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ARDUINO BASED SMART IRRIGATION SYSTEM

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ABSTRACT

Agriculture is one of the most fundamental resources of food production and also plays a vital role in keeping the economy of every nation by contributing to the Gross Domestic Production (GDP). But there are several issues related to traditional methods of agriculture such as excessive wastage of water during irrigation of field, dependency on non-renewable sources such as petroleum coal, time, money, human resource etc. Now-a-days the increasing demand of non renewable power sources, automation and digitization, SMART agriculture is believed to be most expected food production sector in country. This paper aims at developing the Smart Irrigation System using IoT (Internet of Things) technology. The primary objective of the present work is to automate the total irrigation system in terms of water requirement of the crop by monitoring the moisture of soil and climate condition and also to prevent the wastage of water resource. The paper also highlights remote access of the irrigation system from home using IoT technology. Thus the system will provide convenient access of the system and protect the farmer from scorching heat & severe cold.

Keywords: IOT, Automation, Soil Moisture Sensor, Rain Sensor, Wi-Fi, API.

I. INTRODUCTION

In today's world, we all are relying on farmers. But anyone knows who farmers rely on? Nobody, they suffer from various irrigation difficulties like over-irrigation, under irrigation, depletion of underwater, floods, etc. To overcome some of the problems we are trying to make a project which can help farmers to overcome the difficulties. Over irrigation occurs because of poor distribution or the lack of management wastes water, chemicals, and may lead to water pollution. Under irrigation is giving only just enough water for the plant which gives poor soil salinity which leads to increased soil salinity with a consequent build-up of toxic salts in soil surface in areas with high evaporation. This requires either leaching to remove these salts and a method of drainage to carry the salts away. To overcome these irrigation difficulties we have made a project by the use of IoT (internet of things) and ML (machine learning). The hardware consists of various sensors like temperature sensor, humidity sensor, ph sensor, pressure sensor operated by Arduino module and bolt IOT module. Our temperature sensor will predict the weather condition of that area through which farmer will make less use of water in the fields. Our ph sensor will sense the ph of the soil at a regular interval and predict whether that soil needs more water or not. Our main target is to make an irrigation system automatically and to save water for the future purpose.

The current trends in the smart irrigation market include the following techniques which are: • Drip Irrigation: allows for precise control of the application of water and fertilizer, which can greatly reduce the amount of water needed for crop irrigation. • Measuring Water Flow: Precise measurement of water usage with water flow meters can prevent overwatering and reduce costs for farmers. • Data Analytics: New software products that crunch large amounts of data can provide farmers with important information that they previously didn't have access to. • Drilling More Wells: Farmers are relying more on groundwater sources for irrigation and as the water table falls due to unsustainable levels of pumping.

II. METHODOLOGY

In this work, an Arduino microcontroller was used to control and sense the thing such as moisture in the soil. In this purpose, a soil moisture sensor is employed to sense the moisture. The soil moisture sensor is a sensor which varies the value when it contacts the moisture. Basically it is a resistor that works on moisture condition. When the moisture is more than the value of resistance will decrease and when the moisture is less than the resistance value is more. So the sensor was calibrated into the different moisturizing condition of the water. Different values from different conditions are obtained. Different codes are generated according to the value. Put these values in the If condition of code and this If condition decides the pump will work or not

Components

HARDWARE COMPONENTS:

Bolt IoT Bolt WiFi Module Arduino UNO

- LDR
- Temperature Sensor
- SG90 Micro Servo Motor
- Breadboard
- Rain Sensor
- Water Level Sensor

SOFTWARE APPLICATIONS AND ONLINE SERVICES

- Bolt IoT Bolt Cloud
- Bolt IoT Android Application
- Arduino IDE
- Notepad ++

HAND TOOLS AND FABRICATION MACHINES

- Hot Glue Gun
- Soldering iron

ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards. The Arduino UNO is programmed using the Arduino Software (IDE).

