

Build a Smart, Automated IOT Plant Irrigation System with Raspberry Pi and Pub Nub

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ABSTRACT

Agriculture remains the sector which contributes the highest to India's GDP. But, when considering technology that is deployed in this field, we find that the development is not tremendous. Now a day's there is huge enhancement in technologies which have a significant impact on various fields like agriculture, healthcare etc. Agriculture is the primary occupation in our country. India's major income source is depending on agriculture therefore the development of agriculture is important. In today also most of the irrigation system are operated manually. The available traditional techniques are like drip irrigation, sprinkler irrigation etc. These techniques are need to be combined with IoT so that we can make use of water vary efficiently. IoT helps to access information and make major decision making process by getting different values from sensors like soil moisture, water level sensors, water quality etc. This paper focuses primarily on reducing the wastage of water and minimizing the manual labor on field for irrigation so that you can saving time, cash and power of the farmer.

Keyword : - *Water Management, Agriculture, Irrigation, Water quality, IoT, Raspberrypi*

1.INTRODUCTION

One of the key activity smart farming is skills and times. Farmers should know at which time which plant will grow better. Cultivation takes huge amount of time and also money from farmer. So reducing the effort of the farmers is heavy task. It need various resource in large scale. To use modern technologies for farming is reduce human efforts as well as the time require to watering a farm or garden. If we compare traditional system with modern system, wastage of various resources is very high for example water is the important resource for cultivation.

In India, Agriculture is a major part of the GDP of the country. Most of people are doing farming in India. The agriculture field is involves in many industries in India. Let's say to make raw material for clothes we need cotton. So to get a cotton, people need to contact farmer or company that collect cotton from farmers. This is only one example there is many example like this. So basically agriculture is a backbone of the country. To growth of industries depends on the various fields. To make a vast amount of production in agriculture field farmer should know many things like moisture of soil, humidity, temperature, rain fall, etc. To make a cultivation smart we will make a fusion of traditional farming and modern technologies.

Using IoT, we can make communication between devices, machine and also services which based on internet. IoT is also help human to do work very easily. If we have look on policy of Internet of Things of Indian government, they have plan to invest 15 billion up to 2020 in Internet of Things. It is also state that it will help also other industries

like agriculture, banking, retail business, auto mobile, and more by making system automated which are used in it. This will help to increase IoT devices to 2.7 billion. Currently there are 200 million devices which are connected to internet in India. It is assume that India will have share 5-7 % in Global market of internet of things. In agriculture there are more laborer work is there so using automation we can save laborer work and also reduce the size of human resources in cultivation. It is also improve quality and accuracy, saves lots of energy, material. To make this happen researcher and scientist collaborate with large industries and trying to make automatic system which is very efficient and effective. Using automation machine like fan, fridge, AC, lights can be run automatically i.e. depends on environment. It is makes a great use of available resources, like in home it saves electricity and in agriculture it saves water.

1.1 Problem Statement:

In India, agriculture is the need of most of the Indians livelihood and it is one of the main sources of livelihood. Agriculture also has a major impact on economy of the country. The consumption of water increases day by day that may leads to the problem of water scarcity. Now a days not only for crops outdoor plants in home becoming quite difficult for them. Irregular watering prompts mineral defeciency in the soil resulting in rotting of plants. The exact time at which plant needs to be watered can be monitored using soil moisture sensor leading to save water wastage.

A. Conventional Irrigation Methods

The conventional irrigation methods like overhead sprinklers, flood type feeding systems usually wet the lower leaves and stem of the plants. The entire soil surfaces saturated and often stays wet long after irrigation is completed. Such condition promotes infections by leaf mold fungi. On the contrary the drip or trickle irrigation is a type of modern irrigation technique that slowly applies small amounts of water to part of plant root zone.

Water is supplied frequently, often daily to maintain favourable soil moisture condition and prevent moisture stress in the plant with proper use of water resources. Drip irrigation saves water because only the plant's root zone receives moisture. Little water is lost to deep percolation if the proper amount is applied. Drip irrigation is popular because it can increase yields and decrease both water requirements and labour.

Drip irrigation requires about half of the water needed by sprinkler or surface irrigation. Lower operating pressures and flow rates result in reduced energy costs. A higher degree of water control is attainable. Plants can be supplied with more precise amounts of water. Disease and insect damage is reduced because plant foliage stays dry. Operating cost is usually reduced. Federations may continue during the irrigation process because rows between plants remain dry.

