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IOT Based Smart Irrigation System

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ABSTRACT: Agriculture keeps the economy of the country running and also contributes it to the GDP. Indian economy is predominantly agricultural economy. There are several issues related to agriculture in India like small and fragmented land holdings, availability of good quality seeds, availability good manures fertilisers and Biocides, Irrigation and lack of mechanism, inadequate knowledge sharing platforms, soil erosion, inadequate storage facility etc. According to the data India comes second after China, but being 2nd largest irrigated country only one-third of the land is irrigated. India being a tropical monsoon country where the rainfall is uncertain and unreliable Irrigation is most important in our country. This paper aims at reducing the lack of mechanism and increasing the irrigation facility by using SMART IRRIGATION SYSTEM USING IOT technology. The objective of the project is to automate the irrigation which will provide requisite amount of water required by monitoring the soil moisture and monitoring the rain and other climatic conditions to minimise the wastage of water. Due to this it will be easier to monitor the irrigation of the crops. This project. will help the farmer to reduce the wastage of resources in any climatic condition and thus will save their time.

KEYWORDS: Node MCU, Agriculture, IoT, Blynk, Automation, pH Sensor, DHT11 Sensor (Temperature and Humidity), Soil Moisture Sensor, Rain Drop Sensor.

I.INTRODUCTION

We should not forget the factor of increasing population. According to the UN projections, world population will rise from 6.8 billion today to 9.1 billion in 2050 that signifies food production has to be raised to feed the population. As the population increases the production of crops should also increase but the this is not happening due to the lack of knowledge in the irrigation system or lack of mechanism. The agricultural land is also not going to increase rather its going to decrease gradually. Due the barrier of the limited land and knowledge efficient farming should be adopted and modernization in agriculture. To tackle with this problem the IoT is the best plausible solution and it will also help to yield more crops to the full potential.

Smart irrigation System is an IoT based project which would be able to automate the irritation process by taking the inputs from the soil moisture sensor and other climatic conditions like raining, temperature and humidity. This project will help to provide water in adequate quantity when the moisture in the soil at the required level.

II.PROBLEMS IN TRADITIONAL FARMING

- **Soil Moisture**

Water is a crucial factor in plant development. That's why irrigation requires a thoughtful approach, because it should be neither excessive nor insufficient. Soil moisture control is an essential condition for high yield of crops. For the plant, water serves as an agent of moisture restoration it also as a temperature regulator. In the process of thermoregulation, the plant evaporates up to 99% of all water obtained, utilising only 0.2% to 0.5% for the formation of vegetative mass. Therefore, it's easy to know that the plant has different needs for moisture counting on the weather and growth stages.[1] Soil moisture control plays a critical role in optimum crop growth. Accurate monitoring of soil moisture helps us to take control of nutrients and other inputs. In this project we have used a soil moisture sensor of monitoring the soil moisture data. soil sensor enables you to schedule irrigation events more efficiently by either

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increasing or decreasing their frequency and/or intensity, to not wash valuable nutrients or, on the contrary, leave the plants thirsty. A remote soil moisture sensor empowers agriculturalists to estimate the water levels without the necessity to be physically present within the field.

- **pH Value**

Soil pH is a measure of alkalinity (acidity or basicity) of a soil. Soil pH can be defined as the negative logarithm of the hydrogen ion concentration. The pH scale ranges from 0 to 14.

