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Full Length Article

# Smart Agriculture Irrigation System Using Raspberry Pi

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**ABSTRACT**-Water is the most essential contribution for upgrading agricultural productivity and therefore expansion of water system has been a key format in the improvement of farming in the nation. In this thesis we will develop an automated sprinkle system that will help a farmer/people to know about his field, and the status of his plant at his home or he may be residing in any part of the world. This work will help the farmers to irrigate the farmland in a very efficient manner with automated irrigation system based on soil, humidity, weather by using DHT 11 sensor, pH sensor. Whenever there is a change in temperature, humidity and current status of rain of the surroundings these sensors sense the change in temperature and humidity and gives an interrupt signal to the raspberry pi. Water excess irrigation not only reduces plants production but also damages soil fertility and also causes ecological hazards like water wasting and salinity. In recent years the awareness of water and energy conversation has resulted in the greater use of sprinkler system. Currently the automation is one of the important roles in the human life. It not only provides comfort but also reduce energy, efficiency and time saving. Now a day the industries are using an automation and control machines which are high in cost and not suitable for using in a farm & garden field. The proposed sprinkler system will be low in cost and usable by the Indian farmers. Raspberry pi is the main heart of the overall system. Here a system is proposed to monitor crop-field using sensors for soil moisture, humidity and temperature. By monitoring these parameters, the irrigation system can be automated if soil moisture is low.

*Key words:Raspberry pi, DHT 11 sensor, pH sensor*.

## 1. INTRODUCTION

The development in smart environmental technology and the application of Wireless Sensor Networks (WSNs) creates a new way of research in the field of agriculture. Now-a day sensor technologies are very much helpful in creating the smart précised environment. Using this technique, the WSN deployments for various farming applications in the Indian as well as global scenario are surveyed. Also, the possibility of using this technique for the crop growth starting from its cultivation to harvesting is analysed. In this way, various parameters needed for particular crop maintenance is focused and the problems for improvement and future development are considered. Agriculture plays a vital role in the development of country's economy. The daily need for food shows the importance of agricultural development. Growing a particular crop in a particular region takes the privilege of monitoring the growth from cultivation till harvesting. One of the main challenges in agricultural activities is irrigation. As the global climate decreases the source of water throughout the world, it is necessary to take steps for preserving it. However traditional irrigation management is done by the people itself. It requires the presence and continuous monitoring of irrigation by the farmers in the field area. The user must need to manually change the direction of water flow using large pipes in the field. It creates a need for more labour work and maintenance. A little advancement in traditional system involves in establishing centralized control of irrigated land using wired architecture which will also leads to more cost and maintenance manually.

Many researches are done in the field of agriculture and most of them signify the use of wireless sensor network that collect data from different sensors deployed at various nodes and send it through the IOT. It monitors the environment and collects the information. When the temperature get change in the environment the DHT 11 sensor will sense the humidity PH level of soil and send the date to the raspberry pi then motor will be turn ON supply the water to agriculture land. Then water level sensor is used to sense water level and supply the water to the plant as per their requirement. Those all the process will be monitor and operate by an IOT with any manual operation.

Two of the most common problems with farm irrigation systems have to do with irrigation scheduling. Irrigation scheduling is simply answering the questions of “When do I water?” and “How long do I water?”. Starting an irrigation cycle too early and/or running an irrigation cycle too long is considered over watering. At the very least this practice wastes water and money. However, overwatering can cause crop damage if done on a prolonged basis. Likewise, starting an irrigation cycle too late or not running the system for a long enough period of time is considered under watering and can cause reduced yields and poor crop quality which can affect price. Looking at these problems in depth is the key to minimizing their financial and practical impact on crops. The two most common methods for dealing with these problems are evapotranspiration-based control systems and soil moisture-based control systems.

Evapotranspiration is the combined process through which soil moisture is lost directly to the atmosphere through evaporation and plants taking water out of the soil and transpiring it to the atmosphere. Evapotranspiration is typically a calculated value that takes into account factors such as recent rainfall, relative humidity, solar radiation, and a crop coefficient that accounts for the plant size and stage of growth. The calculated evapotranspiration will give the grower an estimate as to how much water the soil is losing due to evapotranspiration.

The calculated evapotranspiration will give the grower an estimate as to how much water the soil is losing due to evapotranspiration. Once he knows how much soil moisture, he is losing he can determine how long he needs to irrigation to replace the lost soil moisture. Soil moisture-based control systems use soil moisture sensors to measure the actual soil moisture. This method is typically more accurate the evapotranspiration calculations because it is actually measuring the moisture level in the soil instead of calculating what should be there. Soil moisture control systems tell the grower when to begin an irrigation cycle and also tell him when the soil moisture level reaches field capacity.

## 2. EXISTING SYSTEM

In the existing system robot can be operated only in the manual mode. So it is difficult to perform in automatic operations where it doesn’t require humans.

Drawback

- It cannot be operated automatically.
- Less operations can be performed using robot.
- It’s not user friendly.

