IJournals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 4 Issue 3 March, 2016

Automated Irrigation System using Raspberry pi and Arduino

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ABSTRACT

An automation system for an office or home is increasing day-by-day. It makes an efficient use of the electricity and water and reduces much of the wastage. In small 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 is based on Raspberry pi, Arduino microcontrollers, and zigbee and relay boards to water plants. Raspberry pi is the control block in this automatic irrigation system. The commands from the Arduino are processed at raspberry pi in Matlab C code. Arduino microcontrollers are used to receive the commands from the raspberry pi using zigbee. Zigbee module is used for communication between the Raspberry pi and Arduino. This paper contributes 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; to be done in a reasonable amount of time, it requires a large amount of human resources. Traditionally, all the steps were executed by humans. Nowadays, some systems use technology to reduce the number of workers or the time required to water the plants. With such systems, the control is very limited, and many resources are still wasted. Water is one of these resources that are used excessively. Mass irrigation is one method used to water the plant. This method represents massive losses since the amount of water given is in excess of the plants' needs. The excess water is evacuated 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 probably a solution to reduce costs and prevent loss of resources.

Single-chip microcontrollers equipped 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 that can be integrated with existing smart home control system [4]. An irrigation system using zigbee in wireless sensor network and embedded Linux board provides a web interface to the user 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 or automatic control is the use of various control system for operating equipment. The biggest benefit of automation is that it saves labor; 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 or home is increasing day-by-day. Industrialist and researchers are working to build efficient and economic automatic systems to control different machines like lights, fans, air conditioners based on the requirement. Automation makes an efficient use of the electricity and water 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. Our proposed irrigation system will be very efficient in small areas like office premises, buildings, house gardens etc. where watering plants at regular interval matters.

This paper presents an smart drip irrigation system to water plants with the use of devices like raspberry pi, Arduino microcontrollers. Zigbee is used to control the system wirelessly.

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 sensor. Zigbee module serves as backbone for the communication between master and slave.

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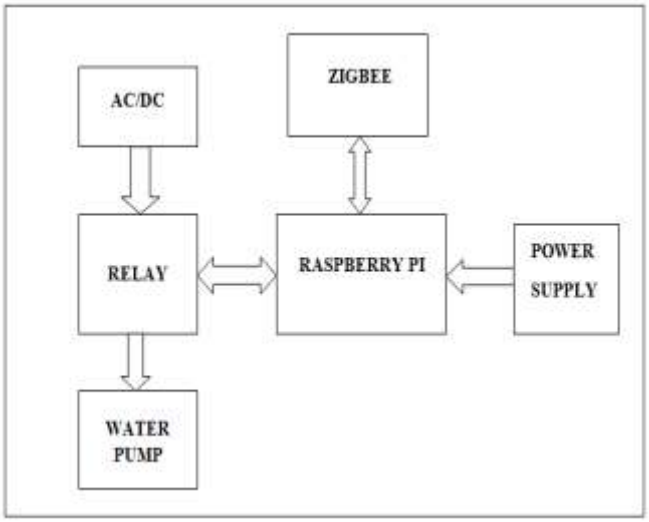

Figure 1: Block Diagram of the Master side of the System

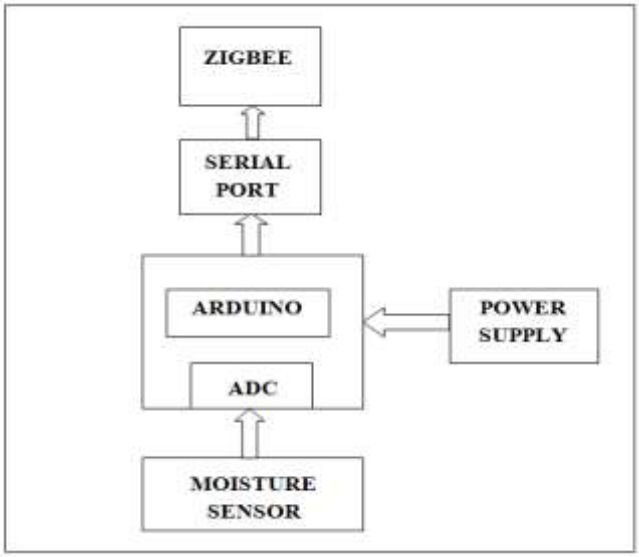

Figure 2: Block Diagram of the Slave side of the System

3.COMPONENTS

The sensor technology to automate irrigation improves water usage efficiency.