Denomination	pH range
Ultra-acidic	< 3.5
Extremely acidic	3.5–4.4
Very strongly acidic	4.5–5.0
Strongly acidic	5.1–5.5
Moderately acidic	5.6–6.0
Slightly acidic	6.1–6.5
Neutral	6.6–7.3
Slightly alkaline	7.4–7.8
Moderately alkaline	7.9–8.4
Strongly alkaline	8.5–9.0
Very strongly alkaline	> 9.0

Table 1 – Classification of Soil pH Range[2]

When the amount of hydrogen ions in the soil increases the soil pH decreases so it is becoming more acidic in nature. From pH 7 to 0 the soil is increasingly becoming more acidic in nature and from pH 7 to 14 the soil is increasingly becoming more alkaline or basic in nature. Factors affecting the soil pH include the climate, mineral content and soil texture. The intensity of bleaching and weathering of soil minerals is mainly caused due to rainfall and temperature. The soil pH decreases over time through acidification due to leaching from high amounts of rainfall in humid and warm environments. Whereas in the dry environment where leaching and weathering is less, we find soil pH to be neutral or alkaline. Soil pH is affected by over and over use of the land. It is also affected by the vegetation on the soil for example forest land are acidic than grasslands.

Measures to reduce acidification-

1. Using proper irrigation management to minimise leaching of nitrate nitrogen and using nitrogen fertiliser in appropriate amount.
2. Applying sulphur according to needs of the crop.
3. Liming to raise the pH between 6.5 to 7.0, of an acidic soil by nature.
4. Applying manual and other organic material in appropriate amounts which are rich in calcium or magnesium.
5. Crop rotation system to minimise acidifying effects.
6. Applying small amount of phosphorus fertiliser rather than large amount at once, with a certain interval of time.[3]

Crop	Soil pH				
	4.7	5	5.7	6.8	7.5
	Relative yield (100 is best; 0 is worst)				
Corn	34	73	83	100	85
Wheat	68	78	89	100	99
Soybeans	65	79	80	100	93
Oats	77	93	99	98	100
Barley	0	23	80	95	100
Alfalfa	2	9	42	100	100
Timothy (grass)	31	47	66	100	95

Table 2- Crop yield relative to pH[4]

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III. SYSTEM ARCHITECTURE

The design of Smart irrigation system includes various components such as NodeMCU ESP8266, Soil Moisture Sensor, Rain Sensor, pH sensor, Temperature-Humidity Sensor(DHT 11), Relay Module, Blynk Cloud and Submersible Pump. It allows the user to automate the irrigation process based on moisture level and climatic condition such as rain. The system consists of a submersible pump which is used to pump water depending upon the environmental condition such as Moisture content in the soil and rain. The pump is connected to the NodeMCU, but as the Node MCU cannot give output voltage greater than 3.3V from its GPIO so we are using a relay module to drive 5V motor pump.All the three sensors i.e., pH sensor, rain sensor, soil moisture sensor and temperature-humidity(DHT 11) sensor are connected to the NodeMCU ESP8266.

The wi-fi key in the NodeMCU makes it possible to link it with Blynk Module which shows the user the data collected from all the sensors consolidated in a graphical way.

- **System Architecture Flowchart**

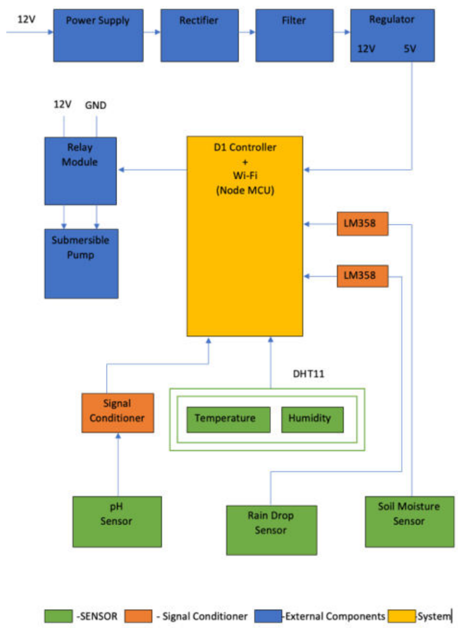

Fig. 1 System Architecture Flowchart

- **Working**

In this setup, four sensors are deployed to collect data from the field/farm. This data is sent to NodeMCU which then further carry outs the commands written in the code. The NodeMCU is powered by a 12V regulated supply. It carries out different functions depending upon the land environmental conditions. Different crops require different soil moisture, temperature-humidity conditions. So we are considering a crop which will require a soil moisture of about 50-55%. So when the soil loses its moisture to less than 50% then Motor pump will turn on automatically to pump the water and it will continue to until the moisture in the water goes up to 55% and after that the pump will be turned off. The sensor data will be sent to Blynk Server in defined interval of time so that it can be monitored from anywhere in the world. All the data is then consolidated in the Blynk App in a graphical manner for better analysis. Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersted. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.