## 3. PROPOSED SYSTEM

In the proposed system is used to monitoring the temperature, humidity, water level by using DTH11 sensor, is used to monitor the field environment & send the data to IOT.

Advantages of proposed system

- It can be operated automatically.
- More operations can be performed using Automation.

## 4. SMART AGRICULTURE IRRIGATION SYSTEM

In the proposed system monitor the field environment and send the data to IOT. The main advantage of the proposed system is that used to monitoring the temperature, humidity, water level by using DHT 11 sensor, Raspberry pi it can send the information of a soil to the user through IoT network for irrigation. Power supply is given to the circuit in the form of voltage or current. Here soil moisture sensor measures the water content of soil.The Raspberry Pi requires a power supply of 5V and 12-volt supply is given to the motor by using relay. DHT11 sensor and soil moisture sensor are interfaced to the of the GPIO pins of Raspberry Pi. pH meter is connected to one of the pins of PIC 16F877A which acts as an ADC, since Raspberry Pi is not compatible with analog value.

DHT11 sensor is used to monitor the temperature, humidity water level of soil, whenever temperature level become below 45°C the motor will turn ON and water is supply to soil base on the temperature the motor will get turn ON and OFF. The water level sensor is used to maintain water level we set three default level high, low and medium, depending up on the requirement of plant it will irrigation water supply. Node-red software is used in Raspberry Pi as programming language. Based on the pH value the information regarding the nutrient levels in the soil is obtained sensor is used to measure of acidity in water.

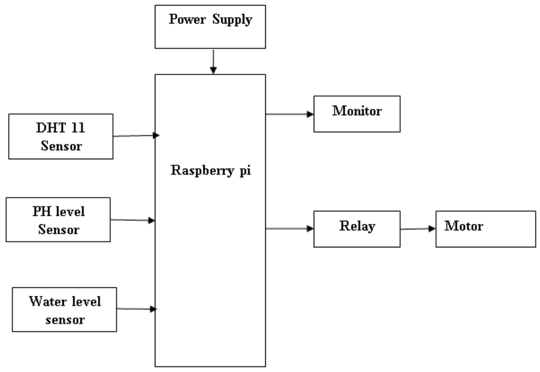



Fig:1 Block diagram proposed system.

## 5. DHT 11 SENSOR

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The DHT11 converts the resistance measurement to relative humidity on a chip mounted to the back of the unit and transmits the humidity and temperature readings directly to the RASPBERRY PI.The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.5V power and I/O2.5mA max current use during conversion (while requesting data).Good for 20-80% humidity readings with 5% accuracy. Good for 0-50°C temperature readings ±2°C accuracy.

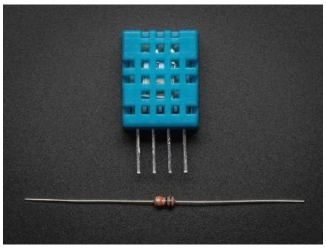


Fig.2. DHT11 sensor.

No more than 1 Hz sampling rate (once every second) Body size 15.5mm x 12mm x 5.5mm.4 pins with 0.1" spacing.

## 6. PH SENSOR

PH meter measures the activity of the hydrogen ions in the solutions to determine the pH of the sample. This activity is compared to pure water (a neutral solution) using a pH scale of 0 to 14 to determine the acidity or alkalinity of the sample solutions. An ADC is interfaced with the pH meter in order to convert into digital values. Based on the pH value the information regarding the nutrient levels in the soil is obtained pH sensor is used to measure of acidity in water.

Fig.4..PH sensor.

## 7. WATER LEVEL SENSOR

A water sensor is a device used in the detection of the water level for various applications. Water sensors are of several types that include ultrasonic sensors, pressure transducers, bubblers, and float sensors. There are a number of differenttypes of water level sensor used to detect the point level of a water. Some types use a magnetic float, which rise and fall with the water in the container. Once the water, and by extension, the magnet, reach a certain level, a reed magnetic switch is activated. Commonly, there is a switch towards the top and the bottom of the container, allowing detection of minimum and maximum levels of water. Many sensors also include a protective shield to protect the magnet from turbulence or interference from direct contact with the water.

Fig.5. WATER LEVEL SENSOR.

## 8. RASPBERRY PI TECHNOLOGY

A hazardous environment monitoring and control for monitoring information concerning safety and security, using wireless sensor network (WSN) with Raspberry Pi technology and the concept of implementation is described in the context of the industrial safety monitoring scenario. The deployed wireless sensor network is used to perform data acquisition with focus on several parameters like current, voltage, temperature, fire, poisonous gas leakage and water level. The advanced system for process management via a credit card sized single board computer called Raspberry Pi based multi parameter monitoring hardware system designed using RS232 and microcontroller that measures and controls various hazardous parameters.

Fig.6.Raspberry Pi.

The system comprises of a single master and single slave with wireless mode of communication and a Raspberry Pi system that can operate on Linux operating system. The Proper use of wireless sensor networks (WSNs) can lower the rate of catastrophic failures, and increase the efficiency and productivity of industrial operations.Diversification of remote-control mode is the inevitable trend of development of smart appliances. The project proposes a review on remote control system of smart appliances based on wireless sensor network. Status of the industrial appliances can be queried and controlled through the remote controller.