B. Problems in Traditional System

In the case of traditional irrigation system irrigation is done manually by farmers. Since, the water is irrigated directly in the land, plants under go high stress from variation in soil moisture, therefore plant appearance is reduced. The absence of automatic controlling of the system result in improper water control system. The major reason for these limitations is the growth of population which is increasing at a faster rate. At present there is emerging global water crisis where managing scarcity of water has become a serious job. This growth can be seen in countries which have shortage of water resources and are economically poor. So this is the serious problem in Traditional Irrigation System.

Limitations of existing system:

- Physical work of farmer to control drip irrigation
- Wastage of water
- Wastage of time
- As water sits in irrigation channels malarial mosquitoes can breed.

C. Smart Irrigation System

Smart irrigation systems offer a variety of advantages over traditional irrigation systems. Smart irrigation systems can optimize water levels based on things such as soil moisture and weather predictions. This is done with wireless moisture sensors that communicate with the smart irrigation controls and help inform the system whether or not the landscape is in need of water. Additionally, the smart irrigation controlled receives local weather data that can help it determine when a landscape should be watered.

The Smart Irrigation System is an IoT based device which is capable of automating the irrigation process by analysing the moisture of soil and the climate condition (like raining). Also the data of sensors will be displayed in graphical form on BOLT cloud page.

The advantages of these smart irrigation systems are wide reaching. The smart irrigation system will help you have better control of your landscape and irrigation needs as well as peace of mind that the smart system can make decisions independently if you are away.

You will save a significant amount of money on your water bills because through intelligent control and automation, your smart irrigation system will optimize resources so that everything gets what it needs without needless waste. Additionally, we have all seen many places in the country that have experienced droughts and we know that our water resources are precious. With smart irrigation systems we can be better stewards of our resources which is better for the environment.

The opportunity to save dramatically, have better control and be more eco-friendly while maintaining a lush and beautiful landscape are just a few of the advantages a smart irrigation system provides and would make a wonderful addition to any home.

Smart Irrigation System uses valves to turn irrigation ON and OFF. These valves may be easily automated by using controllers and solenoids. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labour to turn valves on and off.

2. OBJECTIVE

- The main objective of this project is to provide an automatic irrigation system thereby saving time, money & power of the farmer. The traditional farm-land irrigation techniques require manual intervention. With the automated technology of irrigation the human intervention can be minimized.
- Continuously monitoring the status of soil through sensors and provide signal for taking necessary actions.
- To get the output of the sensors and provide water to crop.
- To observe parameters for better yield.
- To improve and stabilize the crop yields of smallholder olive farmers through the implementation of sustainable irrigation systems. To promote water management practices that optimizes the volume and timing of water distribution.
- To generate positive economic consequences for farmers and their families. Minimize year to year yield fluctuations, leading to higher and more stable farm income.

3. COMPONENT DESCRIPTION

In this system there are many components are used like,

- 3-6V Water Pump
- Silicone Tubing
- 5V Power Supply (Phone Charging Cable will do)
- Raspberry Pi 3
- Temperature/Humidity Sensor
- Soil Moisture Sensor

3.1 Raspberry PI

Raspberry Pi is nothing but a computer and it has ARM processor which is very powerful and light weight. It also has USB ports, Wi-Fi modules (Raspberry Pi 3 Model B), HDMI port and Ethernet Port. Raspberry Pi has its own OS like Raspbian, Ubuntu MATE, Snappy Ubuntu, Pidora, Linutop, SARPi, Arch Linux ARM, Gentoo Linux FreeBSD, Kali Linux, RISC OS Pi [18]

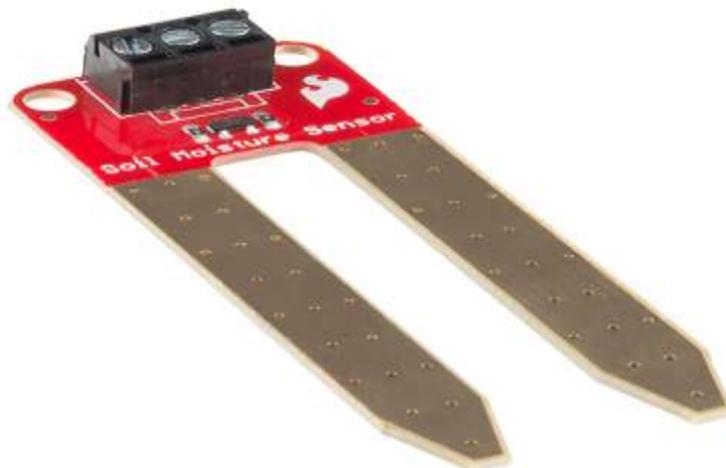


Raspberry Pi

It is like small computer it has multimedia application support. It is because of HDMI and graphics support. But it has also some limitation it doesn't have Hard Disk Drive (HDD) or Solid State Drive (SSD) but we can put Micro SD card in it so we can boot the OS of Raspberry Pi.

