Survey On Smart Irrigation Using Raspberry Pi

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Abstract

An automatic irrigation system is very essential in current scenario. Weather and climate changes are the challenging factors for agriculture. At the same time, we are in the demand for higher productivity. So, we need automatic irrigation that will save water and improve the fertility of soil and increase the productivity of yields. Smart irrigation must be easy to install and configure. Farmers would be able to smear the right amount of water at the right time by automating farm irrigation with the help of sensors. Automatic irrigation system implements the farmers need by incorporating soil moisture sensor and embedded controller. The automatic turn on and turn off motors are using by controllers. The microcontroller in the system promises to reduce the power consumption and the results are in lower power consumption. Farmers can get the information and control the system through App.

Keywords: Arduino UNO, AISWP, WSNT, SPV,PIC, TDR, LCD, ARM

1. Introduction

India is an agro based country and around 61% of total land in India is responsible to feed around 1.3 billion populations. In the present era, water scarcity due to over exploitation have resulted the urge of developing a new technology that could save water from being wasted. A way for checking water loss in agriculture is by making irrigation system smart.

Smart irrigation system is an effective and efficient way of watering fields. It monitors weather, soil conditions and automatically adjusts watering schedule. Hence, approaching smart irrigation system has become a prime concern to give farmer a smart tool which would support them in yielding quality crops.

In agricultural, farmer depends to a large extent on the availability of water and power. Power can be used from solar without depending the grid power. This not only reduces the cost of electricity but also save the energy.

One of the approaches is to make this system accessible from even far distance so that the farmer has the information and control on the field 24x7 throughout a year [1]. The whole setup is controlled by an Arduino UNO which is a microcontroller and the data is sent and received by a Wi-Fi module

2. Irrigation System

Irrigation is the artificial way of watering crops in fields. In irrigation the available techniques are like ditch irrigation, terraced irrigation, drip irrigation, sprinkler system, surface irrigation and sub-surface irrigation. The manually operated irrigation system is replaced with automated and Semi-automated techniques to use the water efficiently and effectively.

Sensor based Automatic Irrigation System is based on Soil Moisture Sensor and it will measure the level of moisture in the soil and sends the signal to the Raspberry pi and accordingly it will irrigate the crops. The Raspberry pi plays instead of Micro-controller. This Raspberry pi will compare the values received from moisture sensor. Based on the values received from the sensors, the Raspberry pi will turn the irrigation system ON/OFF[2]. If we install the automatic irrigation system and we are determining the pH value it saves time and ensures the usage of water and farmers get to know the current situation of their crops.

Automated Irrigation System using Weather Prediction (AISWP) method helps us to use the available water resources more efficiently by sensing the moisture present in the soil and apart from that it is actually predicting the weather by sensing two parameters which are temperature and humidity, to improve the usage of water in agriculture [3]. This automated irrigation system is not only supply the water based on moisture in the soil, but also it takes weather conditions into consideration has made the usage of water more efficient.

In addition, based on soil moisture value land is automatically irrigated by ON/OFF of the motor using Arduino UNO microcontroller. The status will be displayed to the user through the App. An automatic irrigation system provides water to the farms based on water level conditions using an android application, WSN and GPRS modules [4]. Sensor values are continuously fed to ARDUINO microcontroller. The sensor information is compared with the threshold values and based on that, decision will be taken to water the crops. This irrigation system has been working with high efficiency and top speed. This system sends message to the user whenever sensors exceed their threshold value, by this system every user can understand the soil conditions and controls the system manually. The advantages are low latency, high reliability, reduced operational cost, high flexibility.

An automatic irrigation system using low cost soil moisture sensor and android App [5] to develop an app based self-made capacitive sensors. Raspberry Pi microcontroller is used to test the moisture level by comparing the threshold and control the inflow of water for optimal use of water. An automatic irrigation system is used to increase the productivity of crop by providing optimal amount of water. The system sets the irrigation time based on the moisture reading from the sensors and irrigates the field automatically. The advantage of this design is low cost, low power, robust, small size and, highly versatile reduce the wastage of water.

An automatic solar powered drip irrigation system adopt wireless sensor network technology (WSNT) by integrating Solar Photovoltaic System (SPV), Arduino Microcontroller, Soil Moisture Sensor, Mobile Bluetooth, Water Tank, Pump etc[6]. WSNT employed in this work contributes to save energy, water, fertilizers and ensure uniform watering at right time without manual intervention to enhance the quality and quantity of agricultural yields.

PIC Microcontroller based automated irrigation system best suit for places where water is scarce and has to be used in limited quantity [7]. PIC controller displays the soil moistures level and switches are provided to set the limits of humidity. At regular time interval, the humidity and temperature levels are passed to LCD

through the serial port. Microcontroller is used to control the relays through the high current IC. The flow of water is controlled by solenoid valves.

Automated irrigation system based on 8051 series microcontroller [8], is programmed to receive the input signal of varying moisture condition of the soil through the sensing arrangement. It operates the pump based on the signal received. The LCD display shows the status of the soil and water pump to the user. If we use microcontroller based automated irrigation system, the irrigation will take place only when there will be acute requirement of water. The advantage of using this method is to reduce human intervention and ensure proper irrigation.

