International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Raspberry pi and Arduino Based Automated Irrigation System

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Abstract: ***Automation is increasing day-by-day in home and office. It makes an efficient use of the electricity and water and reduces much of the wastage. In areas like office premises, buildings, house gardens etc. where watering plants at regular interval matters, the proposed irrigation system will be very efficient. The paper presents a home automation system which is based on Raspberry pi, Arduino microcontrollers, and zigbee and relay boards to water plants. Raspberry pi acts as the control block in the automatic irrigation system to control the flow of motor. The commands from the Arduino are processed at raspberry pi. Zigbee module is used for communication between the Raspberry pi and Arduino. This paper presents an efficient and fairly cheap automation irrigation system. By using moisture sensor we will make the irrigation system smart and automated. System once installed has no maintenance cost and is easy to use.***

Keywords: Raspberry pi, Arduino, Zigbee, relay, automatic irrigation system

1. Introduction

Irrigation of plants is usually a very time-consuming activity which has to be done in a reasonable amount of time; it requires a large amount of human resources. All the steps were executed by humans traditionally. Nowadays, some systems use technology to reduce the number of workers and to reduce the time required to water the plants. With such systems, the control is very limited and many of the resources are still wasted. Water is one of these resources which is used excessively. Mass irrigation is the method which is used to water the plant. This method represents massive losses since the amount of water given exceeds the plants' needs. The excess water gets discharged by the holes of the pots, or it percolates through the soil in the fields. In addition to the excess cost of water, labour is becoming more and more expensive. As a result, if no effort is invested in optimizing these resources, there will be more money involved in the same process. Technology is a probable solution to reduce costs and prevent loss of resources.

Single-chip microcontrollers with wireless transceivers are gaining popularity in smart home automation because of their built-in resources, low power consumption, size. A wireless irrigation system for a smart home garden can be integrated with existing smart home control system [4]. An irrigation system using zigbee in wireless sensor network and embedded Linux board provide to the user web interface so that the user can control and monitor the system remotely. The system works according to algorithm developed for watering the crop User can make the system ON or OFF remotely [9].

Automation is the use of various control system for operating equipment. The biggest benefit of automation is that labors are saved; however, it is also used to save energy and materials and to improve quality, accuracy and precision. The requirement of building an automation system for an office and home is increasing day-by-day. Researchers and industrialist are working to build very efficient and economic automatic systems which control different machines like fans, lights, air conditioners based on the requirement. Automation makes an efficient use of the water and electricity and reduces much of the wastage [1].

The proposed irrigation system makes the efficient use of water. Water is fed to the plant whenever there is need. There already exist irrigation systems which water plants on the basis of soil humidity, pH value of soil, temperature and light. Wherever these parameters are required in big agricultural fields their productivity of the crop matters. The proposed irrigation system will be very efficient in areas like house gardens, office premises, buildings etc. where watering plants at regular interval matters.

This paper presents an smart drip irrigation system to water plants using devices like raspberry pi, Arduino microcontrollers. Zigbee is used to control the system wirelessly. And also the user gets the status time to time.

2. Proposed System

The block diagram of the proposed automated irrigation system consists of the raspberry pi and Arduino. The proposed system is divided into two as master and slave. The master consists of Raspberry pi, relay and water pump. The slave consists of Arduino and moisture and temperature sensors. Zigbee module serves as backbone for the communication between master and slave.