3.2 Soil moisture sensor

In IoT (Internet of Things) sensor is important part of the system, without it system cannot be working like heart in human body. Using sensor, it takes physical parameter from world and convert it into electronic system and send it to main controller for ex. Raspberry Pi. One of the sensor which this system used is soil moisture sensor. This sensor is used for measuring level of soil. Output of this sensor can be analog signal or it can be digital signal. It has two copper electrodes which is used for measure moisture from the soil.



Soil Moisture Sensor

To make cultivation better, farmer have to know moisture level of soil and this sensor is doing same things, so soil moisture sensor is important for farming related application. Actually if farmer knows exact moisture level of soil it

will be helpful to saving water and also improve the quality of plant. Because if it take care of plant during its growing stage it will be give good quality product.

3.3. Temperature/ Humidity Sensor

A humidity sensor (or hygrometer) senses, measures and reports both moisture and air temperature. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. Relative humidity becomes an important factor when looking for comfort.

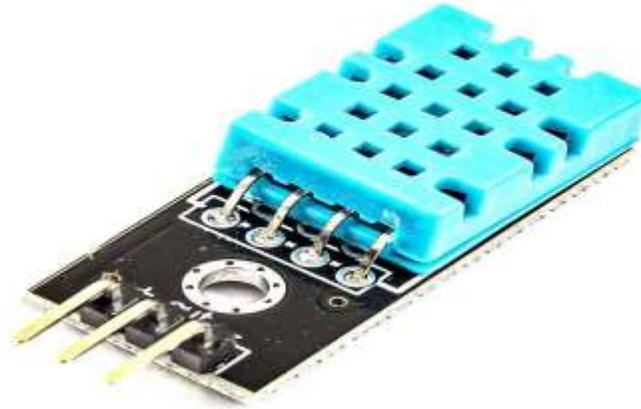


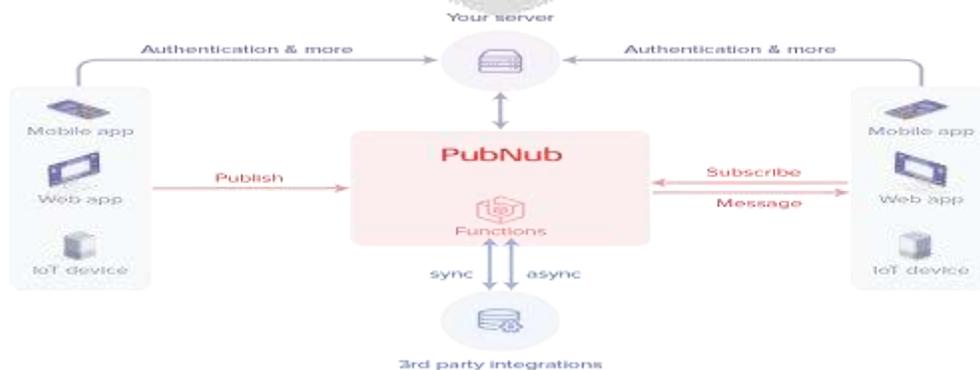
Photo by ElectroPeak

Temperature/Humidity Sensor

Humidity sensors work by detecting changes that alter electrical currents or temperature in the air. A capacitive humidity sensor measures relative humidity by placing a thin strip of metal oxide between two electrodes. The metal oxide's electrical capacity changes with the atmosphere's relative humidity. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones.

3.4.PUB NUB

PubNub takes care of the infrastructure needed for the real-time communication layer of your apps so that you can focus on your application innovation. You benefit from our global scalability, 99.999% uptime SLA, and extensible platform for new real-time use cases and other third-party APIs.



PubNub is optimized for maximum performance and reliability using the best methods and built by an expert engineering team with many years of experience delivering scalable infrastructure products. By using PubNub you leverage our team's expertise and operational skills to successfully provide a highly-available, real-time data stream network for fast and reliable messaging and signaling.