## 9. INTERNET OF THINGS (IOT)

The internet of things (IoT) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.

When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.

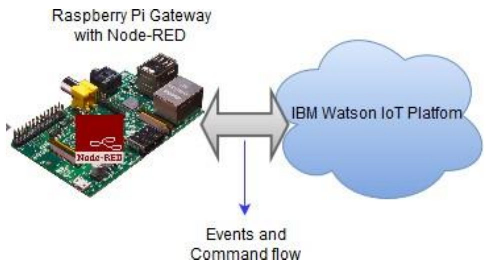


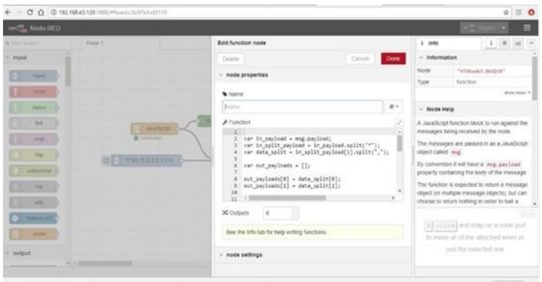

Fig.7: Block diagram of IOT

## 10.SOFTWARE DISCRIPTION

Node-RED is a visual tool for wiring the Internet of Things, but it can also be used for other types of applications to quickly assemble flows of services. The name is not the most intuitive name. The reason why ‘Node’ is in the name is because the tool is implemented as Node application but from a consumer point of view that’s really only an internal implementation detail. Node-RED is available as open source and has been implemented by the IBM Emerging Technology organization. Node-RED is included in the Bluemix Internet of Things starter application, but you can also deploy it as Node.js application separately. To use Node-RED for Internet of Things scenarios you need to add the Internet of Things Foundation service to your Bluemix application. The IoT service allows to register and connect different types of devices. After this you can use the incoming and outgoing MQTT nodes in your flows. Take a look at the existing Bluemix Internet of Things samples. Most of them use Node-RED to define flows where either incoming sensor data from ‘things’ is handled, e.g. stored in databases, or where commands are sent to devices. Node-RED can not only be used for Internet of Things applications, but it is a generic event-processing engine. For example, you can use it to listen to events from http, web sockets, tcp, Twitter and more and store this data in databases without having to program much if at all. You can also use it for example to implement simple REST APIs. Ryan Baxter provided just last week a Node-RED sample that isn’t an IoT app. He used Node-RED to build a personal weather alert system, which works by controlling the lights in his home. Brimley built a flow that connected to the forecast.io weather API every three minutes to check local rainfall predictions. A second node took the response from forecast.io and used it to calculate how many minutes until rainfall would arrive at his home.

## 11. BROWSER-BASED FLOW EDITING

Node-RED provides a browser-based flow editor that makes it easy to wire together flows using the wide range of nodes in the palette. Flows can be then deployed to the runtime in a single-click. JavaScript functions can be created within the editor using a rich text editor. A built-in library allows you to save useful functions, templates or flows for re-use.



## 12. BUILT ON NODE.js

The light-weight runtime is built on Node.js, taking full advantage of its event-driven, non-blocking model. This makes it ideal to run at the edge of the network on low-cost hardware such as the Raspberry Pi as well as in the cloud. With over 225,000 modules in Node's package repository, it is easy to extend the range of palette nodes to add new capabilities.

## 13. CONCLUSION:

Fresh water is a delicate resource, and we must find ways touse it sustainably. The largest irrigated crop by surface area in North America, turf has a demand for an estimated 9 billiongallons each day. Due to current shortages, there is strongsocial, environmental, and monetary incentive to shrink this enormous consumer. In this work, we seek to improve the efficiency of turf irrigation systems by analyzing heterogeneous water needs across a span of turf. To this end, we develop computationally-light moisture movement model within an optimization framework to produce optimal valve scheduling within an irrigation system. To test its effectiveness, we produce the MAGIC sprinkler node, with the ability to actuate, sense local soil conditions, and communicate wirelessly with sister nodes in the network. Through two separate deployments spanning a total of 7 weeks, we find that the MAGIC system can reduce system water consumption by 23.4% over our campus’ control strategy, and by 12.3% over a state-of-the-art evapotranspiration system. Despite this reduced water usage, MAGIC was also found to reduce turf exposure to unhealthy levels of moisture by a factor of 3.23 over the campus’ control, and a factor of 4.08 over the evapotranspiration control. The MAGIC system is expected to return its investment in 16-18months based on water savings alone.

## 14. RESULT AND ANALYSIS

DHT11 sensor is used to monitor the temperature, humidity water level of soil,whenever temperature level become below 45°C the motor will turn ON and water is supply to soil base on the temperature the motor will get turn ON and OFF.GPIO 03 pin is connected with raspberry pi and after sensing the temperature and humidity of the soil. In this output screen short temperature level is 30 °C and humidity level 60% high so motor is in OFF condition.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