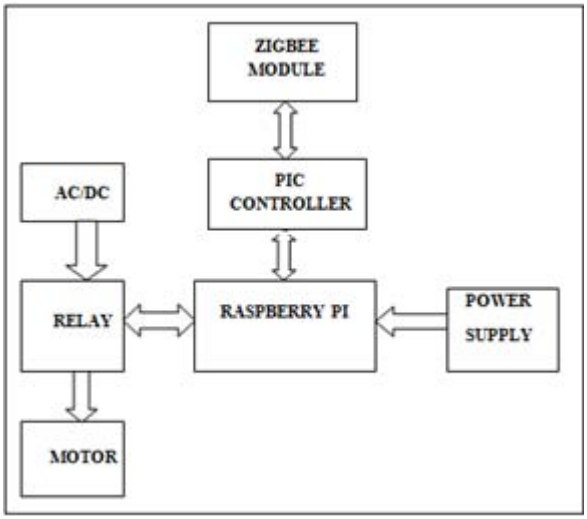

Figure 1: Block Diagram of the Master side of the System

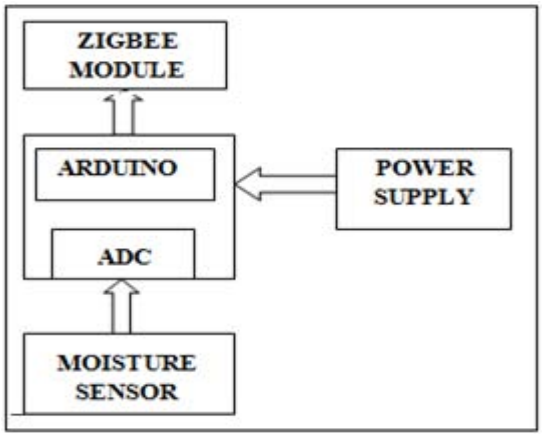

Figure 2: Block Diagram of the Slave side of the System

3. Components

The sensor technology to automate irrigation improves water usage efficiency.

A.Raspberry Pi

Raspberry pi is a pocket personal computer with Linux operating system on it. This is great cheap to encourage young people for learning, programming, experimenting and for making innovation. Resembling like motherboard, raspberry pi has all the components to connect inputs, outputs and storage.

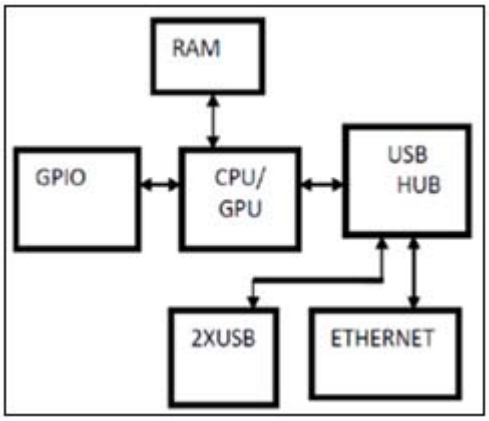

Figure 3: Block Diagram of Raspberry Pi model B

B. Arduino

The Arduino Uno is a microcontroller board based on the ATmega328. It consist of 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a power jack, a USB connection, an ICSP header, and a reset button. It contains everything which is needed to support the microcontroller. Simply connect it to a computer with a USB cable or power it with a battery or use AC-to-DC adapter to get started.

C. Moisture Sensor

Soil moisture sensors measure the water content in soil. Moisture in the soil is an important component in the atmospheric water cycle, both on a small agricultural scale as well as in large-scale modeling of land and atmosphere interactions. Vegetation and crops always depend more on the moisture available at root level rather than precipitation occurrence. For water budgeting planning as well as the actual scheduling of irrigation action requires information of the soil moisture. The degree of soil wetness helps to forecast the risk of flash floods, or the occurrence of fog .A soil moisture probe is made up of multiple moisture sensors. Moisture sensors is used which can be inserted in the soil, in order to measure the moisture content of the soil. The moisture sensor is connected to transistor. One probe is connected to the collector and one to the base of the transistor. The output voltage is taken at the emitter. As the base or collector current is high the output voltage is also high. More output voltage means more moisture.

D. ZigBee Modules

ZigBee (over IEEE 802.15.4) technologies based on short range WSN and it was selected for this sensor network which is battery operated because of its low cost, low power consumption, and greater useful range as compared to other wireless technologies like Bluetooth (over IEEE 802.15.1), UWB (over IEEE 802.15.3), and Wi-Fi (over IEEE 802.11) . The ZigBee devices operate in industrial, scientific, and medical 2.4-GHz radio band and allow the operation in a mesh networking architecture, which can be differentiated into three categories such as : 1) coordinator; 2) router; and 3) end device.

4. Methodology

The system can be represented using algorithms and algorithms are designed using flowcharts.

