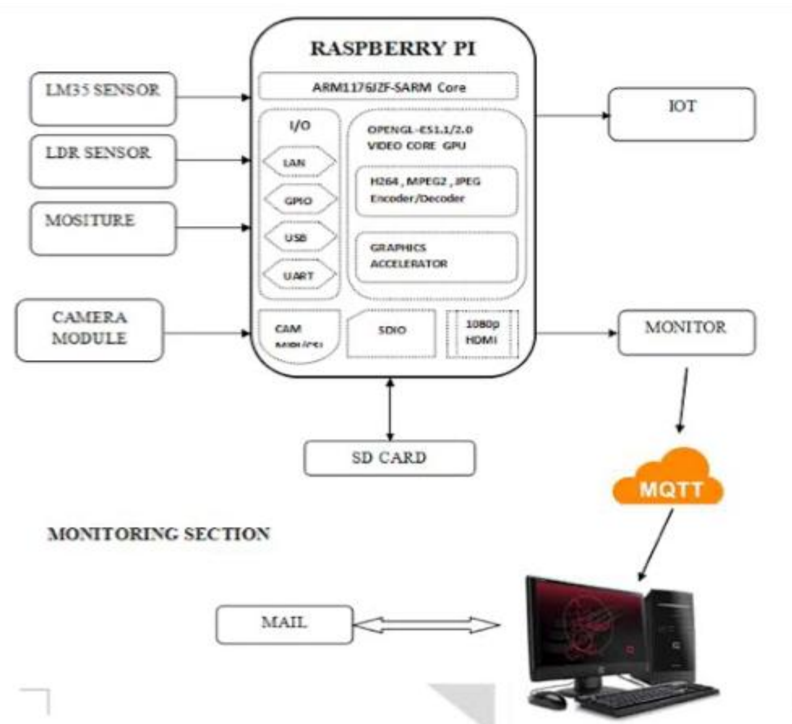


Fig. 1. *Architecture diagram*

4. Raspberry Pi additionally uses a base System for storage or instrumentality. The NRF24L01 module has been used to establish a communication link between the Arduino UNO and Raspberry pi 3 model B+.

5. The reason behind using the nRF24L01 module instead of Wi-Fi is firstly to keep its connection local and private. Secondly, it is not possible to have Wi-Fi in the field, at least not with those with a widespread field. Thirdly, the range and speed of message transfer are flexible.]

6. Normally, the power to the system can be provided with a battery. However, in some cases like for the Arduino in the field, we can use solar power to supply power instead of a battery.

7. The farmer will access the data regarding the sphere condition anytime, thereby reducing the person's power and time.

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8. The information from the detector arrays is transmitted through the neighboring detector arrays that transmit them more to their neighbors.

9. The main purpose of this kind of serial transmission involving consecutive detector arrays is to extend the vary and to make sure the reception of information from all detector arrays at the server finishes in a very foolproof method.

10. This is this proposed work, in this proposed work not all sensors are communicated with the Arduino Uno. But in our model, we will be implementing all sensors that are mentioned in the implementation section.

*A. Abbreviations and Acronyms*

- IoT - Internet of Things
- SDN - Software Defined Network
- ET - evapotranspiration
- MLP - Multilayer Perceptron
- M2M - Machine-to-Machine

## Methodology

The machine contains multiple sensor and processor types. The two controllers to operate the sensors are Raspberry Pi and Arduino Uno. Raspberry pi acts as a connection to the network and helps with data representation. Arduino controls the function of the sensors. Both of them communicate using RF modules, which is optimum as the environment now consists of fewer wires, and wifi is not required.

*A. UML Diagrams:-*

We have the class diagram to help the reader better understand the static view of our system. This class diagram will help the reader to understand how the automation system works, data storage, and usage of that data.