3. Smart Irrigation System

For measuring the volumetric water content of soil, soil moisture sensor is used. The soil moisture sensor is low in cost and this sensor will integrate with microcontroller for automatic irrigation. This system can replace human labour, save the water and at the same time, the plant gets optimum level of water, and increase the productivity of crop. By setting the irrigation time, it automatically irrigate the field depend upon the moisture reading from the sensors.

The soil moisture sensor is used to measure the water content of soil with the help of TDR sensor [9]. TDR (Time-domain reflectometer) is the soil moisture monitoring system with simultaneous measurement of soil temperature and electrical conductivity. These two quantities are more vital for a variety of hydrological processes and the interaction of soil and atmosphere for climate predictions. The superiority of TDR over other soil water content measurement methods are: (i) superior accuracy to within 1 or 2% of volumetric water content; (ii) calibration requirements are minimal (iii) lack of radiation hazard (iv) application of TDR probes can give an excellent spatial and temporal resolution; (v) measurements are rapid, non-destructive and simple to obtain.

For soil moisture, the parameters are moisture content and water potential are needed. The Watermark 200SS granular matrix water potential sensor is used, and which is supported by a scaled MV-VG model for soil moisture retention curve prediction[10]. This model provides a correlation between the soil moisture content and water potential. Finally this system is flexible, low cost, simple to use and offers real-time monitoring.

ATMEGA 328P on Arduino UNO platform is used for monitor and maintain the soil moisture content [11]. This microcontroller uses soil moisture sensors to measure the exact moisture level in soil. App is used to alert the status of sprinklers. Information from the sensors is updated through modem on a webpage using GSM-GPRS SIM900A; it will help a farmer to check whether the water sprinklers are ON/OFF at any time.

In the paper [12], the soil moisture sensor and the temperature sensor are placed in the root zone of the plants, and the system distributes the information of water level to the user through wireless network. The system is a combination of wireless sensors and wireless base station to form a network, which is used to provide the sensors data to the automatic irrigation system. The relay board is connected with the raspberry pi, which turn the motor on or off. With the help of webcam and mobile phone we can easily monitor the exact status of the field.

In the paper [13], a low cost smart irrigation system, ATMEGA-328 microcontroller which is embedded in the ARDUINO-UNO is used to control the motor, and it confirms the water flow of the pipe through soil moisture sensor. The information is send to the user through the message with the help of wireless sensor network and modem. If the field needs irrigation, then the controller automatically switch on the motor

and send SMS to the mobile phone through wireless network and raspberry pi monitors the current status of the field.

In the paper [14], Arduino Based Automatic Irrigation System Using IoT, they proposed a system that controls the wastage of water during the water supply. Depends upon the soil moisture value the motor will be automatically ON/OFF and the status of the parameter will monitor on android application. Temperature, humidity and moisture values are watched by the particular sensors and deliver the value to the corresponding IP address. When the soil moisture value exceeds the limit, the Arduino microcontroller controls the motor and thus the water wastage is avoided.

In, The automated irrigation system based on soil moisture using Arduino[15], they have proposed a system based on soil moisture sensor and L293D module. This system checks the soil's moisture level and automatically switches on the pump. The timer based device is used during the period of inadequate rainfall. When the motor is ON, the controller access all the data and it will be shown on the LCD Panel and monitor window. Based on the soil's temperature level, the automatic watering level will be scheduled.

In, Microcontroller based automatic plant Irrigation System [16] they proposed a system that detects the moisture level using the Arduino ATmega 328 microcontroller. With the help of the microcontroller, the motor will automatically ON and OFF. This system is mainly used to save the time, reduce the wastage of water and reduce the man power.

In this paper [17], they proposed an App based automatic irrigation system with self-made, low cost sensor and Raspberry Pi microcontroller. The capacitive sensor is used to measure the moisture level. They are placed in different locations of the soil. The system verifies the threshold value of the moisture content and the water flow. The raspberry pi microcontroller collects all the sensor's input and decides to on/off the motor and also controls the water supply. The android app is developed in Java, which is integrated with raspberry pi microcontroller. The app receives the threshold values from the database, which is placed in raspberry pi.

The real time and automatic monitor system is used to improve the crop management reducing waste and labour cost [18]. This system monitors the different climatological soil parameters like temperature, humidity, soil moisture, soil pH, soil conductivity, leaf wetness for maintenance of agricultural production. This system is sensing with zigbee based wireless network.

The smart irrigation is more innovative, user friendly, time saving and more efficient. The parameters are soil moisture, temperature, humidity and pH values. We can measure the four parameters and also include the intruder detecting system[19]. Due to server updates the farmer can know the up to date details about the crop field at anytime and anywhere.

In smart irrigation[20], we can automatically detect the moisture content to control the water motor. By the sensed value of the soil, the irrigation is done through Arduino UNO. The advantage is automatic, efficiency, energy and tie saving. An automated irrigation system is used to optimize water use for crops. The system has a wireless network of soil moisture and temperature sensors placed in the root zone of the plants.

An automated irrigation system based on ARM microcontroller is used for low cost feature for water irrigation system[21]. The temperature sensor and soil moisture sensor is used to detect the water quantity and water level sensor is used to detect the water level in tank.

4. Conclusion:

An automatic irrigation system contains Arduino/Raspberry Pi for control the motor to avoid the wastage of water and sensors are used to detect the humidity of farm field. The entire system can be made communicative through the App with wireless Wi-Fi module. The advantages are low latency, high reliability, reduced operational cost, robust, small size, highly versatile reduce the wastage of water, high flexibility, lack of man power.

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