IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

IOT BASED SMART AGRICULTURE AND WEATHER FORECASTING SYSTEM

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Abstract : In India, agriculture is the most essential occupation for most Indian families. Water is the most important resource for agriculture. Irrigation is a water supply method, but a lot of water can be wasted. In this regard, we proposed a project called IoT-based intelligent agriculture and weather forecasting system to save water and time. The proposed system uses various sensors such as temperature, humidity and soil moisture sensors to detect different parameters of the soil and automatically irrigate the land by turning the motor on and off based on the soil moisture value. Will be done. These collected parameters and engine status are displayed in the user's Android application. Weather forecasts are attempts by meteorologists to predict weather conditions that are expected to be meteorological conditions at a later date. Based on data analysis humidity, temperature and precipitation can be considered as some of the climatic parameters. In this project, only the temperature and humidity is considered in the experimental analysis. DHT11 sensor which is a temperature/humidity sensor is used to collect data for the same. The temperature and humidity analysis of a particular region can be done by this sensor.

Index Terms - **Data Analysis, Arduino UNO, Temperature Sensor, Soil Moisture Level, Weather analysis.**

I. INTRODUCTION:

In India, agriculture is a vital occupation for most of the population which allows it to play a significant role in the Indian economy. IoT is changing the graphs for the agriculture domain and encouraging farmers to help fight their problems that they face during farming. New innovatory IoT applications help the farmer reduce these issues and increase the standard and value effectiveness of agricultural production. Internet of Things (IoT) could be a technology where a mobile device is accustomed to monitor the function of a sensor. The communicating objects that are installed at different regions which are distant from each other are interconnected with the help of IoT. With the help of Internet of Things (IoT) the sensors can sense data from various sensors and attach it to the internet to exchange information. It can be used to upgrade the status of the device. This can be done employing a higher communication device like a Wi-Fi module or NodeMCU. Once the info is processed by the central module it is converted to meaningful data and passed on to the user. Hand-held devices such as mobile, tablet can be used to view the information. These days water scarcity may be a major issue for farming. Through this automated irrigation system farmers can irrigate their farm in a well organised manner. The unnecessary water flow into the agricultural land can be avoided by using this proposed system. Temperature, moisture and humidity readings are continuously monitored by using respective sensors and sending the values to the cloud server. An android application continuously collects the information from the assigned cloud server channel. When the soil moisture value exceeds the assigned value then the relay, which is connected to the arduino, gets command from the controller to turn ON the motor. There can be 6 possible options in the android application that includes the status of the water pump, moisture level, temperature/humidity as well as rain intensity and air quality. We can discover meaningful information, making predictions and higher cognitive processes with the help of data analysis. Analysing the information involves cleaning, transforming and building data models for the available dataset. So time-series data i.e. the continual weather data of a specific region to predict the longer term atmospheric condition for the information analysis to predict the further atmospheric condition. Real time data of temperature-humidity can be collected using the DHT11 sensor which is interfaced with the Arduino UNO.

II. LITERATURE SURVEY:

[I] IOT based agriculture systems can be very user friendly for farmers. Poor irrigation isn't good for agriculture. The threshold values for atmospheric conditions like humidity, temperature, moisture are often fixed for a specific region. The system also senses the invasion of rodents which may be a primary reason for reduction in crop yields. This method helps to set up irrigation schedules supporting the sensed real time data from the sphere and data from the weather repository. This method recommends and informs the farmers about the necessity of irrigation. Continuous need of internet connectivity will be overcome by sending suggestions via SMS to the farmer directly on his mobile employing a GSM module rather than a mobile application.

[II] For observing and controlling the systems farmers are improving their yields with the help of automation assistance using parameters such as Temperature, humidity and soil moisture. An embedded system is used to control irrigation automatically in the present system. A wireless sensor network (WNS) is used in this project for real time sensing of an irrigation system. This avoids wastage of water and provides an equivalent level of water into the farm. When the level of moisture of soil reaches below a threshold value the motor is turned on and turned-off while the level of is at normal. This is because the motor is programmed in such a way. The user gets the information displayed on his android application and can also know the current status of the motor. The main aim of this project is to produce an automatic irrigation system which consumes time, capital & power of the agronomist. Human intervention is required in the traditional techniques. Minimum human intervention is required in this automated system.