Fig. 2. *Class diagram*

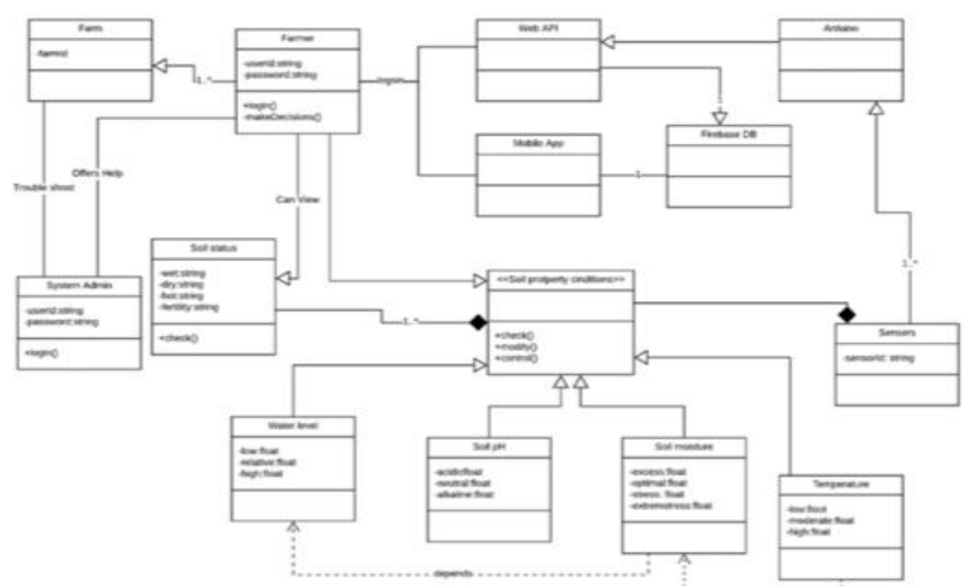


Fig:- Class diagram for Farming Automation using IoT

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*B. Components Used*

1. *Raspberry Pi:* This is the Raspberry Pi 3. It is used to monitor the functionality of several sensors used in the system. It works like the compressed version of the CPU. It gets the data from the sensors, then sends that data to the database in this case Firebase system, and then compares it to the threshold value (required value for sensors to work). After this step, it will operate the equipment according to the result from the comparison.

2. *Arduino Uno:* The Arduino Uno microcontroller board is based on the ATmega328P microcontroller (datasheet). It has 14 optical input/output pins, 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB link, a power port, an ICSP header, and a reset button. It comes with everything you'll need to get started with the microcontroller; simply plug it into a device with a USB cable or power it with an AC-to-DC converter or battery. The Arduino Uno microcontroller board is based on the ATmega328P microcontroller (datasheet).

3. *Soil Moisture sensor:* This is an easy-to-use electric soil moisture sensor. The sensor is essentially embedded in the soil and can track the moisture or water level of the materials inside it. When the level of moisture in the earth is high, it produces a 5V propelled yield, and when the level of suddenness in the earth is low, it produces a 0V propelled yield. To configure the soggy confining pin, the sensor is connected to a potentiometer. When the sensor senses more moisture than the set tip, the propelled yield increases, and the yield is shown by an LED. Although the moisture on the field is below the set cap, the yield remains low. The automatic yield can be connected to a smaller scale controller to understand the moisture level. Furthermore, the sensor generates a simple output that can be connected to the ADC of a smaller scale controller to obtain the desired amount of clamminess in the solid. The soil sensor is used to check the moisture in the field and detect any irregularities in the moisture levels.

4. *Water sensor:* The Water Sensor Square is recommended for water recognition. An electronic component connector, a 1 Mega Watt resistor, and a few lines of exposed coordinating wires are included in the square. This sensor works by shifting a collection of the associated ground takes after, and the sensation takes after is connected to the grounded takes after. The sensor takes over after building a 1 MegaWatt draw-up resistor. Until a drop of water shorts the sensor to the grounded conductor, the resistor will pull the sensor conductor high. By adding a movement of revealed parallel wires to determine the water dab/water gauge, this system will assess the water level.

5. *nRF24L01:* This module transmits data back and forth on a specific channel. In addition to that, we can control the speed, channel, and range of the data transmission following our requirements. The connection here is private and communication takes place between two of the NRF24L01 modules. The communication signal is in the form of radio waves.

6. *Relay Module:* This module is connected to the Arduino and water motor. It receives commands from Arduino as to when it should stop and start the motor for the water supply. As a function, when the water level reaches a certain threshold (which is set in Raspberry pi) the relay module cuts off the power to the motor. Similarly, when the water level is below that threshold the motor is turned on.

7. *Ultrasonic ranger:* This sensor has multiple ways it can be used in. Here, we have used it to detect movement in the field. For instance, to detect rodents in the field we can use this particular sensor for an alert. Intrusion detection can be done using this sensor.

8. *Temperature and humidity sensor:* This sensor can detect both humidity level and temperature level. Using this can benefit the user with knowledge about the requirement of water following the temperature and humidity in the environment.

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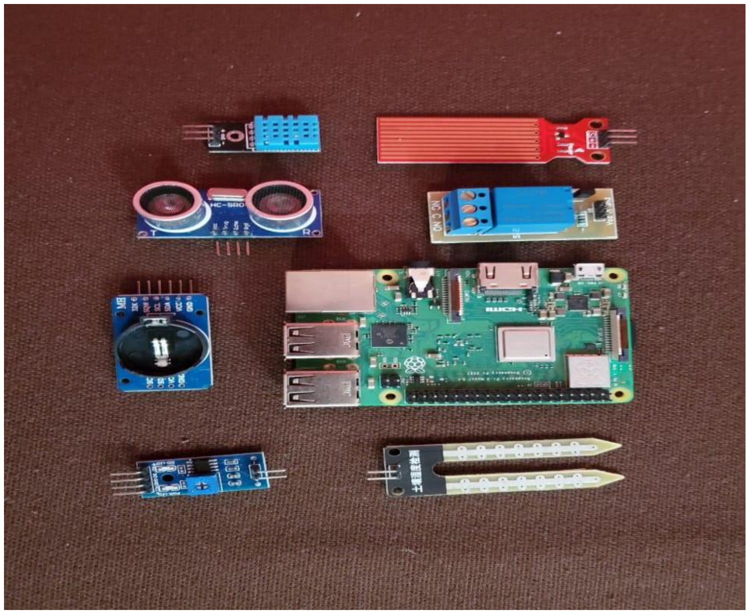

Fig. 3. *All the components used*

## Implementation

Implementation of our project can be understood from the above figures and will be explained in the following steps below:

1. First of all, we'll be setting up our Raspberry Pi 3 and Arduino Uno with the nRF24L01 module. This module helps the two controllers to communicate wirelessly with each other.