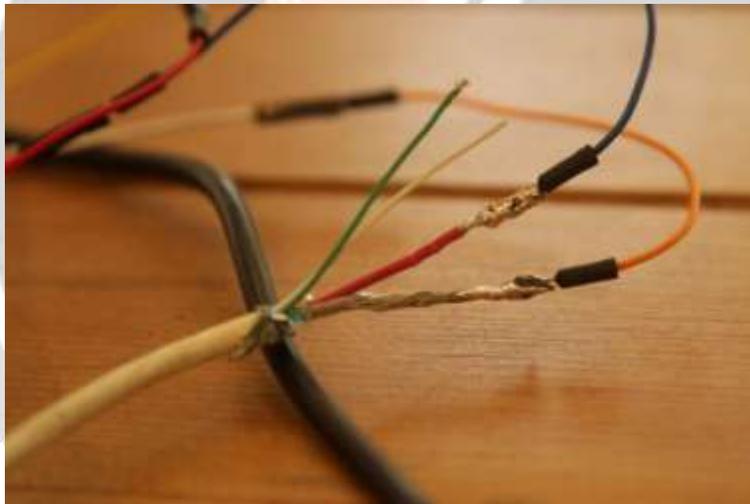
4. WORKING PRINCIPLE

The main working principle behind this system is in connecting the soil moisture sensor, which was previously embedded into the plant, to the Raspberry Pi, which is also connected to other electronic components. Measurement of soil moisture is done by the sensor which forwards the information and parameters regarding the soil moisture to the microcontroller, which controls the pump. If the level of soil moisture drops below a certain value, the microcontroller sends the signal to the relay module which then runs a pump and certain amount of water is delivered to the plant. Once the enough water is delivered, the pump stops doing its work. Power supply has a task to power the complete system and the recommended voltage should respect the input supply range for the microcontroller, that is, from 7V to 12V.

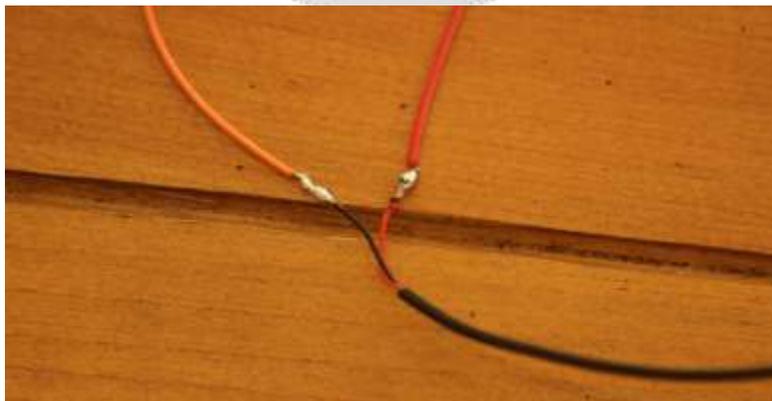
4.1. Wiring

First and foremost, if you don't have a dedicated 5V power supply, you can easily make one out of an old phone charging cable. Simply, snip the head off of the phone adapter and strip about 5 inches of the rubber casing to expose the wires.

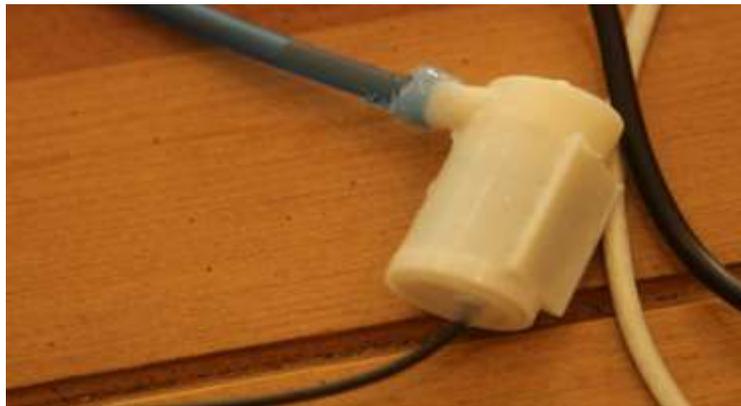
The wires will be flimsy, so soldering some female header wires to the exposed phone cable wires will be a good idea.