[III] R is used to analyse the stacked-up real time data. Devices other than Arduino and Raspberry Pi are used to collect the data. With the help of ARIMA model using R studio, the values are predicted. The system is programmed such that it can take a dataset of values starting from June, or it can be programmed as per the users requirement. The prediction of future weather values is done accurately by considering the primary two successive years. To find which model is acceptable for predicting the weather parameters, two or more datasets are considered and the identical datasets are cast-off, hence the most reliable model is considered. Furthermore the real-time parameters can also be considered.

III. LITERATURE SUMMARY:

From the above literature survey it can be summarised that it is possible to design a system which is useful in observing the field data as well as controlling the field operations thus, providing the flexibility. The plan is to create a system using Far-reaching sensors that screens different environmental parameters like temperature-humidity, invasion of rodents, moisture level of soil, and so on. There are various drawbacks in existing systems, some of them are -

- Waterlogging is a major issue due to the lack of a proper water control system.
- No constant monitoring over lurking animals which can damage the crops.

IV. METHODOLOGY

Our project is basically divided into two parts: Smart Agriculture System and Weather Forecasting.

- Smart Agriculture: We are using Soil Moisture Sensor to check the moisture level which detects the changes in the moisture level and accordingly the readings will be shown on the thingspeak server. The readings detected by the soil moisture sensor are also displayed on the mobile application and notifies the user. The user can then control the water sprinklers through the app by turning the sprinklers ON or OFF. We are using a PIR motion sensor to detect movement of lurking animals and birds that may harm the crops in the absence of the owner. If a movement is detected, the buzzer will alert the

user and also it may intimidate the animals. The buzzer system may also be useful in the yielding season as there is a fear of theft.

- Weather forecasting: The weather forecasting will help the user to protect the crop during sudden climate changes. We are using Temperature and Humidity Sensor, Rainfall Sensor, Air Quality Sensor and Barometric Sensor. The reading of these sensors will be shown on the mobile application and will help alert the user.

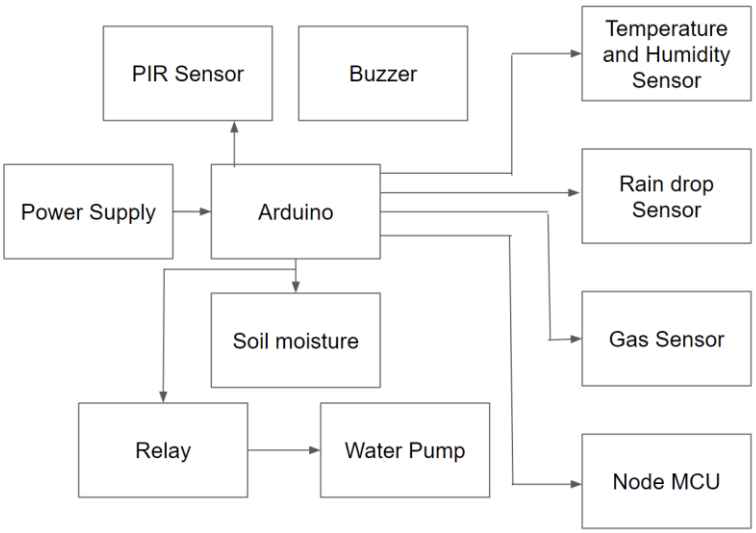

Fig. 1 : working of system

V. COMPONENTS

[A] ARDUINO: Arduino UNO is an ATmega328P based microcontroller board. This board consists of 14 digital pins which operate as i/o pins, 6 of these pins can be used as PWM outputs, other 6 pins work as analog i/p. It also consists of a 16 MHz Ceramic Resonator which produces clock signals which controls timer in a computer, an ICSP header which allows the user to reprogram the embedded controller, a USB connection which is used to connect the board and pc to program it, a power jack which allows external power supply to be connected via an adaptor and a reset button which will reset the arduino. An Arduino board contains everything that supports the microcontrollers; simply connect it to a computer with a power or USB cable with an AC-DC battery to kick start. In Italian "UNO" means one and was chosen to mark the release of Software (IDE) 1.0 i.e. Arduino Software. Arduino refers to the UNO board and the 1.0 version of software(IDE). USB Arduino UNO had a UNO board in their first series and Arduino platform was the reference for an extensive list of past, current or outdated boards.