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- **Main Components**

In this project we have used the following components-

1. Soil Moisture Sensor-The soil moisture sensor module is used to detect the moisture of the soil. It measures the volumetric content of water inside the soil and gives us the moisture level as output. The module has both digital and analog outputs and a potentiometer to adjust the threshold level.[5]
2. Rain Drop Sensor – Bakelite or Mica board with Nickel coating in the form lines is being use as Raindrop sensor predominantly. Basic principal of raindrop sensor is on resistance which is allows to measure moisture through analog output pins and provide digital output when threshold moisture levels reached more than desired limits. It consist of electronics module and printed circuit board that collects the rain drops. As rain drops collected on the circuit board, they create paths of parallel resistance that are measured via op amp. This resistance is inversely proportional to amount of water collected. More the water on surface means better conductivity and will result in a lower resistance. Less water on the surface means poor conductivity and will result in a higher resistance because water is a conductor of electricity and presence of water connects nickel lines in parallel so reduces resistance and reduces voltage drop across it.
3. DHT11 (Temperature and Humidity) Sensor- The DHT11 is the most commonly used Temperature and humidity sensor. The sensor is equipped with a NTC to measure temperature. The sensor is already factory calibrated and hence easy to interface with other microcontrollers. The sensor is able to measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%.[6]
4. pH Sensor- Soil content and quality are the major factors for crop yield. Water infiltration and retention affects the density and its soil material. Nutrient availability is affected by the pH of the soil chemically. Some soil characteristics are permanent qualities of a soil, and therefore part of soil selection criteria and optimisation. If we have to improve the soil health, we should start the process of measuring the pH of the soil.
5. Blynk- Blynk is a platform developed for Internet of things. Blynk helps us to control the hardware remotely, it will we able to display the sensor data and also store it and also it is able to represent the data in the graphical format.
    - Blynk App- In this you are able to interface your projects. Along with that you are to assign the pin numbers.
    - Blynk Server- Blynk server is mainly used for the communication between the hardware and the smartphone.
    - Blynk libraries- It helps us to enable communication with the server and process all incoming and outgoing commands between the all the popular hardware platforms.

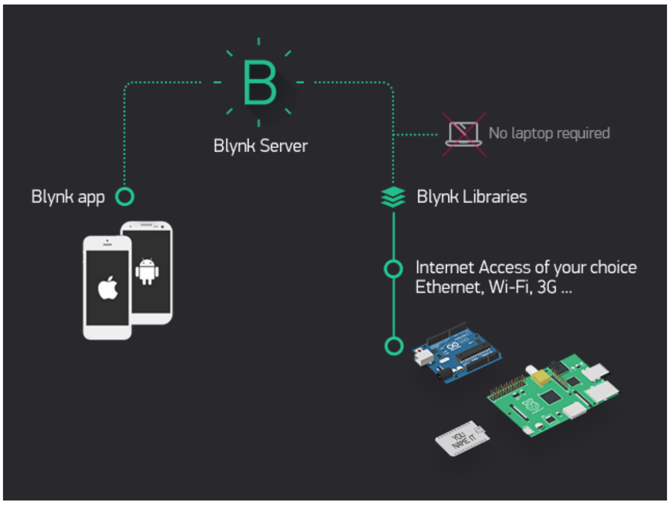

Fig. 2-System architecture for Blynk

IV. RESULT

In Fig. 3, we can see the graphical representation of the real-time data acquired from the field. As seen in the figure we can see the real-time temperature and humidity in the gauge and also its graphically represented below. In the LCD Screen we can see the denoted pH level of the soil sample and the soil moisture is low, as the soil moisture is low the submergible pump will start pumping the water into the fields until the desired moisture is achieved.