Figure 1. ARDUINO UNO

BOLT IOT WIFI MODULE

BOLT is an Internet of Things platform (Hardware+ Software) that enables user to build IoT products and projects. It is developed by company name INVENTROM Pvt Ltd. Using BOLT, users can control and monitor devices from any part of the world. The Bolt Cloud API provides an interface for communication between the Bolt devices and any 3rd party system e.g. mobile application, web server, python programs etc. The API contains very intuitive control, monitoring, communication and utility functions for the Bolt Devices connected to your account. The Bolt Cloud API uses HTTP protocol for communication and uses the HTTP GET and HTTP POST methods. Hence users can execute actions and retrieve information from Bolt devices programmatically using conventional HTTP requests.

Here are a few use cases of the API:

● Use the API in native apps on IOS and Android to control and monitor Bolt devices over the Internet.

● Pull collect sensor data connect to Bolt device, to any other cloud to run your custom AI algorithms and analytics.

● Connect Bolt Cloud to any VPS (Virtual Private Server) and run your code in any language of your choice.

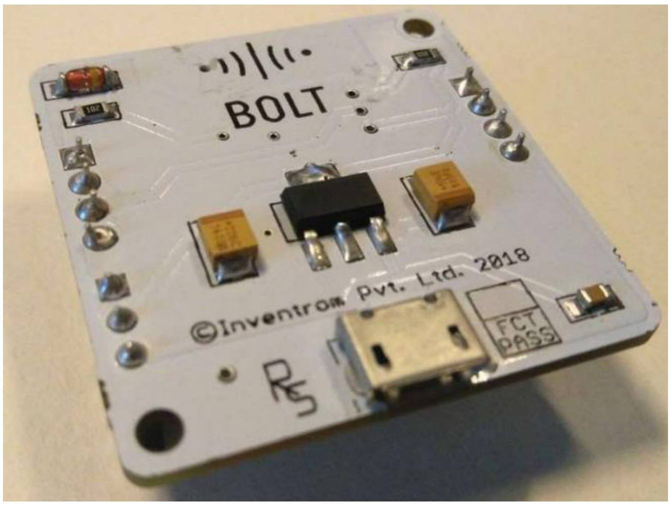

Figure 2. BOLT IoT WiFi Module.

LIGHT SENSOR

A Light Sensor generates an output signal indicating the intensity of light by measuring the radiant energy that exists in a very narrow range of frequencies basically called "light", and which ranges in frequency from "Infra-red" to "Visible" up to "Ultraviolet" light spectrum. The light sensor is a passive device that converts this "light energy" whether visible or in the infrared parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "Photo Sensors" because of the convert light energy (photons) into electricity (electrons).

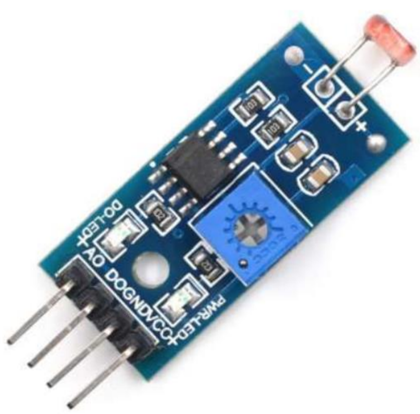

Figure 3. Light Sensor

TEMPERATURE SENSOR

A temperature sensor is a device, usually an RTD (resistance temperature detector) or a thermocouple, that collects the data about temperature from a particular source and converts the data into an understandable form for a device or an observer. Temperature sensors are used in many applications like HV and AC system environmental controls, food processing units, medical devices, chemical handling and automotive under the hood monitoring and control systems, etc. There are different types of temperature sensors that have sensing capacity depending upon their range of application. Different types of temperature sensors are as follows: • Thermocouples • Resistor temperature detectors (RTD), Thermistor

Figure 4. Temperature Sensor

WATER LEVEL SENSOR

Water Level sensors are used to detect the level of substances that can flow. Such substances include liquids, slurries, granular material and powders. Level measurements can be done inside containers or it can be the level of a river or lake. Such measurements can be used to determine the number of materials within a closed container or the flow of water in open channels.