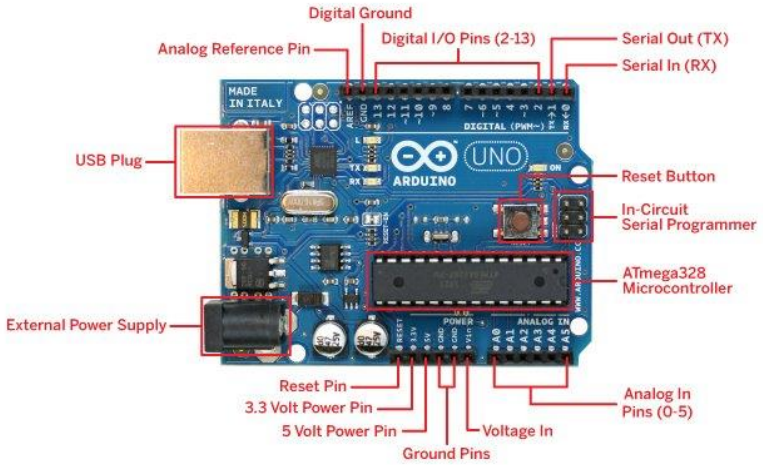

Fig 2. Pin Diagram of Arduino UNO

[B] NODE MCU: NODE MCU is an non-proprietary electronic platform supporting user-friendly hardware and software. In this project Arduino is employed to display the message on the LCD per the code written within the Arduino software. Whenever the sensor reads the data it sends it to the microcontroller which further sends readings to the nodemcu via which real time data can be sent to the cloud server.

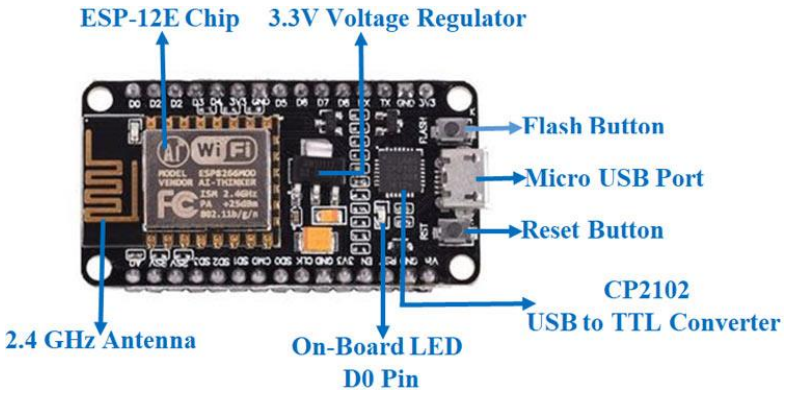

Fig. 3 Pin diagram of Node MCU

[C] MQ-5 GAS DETECTOR MQ-5 Gas Sensor is an air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and CO2.

[D] SOIL MOISTURE SENSOR This sensor measures the moisture content of the soil and can estimate the amount of water stored in the soil horizon. These sensors do not measure water in the soil directly.

[E] RAINDROP SENSOR This is a digital sensor used for detection of rain intensity. It is made up of two modules: firstly, a rain sensing board which detects the rain and the secondly a control module, that compares the analog value, and converts into digital value. These sensors are used in the automobile to control the windshield wipers automatically, in the agriculture field to sense rain.

[F] PIR SENSOR PIR sensor also known as passive infrared sensor. It is an electronic sensor which detects the presence of objects in its field of view using (IR) infrared light radiating from objects in its field of view. These are most commonly used in PIR-based motion detection applications. These PIR sensors are widely used in security systems, automated lighting systems and many other such applications.

[G] DHT11 SENSOR This sensor is an inexpensive digital sensor used for detecting the humidity and temperature of a particular area. The DHT11 sensor is easy to interface with many microcontrollers such as: Arduino, Raspberry Pi, etc. to measure humidity and temperature continuously. A DHT11 humidity and temperature sensor is available as both a module as well as just a sensor.

[H] BUZZER The buzzer is an audio device, which can either be mechanical or electromechanical. Most common applications of buzzers include alarm, timers, and audio outputs for user input like a mouse click or keystroke

VI. HARDWARE DESIGN

The proposed design of IoT based Smart Agriculture and Weather Forecasting System is basically divided into two parts.The first half of the proposed design includes Smart Agricultural System which is designed with new IoT technologies. The second half is a weather forecasting system which helps in analysis of data which is collected by various sensors. For the Smart Agriculture system we have used components like Soil Moisture , PIR, Buzzer, Relay, Water Pump. The Soil Moisture sensor is interfaced with the arduino in such a way that when the moisture level is greater than 10% (i.e the soil is dried) these readings are sent back to the arduino which further instructs the relay to turn on the motor. Similarly, when the moisture level is less than or equal to 10% this will indicate to us that moisture in the soil is sufficient and the motor remains off. We are using a PIR sensor which will detect the motion of lurking animals. Also, this sensor will to an extent help us in preventing the crops from thefts during the yielding season.When the motion is detected the readings are sent to the arduino which will command the buzzer. The next half of the project is based on a Weather forecasting system.We are using DHT11(Temperature and Humidity Sensor), Raindrop Sensor, MQ-5 (Gas Sensor). DHT11 helps in sensing the temperature and humidity of the environment. Raindrop Sensor detects the rain intensity and the Mq-5 gas sensor helps in detecting any pollutants or harmful gases in the surrounding air.