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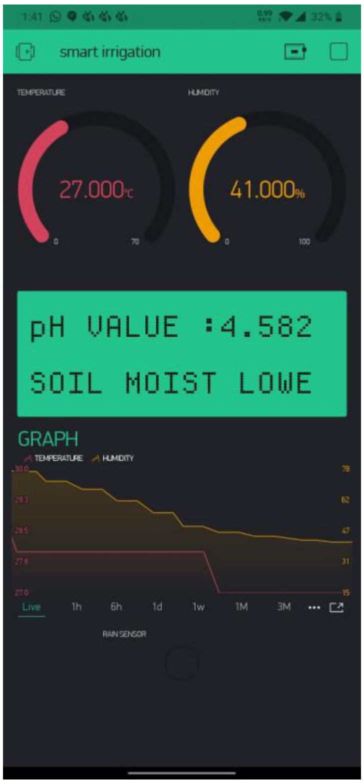

Fig. 3 Graphical Representation of the data

In Fig. 4, we can see that the LED is switched on as soon as it starts raining outside and it is also displays Raining outside on the LCD screen.

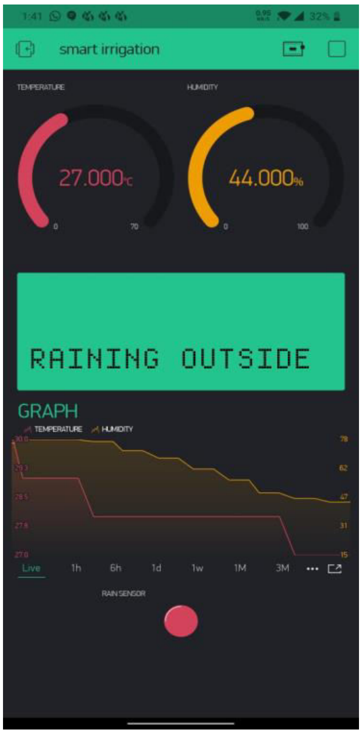

Fig. 4 Rain Sensor activate

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V. CONCLUSION

So, in this project we were able to achieve the desired goal. So once the soil moisture sensor module is inserted in the soil, we were able to determine if the moisture in the soil is low or high. If the soil moisture is low the submersible pump would start pumping the water into the fields until the desired moisture level is achieved when this happens the system would shut down automatically. Even if there is a power shortage the system would shut down at that instant and when the electricity supply is back to normal, the system would reboot and would start the process of taking the data soil moisture sensor and the process would continue. When its starts raining the rain drop sensor will sense it and the system will stop the process, once after the rain stops if the moisture content is not yet achieved the system will resume and shut down on its own when the we complete the process. Along with the moisture the project is equipped with pH sensor which tell the pH value once dipped in the soil sample. Once we get the pH value if the soil is acidic in nature, we can decide what type of fertilizer is to be added in the soil to make it more fertile in nature.

VI. FUTURE SCOPE

This project can be further made more innovative by adding Artificial Intelligence to the current hardware, it would be able to predict the climatic conditions and the actions done by the user. Also, this intelligent system will help to understand the faults and correct them, as in the system would give them suggestions. The current system works on the Wi-Fi system but it could be further modified by using the GSM module. GSM module uses sim card for the communication between the hardware and the cloud. If the system is used by a complete village, it would be easier to understand the topographical conditions. If the whole village uses the system, it would be easier to understand the soil quality overall the area and plan the vegetation to be cultivated. Thereby, this project would be very useful in the development in agriculture field.