Figure 5. Water level Sensor

RAIN SENSOR

Rain sensor or rain switch is a switching device activated by rainfall. It is used water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall. The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers. An additional application in professional satellite communications antennas is to trigger a rain blower on the aperture of the antenna feed, to remove water droplets from the cover that keeps pressurized and dry air inside the waveguides.

Figure 6. Rain Sensor

SERVO MOTOR

A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing. Our main motive of servo here is to show the implementation of the valve in motor for the pipeline.

Figure 7. Servo Motor

INTERNET OF THINGS

The Internet of things (IoT) is the extension of Internet connectivity into physical devices and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware (such as sensors), these devices can communicate and interact with others over the Internet, and they can be remotely monitored and controlled. The definition of the Internet of things has evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers.

VPS (VIRTUAL PRIVATE SERVER)

A virtual private server (VPS) is a virtual server that the user perceives as a dedicated/private server even though it is installed on a physical computer running multiple operating systems. A virtual private server is also known as a virtual dedicated server (VDS). The concept of a virtual private server can be better explained as a virtual machine that caters to the individual needs of a user just as a separate physical computer that is dedicated to a particular user. The virtual dedicated server provides the same functionality and privacy as that of a normal physical computer. A number of virtual private servers can be installed on a single physical server with each one running its own operating system. Virtual private servers connect shared Web hosting services and dedicated hosting services by filling the gap between them. Because virtual dedicated servers can have their own copy of the operating system. VPS provides the user with super-user privileges in the operating system. VPS enables the user to install any kind of software that is capable of running on that operating system. On the virtual private server we are installing Ubuntu which contains a wide range of software that includes LibreOffice, Firefox, Thunderbird, Transmission, and several lightweight software. Ubuntu builds on the Debian architecture and infrastructure and collaborates widely with Debian developers, but there are important differences. Ubuntu has a distinctive user interface, a separate developer community (though many developers participate in both projects) and a different release process.

BOLT LIBRARY

Bolt is a C++ template library optimized for GPUs. Bolt is designed to provide high-performance library implementations for common algorithms such as scan, reduce, transform, and sort. The Bolt interface was modelled on the C++ Standard Template Library (STL). Developers familiar with STL will recognize many of the Bolt APIs and customization techniques. C++ templates can be used to customize the algorithms with new types (for example, the Bolt sort can operate on ints, float, or any custom type defined by the user). Additionally, Bolt

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lets users customize the template routines using function objects (functors) written in OpenCL ™ for example, to provide a custom comparison operation for sort, or a custom reduction operation. Bolt can directly interface with host memory structures such as std::vector or host arrays (e.g. float*). On today's GPU systems, the host memory is mapped or copied automatically to the GPU. On future systems that support the Heterogeneous System Architecture, the GPU will directly access the host data structures. Bolt also provides a bolt::cl::device_vector that can be used to allocate and manage device-local memory for higher performance on discrete GPU systems. Bolt APIs can accept either host memory or the device vector.