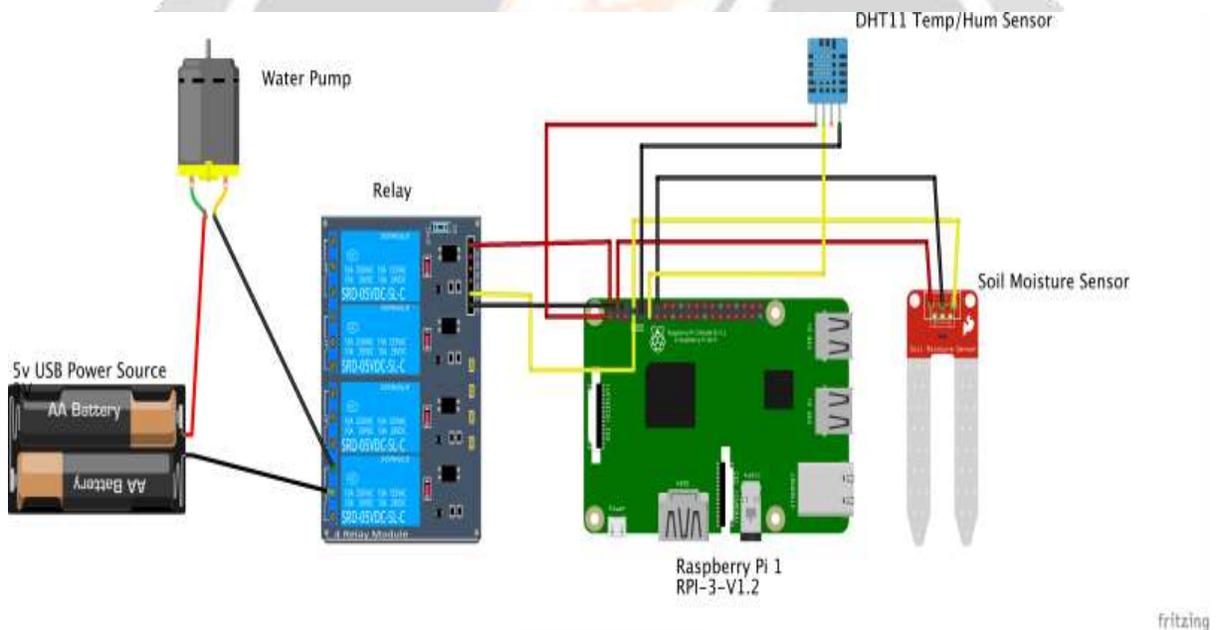
It'd be a good idea to do this for the pump's exposed wires as well.



If you're worried about the silicon tubing not being an air-tight fit on the pump, you can always hot glue around the nosel to create a perfect seal.



Now you're ready to start wiring up your components! Follow this diagram and make sure you plug in extra male-wires to the female headers we soldered earlier to connect everything together.



Notice that we used a relay in our circuit as the Raspberry Pi can only safely tolerate input voltages under 3.3V. Therefore, we need to isolate our 5V power supply to avoid any damage to the Pi.

5. CONCLUSIONS AND FUTURE SCOPE

Overall, this paper provides a novel approach to save a water usage and make irrigation system better. Raspberry pi is an important part of system which is handle the processing and working.

- As per future perspective, this system can be the more intelligent system which predicts user actions, nutrient level of the plants, time to harvest, etc. With using Machine Learning algorithms more advancements can be done in the future which will help farmer a lot and water consumption can also be reduced in agriculture.

- Smart farming is a concept quickly catching on in the agricultural business. Offering high-precision crop control, useful data collection, and automated farming techniques, there are clearly many advantages a networked farm has to offer.
- Our project scope can be improved by adding feature which can tell the climate condition and water the plants/crops according to the need. If rain is predicted more, less water is supplied to plant. The total cost of providing enough water to the plants throughout a year long can be calculated. By storing the values constantly we can study about the nature call such as Drought.
- The system would provide feedback control system which will monitor and control all the activities of plant growth and irrigation system efficiently. If rain gun sensor can be added so that when it rains there won't be floods. Rain water harvesting can be done and this harvested water can be used to irrigate fields. We can also include many more water quality sensors that affect the crops.
- Hooters can be used so that it gives siren at various occasions such as intrusion detection, floods etc. Using IR sensors any object passing into fields can be detected and alerted.
- Poly-house farming is also smart irrigation technique. This system is used to improve the poly-house farming. It is the new model for poly-house. We can make our poly-house smart, safe and give more production per drop of water. The boosting of the gun with further essential nutrients.
- Our project can be improvised by using a sensor to note the soil pH value such that usage of unnecessary Fertilizers can be reduced and also read the temperature using Thing Speak account. The farmer can get a data without visiting the field and giving cost estimation. Further, it also reduces the investment of farmers.

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