3.1 Raspberry Pi:

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

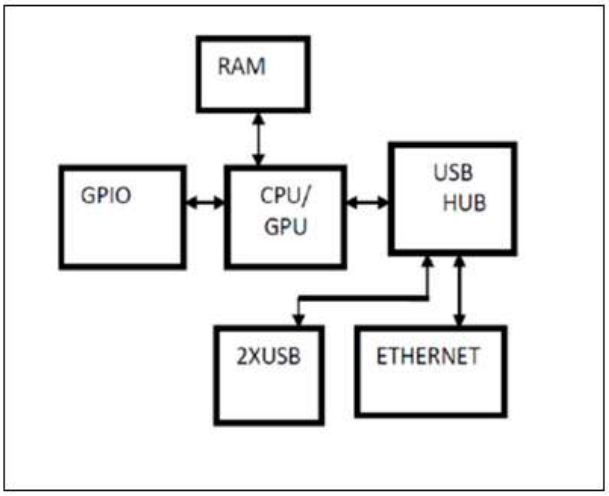

Figure 3: Block Diagram of Raspberry Pi model B

3.2 Arduino*:*

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

3.3 Moisture Sensor:

Soil moisture sensors measure the water content in soil. Soil moisture is an important component in the atmospheric water cycle, both on a small agricultural scale and in large-scale modeling of land/atmosphere interaction. Vegetation and crops always depend more on the moisture available at root level than on precipitation occurrence. Water budgeting for irrigation planning, as well as the actual scheduling of irrigation action, requires local soil moisture information. Knowledge of 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 soil moisture sensors. We will use the moisture sensors 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.

3.4 ZigBee Modules*:*

ZigBee (over IEEE 802.15.4) technologies based on short range WSN and it was selected for this battery-operated sensor network because of its low cost, low power consumption, and greater useful range in comparison with 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 so-called mesh networking architecture, which can be differentiated into three categories: 1) coordinator; 2) router; and 3) end device.

4. METHODOLOGY:

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

4.1 Irrigation Algorithm:

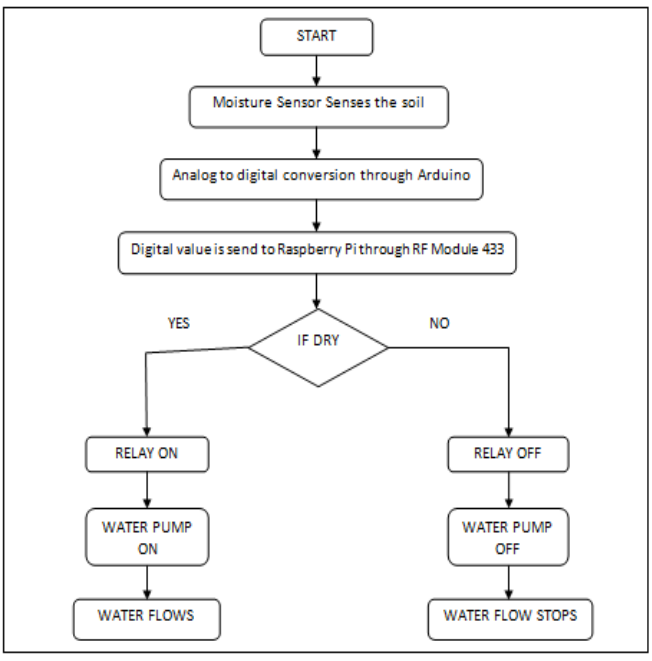

Figure 4: Flow Chart of the System

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.

First the moisture sensor senses the soil. The output of the moisture sensor 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.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 their 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. 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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