III. CIRCUIT DIAGRAM

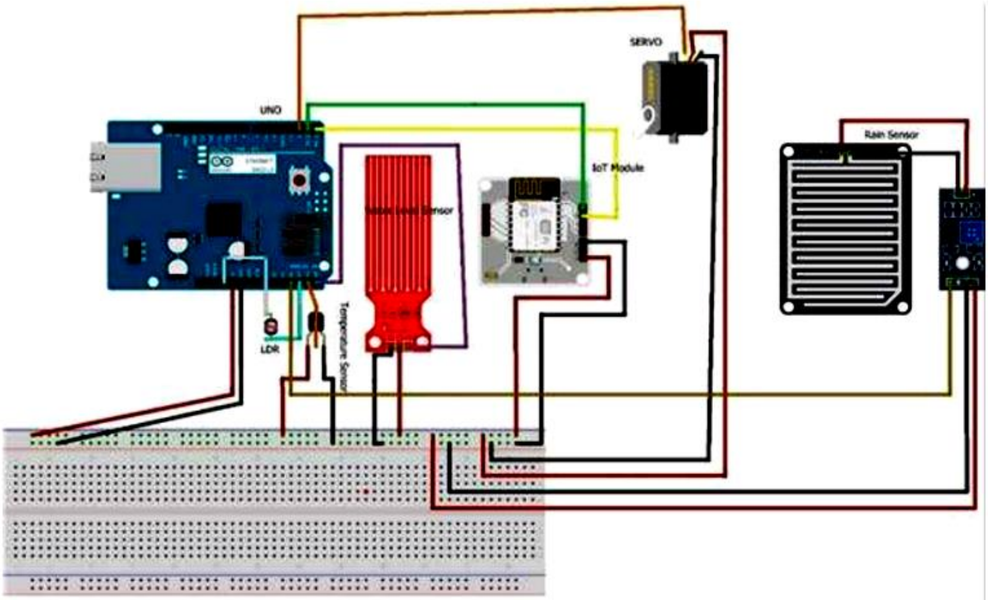
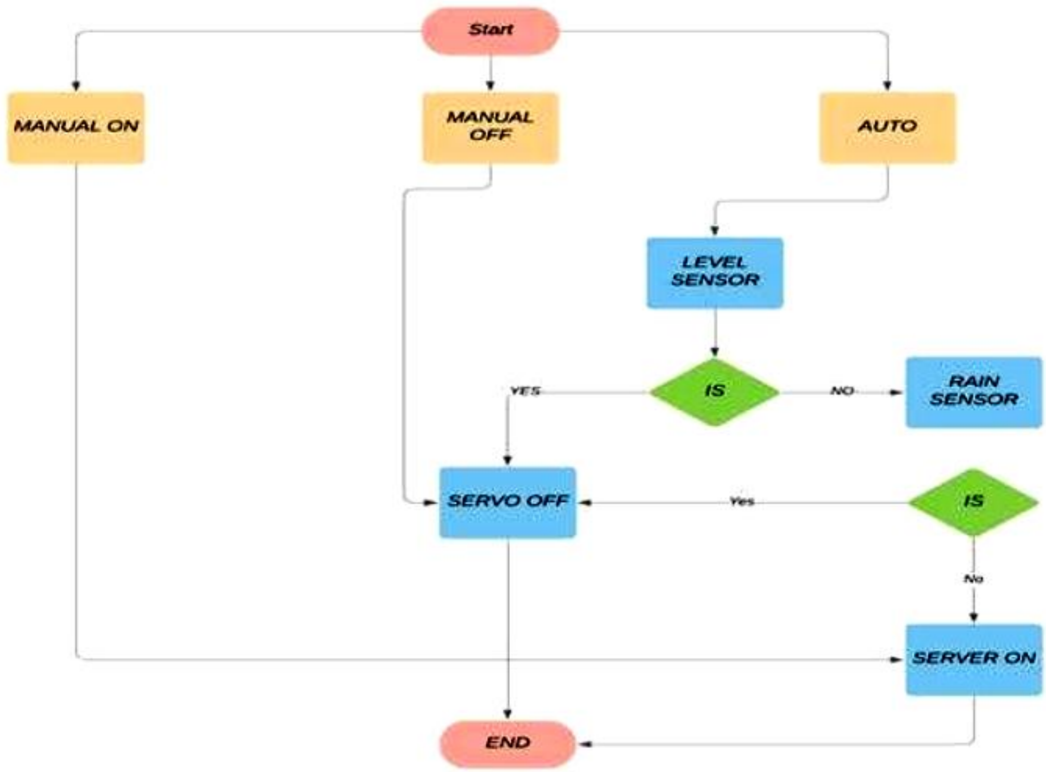


Figure 8. Circuit Diagram

IV. RESULTS AND DISCUSSION

Algorithms Developed



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ALGORITHM

SCENARIO 1
Step 1: Start
Step 2: Mode select
Step 3: If MANUAL ON then SERVO ON
Step 4: End