2. After the first step connect all sensors with Arduino Uno (the schematic diagram is shown in the proposed work section).

3. Check whether all the sensors are in working condition. Do that by connecting individual sensors with the Arduino Uno.

4. After all, sensors are connected and all the data from the sensors will be shown in the Arduino Ide App after you run the source code.

5. In our model, all the sensors will be sending data to Arduino Uno and through the nRF24L01 module, the data will be sent to Raspberry Pi 3.

6. Through the database, we will be able to interpret data that has been collected by Raspberry Pi 3. After the data interpretation for individual sensors and by setting any threshold value for the sensors to work automatically after reaching the threshold values we will use relay modules; it's a cut-off module.

7. When for any particular sensor the threshold value is reached the relay module will start its work.

8. For Example, take a water level sensor. When the water level sensor reaches its threshold value, the relay module is connected to it, and the motor pump will start the motor pump and due to that water will be given to the plants. After when the values become normal, the relay module will cut off the pump motor and it will stop sprinkling water.

## Data Analysis(Times New Roman, bold, 12)

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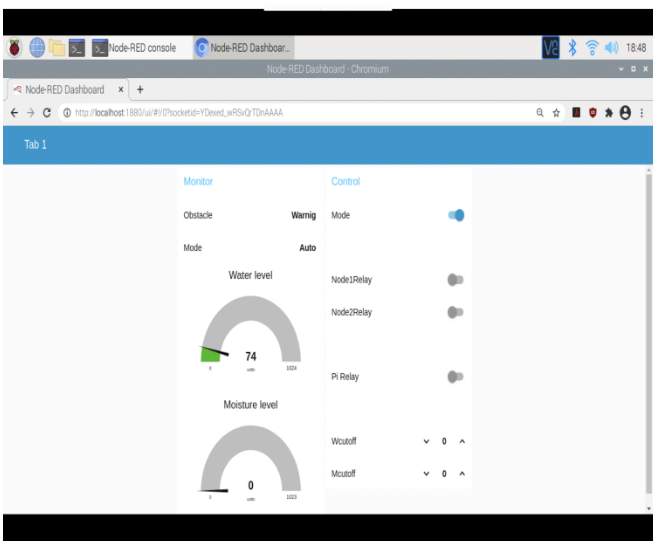
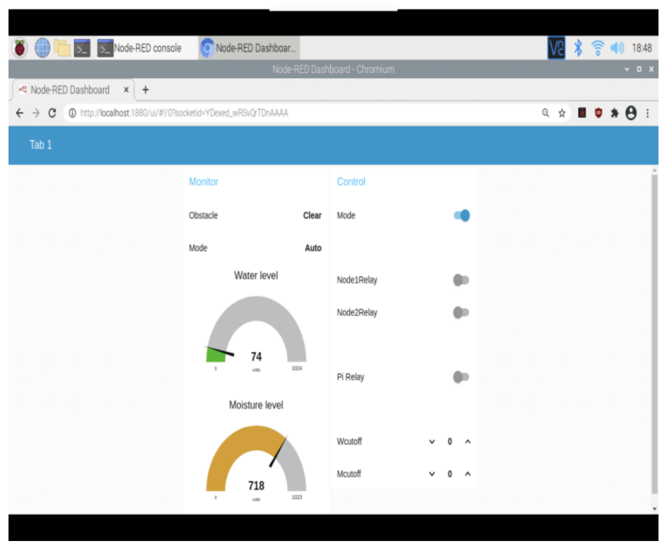
## Results & Discussions

The below-given figures display the output received from the water level sensor, soil moisture sensor, and Infrared obstacle sensor.




## Conclusion

The method suggested here is an automated mechanism where the farmer doesn't have to check the field condition every time because it doesn't require human resources. As related to other programs, the cost of the project is smaller. The system is simple and it is easy for farmers. We are now facing many farming issues and our proposed system is very helpful for our area. It is also possible to save water and use the water needed for this industry. The server saves all details and the URL is collected and can be changed. Both processed and retrieved data can be used for further planting, the future work to be done as data collection.

## Limitations and Future Studies

To provide protection from insect attack for better yield. Focused on the prevention of crops from insect attack which damages the crop leaves and root so it automatically affects the crop yield. To observe other parameters for better yield. Climatic conditions also affect the growth of crops, like temperature increases the water requirement also increases so it can also be monitored.

## Acknowledgement

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