A. Irrigation Algorithm

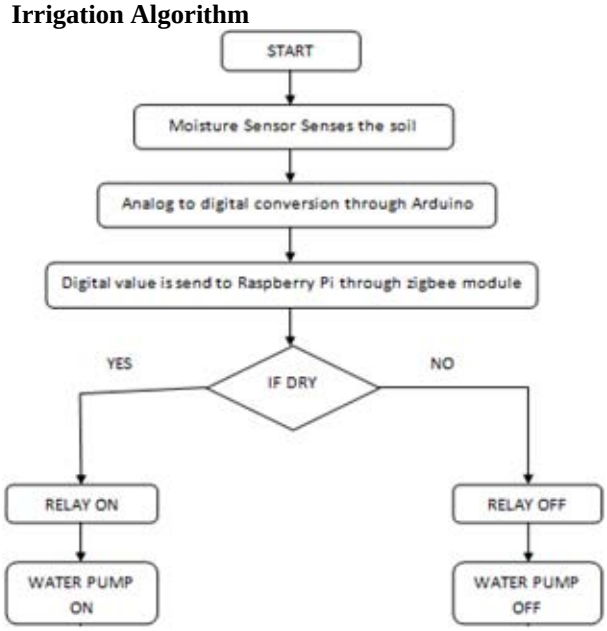

Figure 4: Flow Chart of the System

The logics of the algorithm help to identify whether there is need of water to plant. Further, logics and decision making conditions help soil moisture condition of the soil and it always maintain moisture and also the user gets the status of the motor on the mobile.

First the moisture sensor senses the soil. The output of the moisture is in the analog form. The ADC of the Arduino converts the output of the moisture sensor into digital form. The digital value is then send to the Raspberry pi through RF module which decides whether to soil is wet or dry and according to that water the plant. If the soil is dry, Raspberry pi actuates the relay and water pump starts which leads to water to flow. If the soil is wet, Raspberry pi turns the relay of as a result water pump is off and water flow stop.

5. Result

The installation of the automated irrigation system is done. The experiment was run for watering plants to check the reliability of the system. It is found that the system works properly and the water is passed to the plants as and when required. If the soil is dry, Raspberry pi actuates the relay and water pump starts which leads to water to flow. If the soil is wet, Raspberry pi turns the relay on as a result water pump is off and water flow stop.

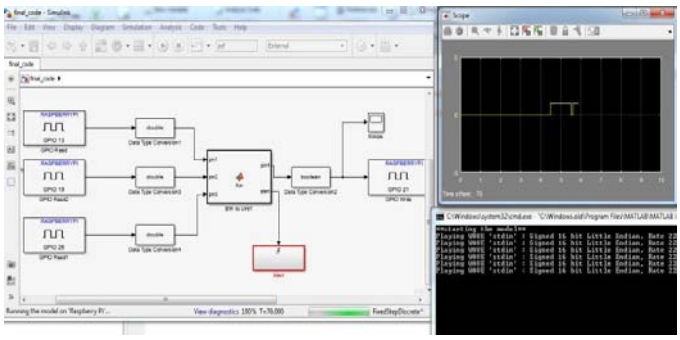

Figure 5: Result showing the status of the motor

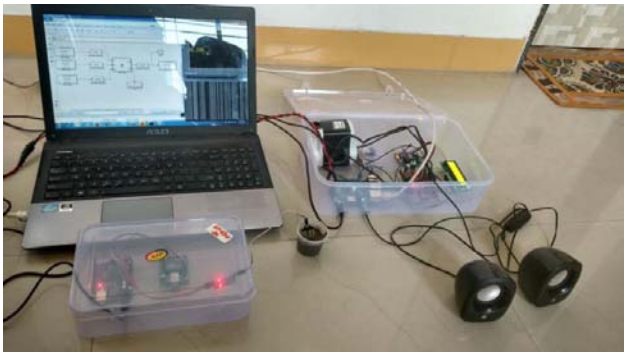

Figure 6: Irrigation System Installation

6. Conclusion

In this work, we successfully develop a system that can help in an automated irrigation system by analyzing the moisture level of the ground. The smart irrigation system proves to be a useful system as it automates and regulates the watering without any manual intervention. The primary applications for this project are for farmers and gardeners who do not have enough time to water crops/plants. The moisture sensors and temperature sensor measure the moisture level (water content) and temperature of the different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the Arduino board which triggers the Water Pump to turn ON and supply the water to respective plant. Also without visiting will get the status of the motor and temperature on mobile.The system features a custom sensor design for power efficiency, cost effectiveness, cheap components, as well as scalability end ease of use. In future there are some tasks that should be done and would develop the system to a more mature state. A modular design that gives the opportunity to users of using energy sources, connectivity and sensors as modules could be a very useful and easy-to-use .The system may be further extended for outdoor utilization.

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