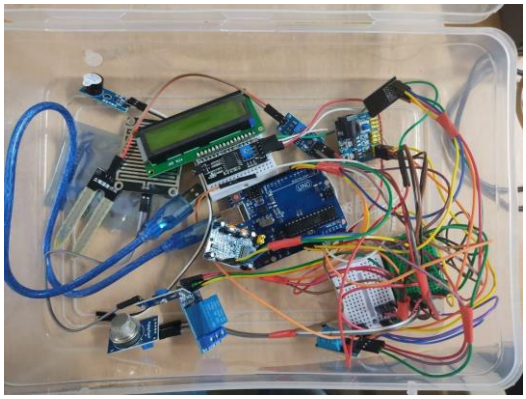

Fig. 4 Initial Set-up

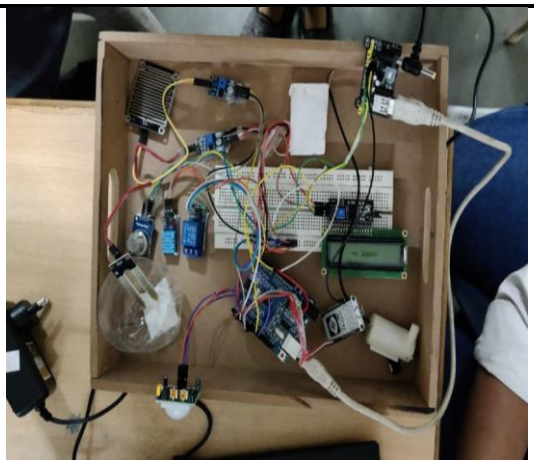

Fig. 5 Final Set-up

VII. SOFTWARE DESIGN

Arduino IDE (Integrated Development Environment) is a platform (for Windows, macOS, Linux) where functions can be written in C and C++. This Software helps to compile and upload programs to all arduino compatible boards, as well as, with the help of third-party extensions, other development boards. We are using arduino IDE version 1.8.19 at the back end of our project to write functions and commands to the microcontroller and sensors.ThingSpeak is Ruby-based open source software that helps the users to connect with Net-enabled devices. It facilitates data access, retrieval and login by providing an API for both social networking devices and websites. ThingSpeak has integrated support from the MATLAB computer software MathWorks, which permits users to analyse/visualise downloaded data in different formats (eg: JASON, XLSM). We are using this server to store and display the real-time data which is collected from various sensors used in the project. Virtuino is an HMI platform for IoT platforms, Arduino, ESP8266, ESP32 and similar boards, MQTT brokers, PLCs and Modbus communications. Virtuino permits the user to create amazing and interactive links for projects using a variety of widgets. We have created an application that will collect real-time data on the thingspeak server using a specific literacy key.

VIII. RESULTS

[A] ThingSpeak Server : The data related to all the sensors is uploaded on the thingspeak server by specifying the write API key of the specific channel-IoT based Smart Agriculture and Weather Forecasting.
The Channel shows the details such as the days for which the channel has been working since, the last entry made on the channel, total number of entries made on the channel. We have fields from 1 to 6 labelled as humidity, temperature, moisture, motion detector , rain respectively. It shows previous entries along with real time entries which are being made. We have used widgets which show numeric values corresponding to the graphical representation. We have also used a lamp indicator which turns red whenever motion is detected.