SCENARIO 2
Step 1: Start
Step 2: Mode select
Step 3: if MANUAL OF then SERVO OFF
Step 4: End

SCENARIO 3
Step 1: Start
Step 2: Mode select
Step 3: If Auto 28
Step 4: Select LEVEL SENSOR
Step 5: Is LEVEL SENSOR FULL
Step 6: YES
Step 7: SERVO OFF
Step 8: END

SCENARIO 4
Step 1: Start
Step 2: Mode select
Step 3: If Auto
Step 4: Select LEVEL SENSOR
Step 5: Is LEVEL SENSOR FULL
Step 6: NO
Step 7: Select RAIN SENSOR
Step 8: Is RAIN SENSOR FULL
Step 9: YES
Step 10: SERVO OFF
Step 11: END

SCENARIO 5
Step 1: Start
Step 2: Mode select
Step 3: If Auto
Step 4: Select LEVEL SENSOR
Step 5: Is LEVEL SENSOR FULL
Step 6: NO
Step 7: Select RAIN SENSOR
Step 8: Is RAIN SENSOR FULL
Step 9: NO
Step 10: SERVO ON
Step 11: END

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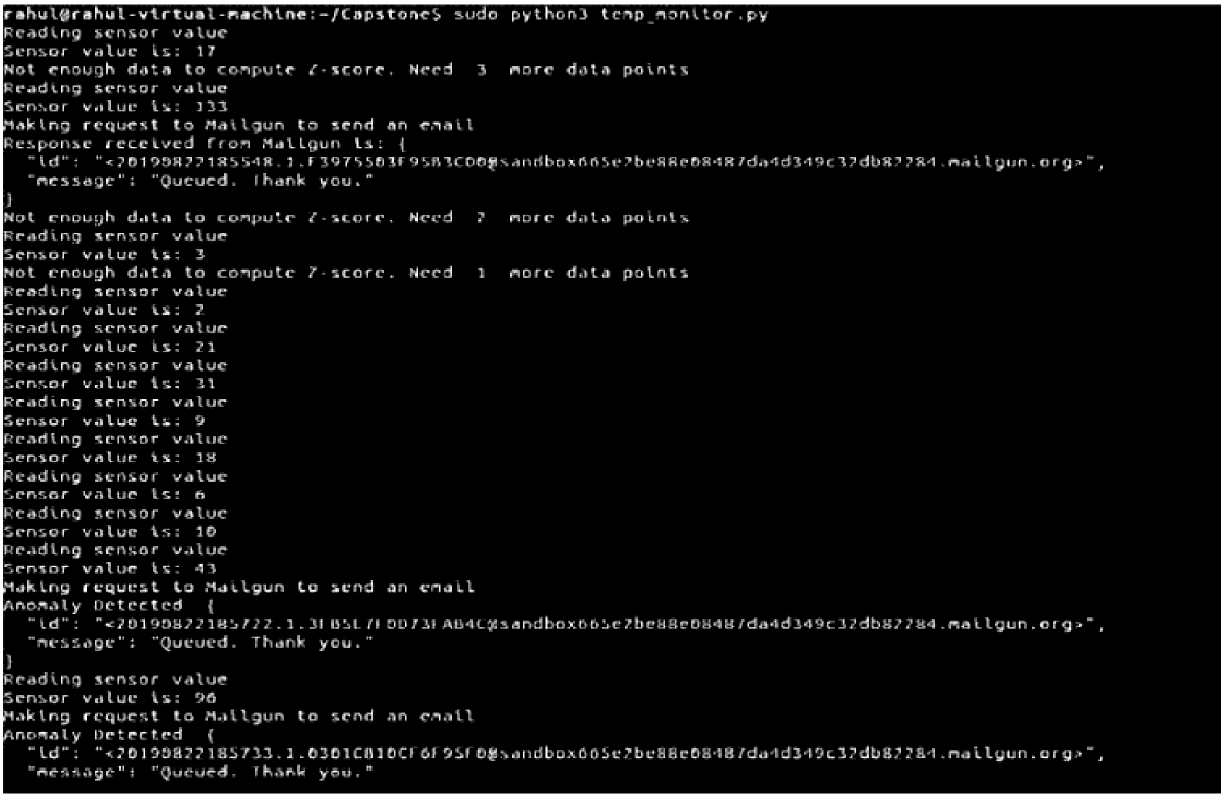
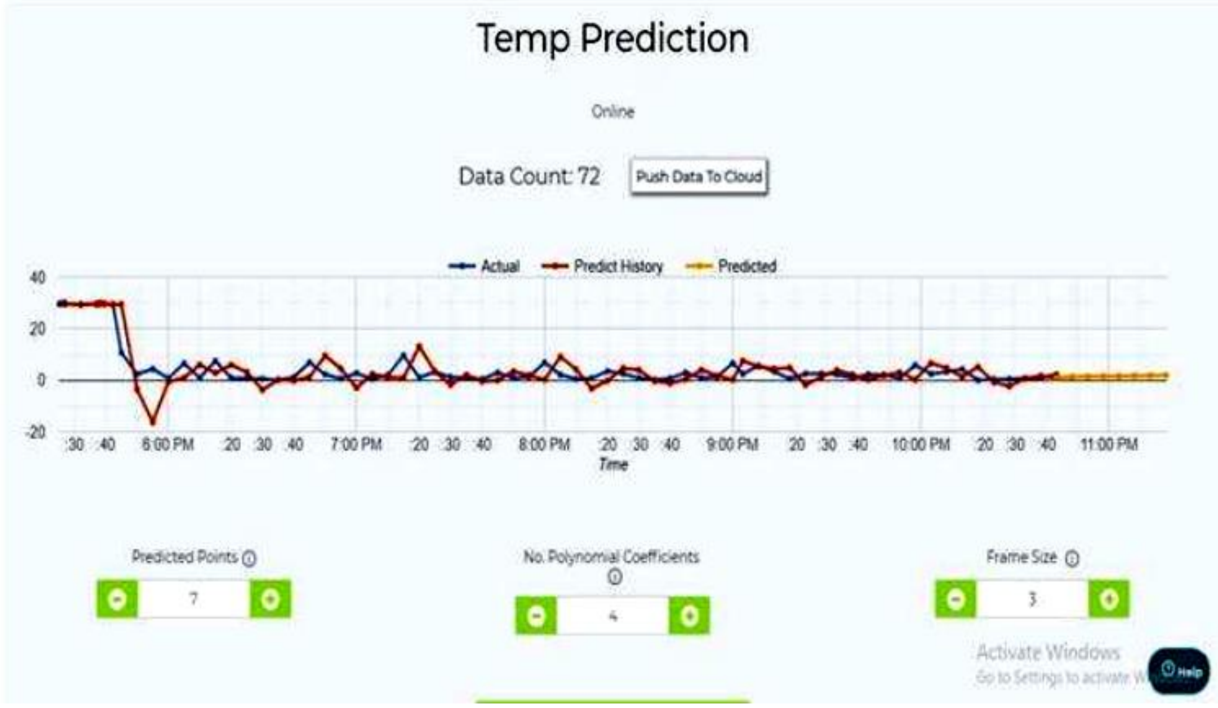
OUTPUT





V. CONCLUSION

An Advanced Irrigation has been proposed so as to automate the irrigation system and reduce the wastage of water in large areas. The system mainly monitors the behavior of soil moisture, air humidity and air temperature and see how it contributes to evaluate the needs of water in a plant. The system uses machine learning to compare real values obtained from sensors with a test value that has been fed to the machine learning for analysis. The result decides whether irrigation needs to be done or not. The farmer receives an alert on his mobile through which he can choose to turn on the water pump or to turn off. As the future is all about finding alternative ways for different tasks, thus the advanced irrigation system provides ways for getting the desirable results and future predictions. Also while doing this, the paper gives the opportunity to explore the full automation and control of the irrigation system employed and hence offering the option to control the flow of pump. Thereby achieving advanced control functions.

VI. REFERENCES

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