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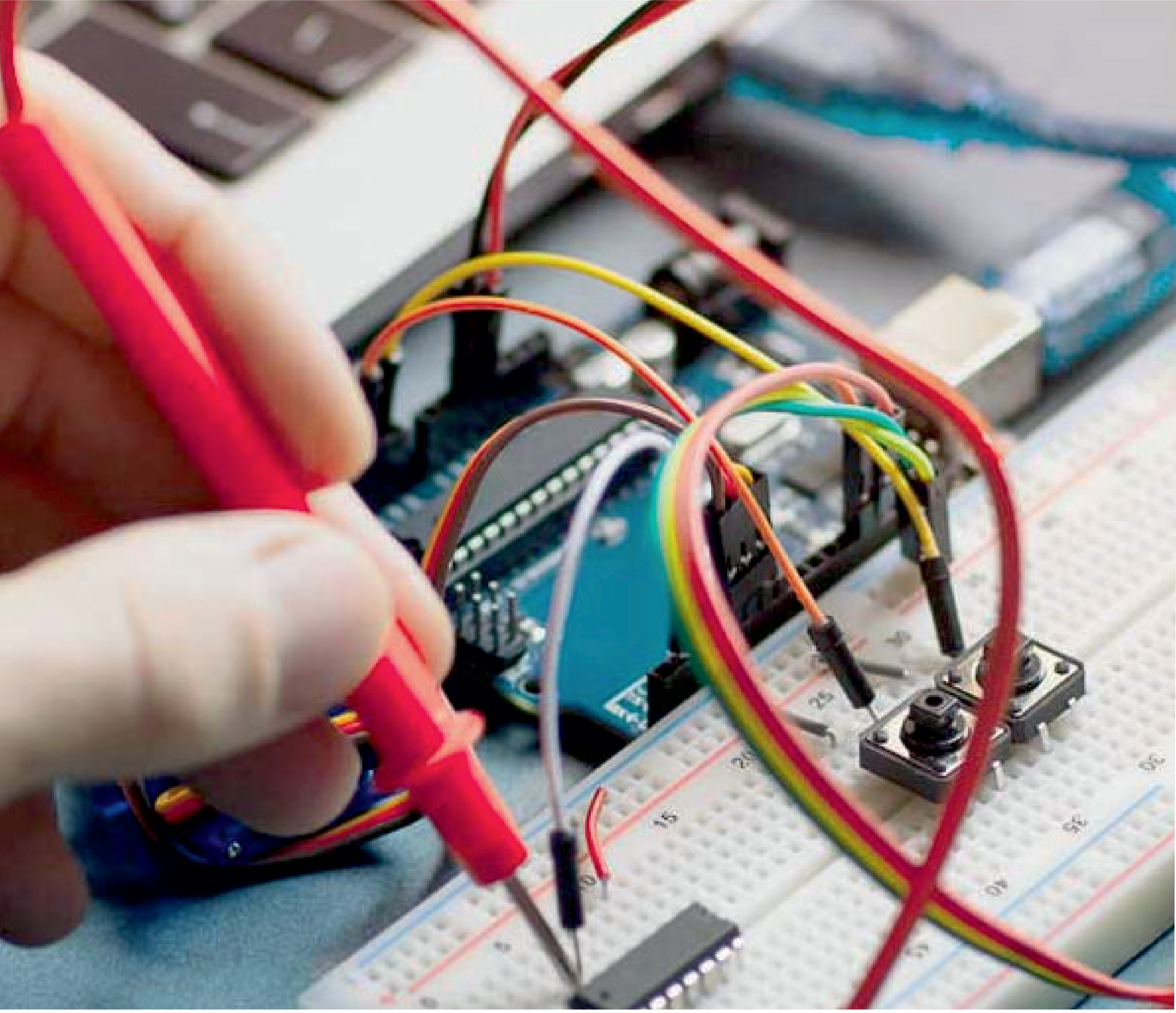

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