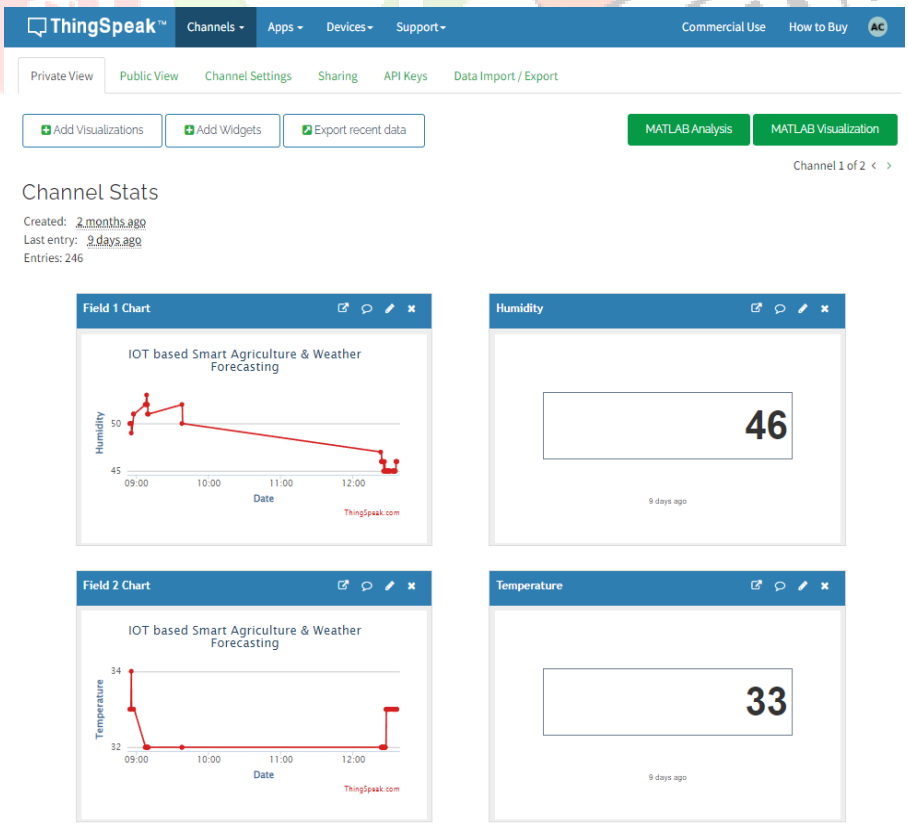

Fig. 6 Result displayed on the channel

Fig. 7 Result displayed on the channel

[B] Virtuino App : We have created an app which will collect real-time data from the thingspeak server using the read and write key of the specific channel.

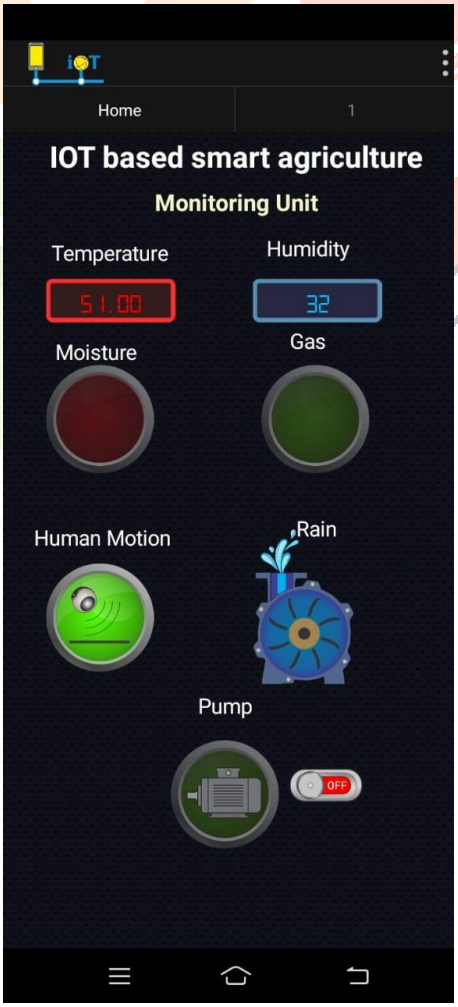

Fig 8. App display page

IX. CONCLUSION

We are in the process of developing market based system which will help in an automation of irrigation system by analysing the moisture content of the ground as well as constantly monitoring the weather .The smart irrigation system will prove to be an useful system as it automates and regulates the irrigation without any manual intervention and prevents overflooding of soil. The primary applications of this project are for farmers, greenhouses and gardeners who want to precisely control the water level in soil. Several types of sensors are deployed here each for a different purpose to sense the parameters considered. The sensors cover a variety of parameters and these sensors will send alerts to the microcontroller which in turn alerts the admin through the mobile application installed on his device through Wi-Fi connection.The power efficiency and cloud database management are also taken into consideration . Our further work on this system will depend on the client requirements which will help in developing the system in a matured state.

X. FUTURE SCOPE

Further the project can be modified as per client requirements and can be upscaled accordingly and depending on the size of field the number of sensors can be multiplied and upgraded for accurate readings all over the field. The system can also be transferred on to a GSM based stand alone embedded system which can monitor and control such sensors irrespective of distance limitations.

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