

IoT Based Smart Home Garden Watering System Using Raspberry Pi 3

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ABSTRACT: In today's world automatic systems are more preferred than manual system. This paper propounds a design for garden watering system based on android application using Raspberry Pi 3. Home automation is the automatic control and monitoring of house hold appliances and also for garden watering. The system used Android application is used to control and monitor the appliances and Wi-Fi technology as a communication protocol to connect system components. Depending upon the moisture level of garden land and daylight intensity, the system can detect the appropriate time of water supply to the plants and trees in the garden. The analog data received from the sensor are transmitted as digital signal via Wi-Fi module to the Raspberry Pi 3. The system is able to notify the user that the water shortage arises in the main water supply and an user can also communicate with the system by sending SMS or email. Nowadays, adopting an optimized garden watering system has become a necessity due to the lack of the world water resource.

KEYWORDS: Android application, IoT, Raspberry Pi 3, Wi-Fi, Sensors, Cloud networking.

I. INTRODUCTION

Home automation is a technique to use computer or smart phone in controlling and monitoring Home appliances and Home features. Directly controlling and staying connected with the home systems used every day via a mobile device would significantly enhance quality of life. It is not only about remotely controlling and monitoring the lights, fan, gas leakage, motion detection and watering the garden from smart phone any where. Again it is not merely about regularly monitoring the security of home from workplace miles away. A smart home can offers all of these – comfort, convenience, monetary savings, and safety. Many people lose their interest in gardening because it needs a lot of efforts to properly maintain the seedlings. Therefore, an automated and quantified system to take care of plants can be a vital tool.

IOT or internet of things is an upcoming technology that makes use of internet to control/monitor electronic/mechanical devices, automobiles and other physical devices connected to the internet. IOT gives user the ability to control more than digital things easily through a comfortable GUI over the internet. Our researchers focus on the use of IOT for home/industry automation and monitoring various physical parameters over the internet. This internet of things projects have been proposed on existing system improvements and new innovative solutions to different problems. Internet of things is a technology which encounters remote monitoring and controlling of devices which being connected to it wirelessly, here the concepts of wireless sensors networks and Ethernet protocols are made of use. Internet of Things (IoT) is advancement in technology where in it makes use of Wireless sensor networks nanotechnology and Miniaturization. IoT is all about many physical devices interacting with each other. Internet of things will provide seamless connectivity between the things in virtual world with real world thereby ensures anytime, anywhere, anything communications. IoT will help the user to approach various applications in a smarter way which might be a smart home, smart agriculture, smart industries or enterprise. The user can check the status of any resources in the network. IoT in use here will have its approach for the local network created and there by monitor the status of embedded

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devices and take necessary measures passing commands controlling the devices which happen across the web server making use of Ethernet protocols

The aim of this is to demonstrate that the automatic garden watering system can be used to reduce water use. This system consists of a distributed wireless network of soil moisture, temperature and ultrasonic sensor. The experiment required sensors, Raspberry pi 3 and pipe to supply water from tank controlled by a gate. Moisture sensor was installed near the roots and daylight sensor was installed further away to clearly detect the sunbeam. These sensors send their data to the raspberry pi to analyze. Main purpose of this project is to save the water and to increase the production of trees and plants in the garden by monitoring the growth of plants. With the help of sensors, controlled by Raspberry Pi 3 microcomputer, we designed a system to automatically sprinkle accurate amount of water by detecting soil moisture, daylight intensity and water level. Each type of plant needs different soil moisture for smooth growth. Hence the soil moisture is a key variable that can be used to determine the quantity of water needed. Besides, the availability of the amount of daylight is also very crucial for a tree. Wrong timing of watering can cause more harm rather than benefit.

II. RELATED WORK

The concept of smart home garden watering system is becoming popular everyday by including various features.

In [1], the system uses Cortex-A8 and ZigBee. The system consists of three parts include user intelligent control terminal, embedded home gateway and home ZigBee wireless network. It can perform functions such as safety and alarm, the indoor environment testing, household electrical appliances control and intelligent lighting and other functions. Users can access Internet web to monitor the home furnishing remotely. The users can also use cell phone with Android smart furnishing control client applications to interact remotely with home furnishing device.

In [2], the system uses Intel Galileo that employs the integration of cloud networking, wireless communication, to provide the user with remote control of various lights, fans, and appliances within their home and storing the data in the cloud. The system will automatically change on the basis of sensors' data. This system is designed to be low cost and expandable allowing a variety of devices to be controlled. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the cloud (Gmail) in a timely manner. This will help the user to analyse the condition of various parameters in the home anytime anywhere.

In [3], an Android based home automation system that allows multiple users to control the appliances by an Android application or through a web site is presented. The system has three hardware components: a local device to transfer signals to home appliances, a web server to store customer records and support services to the other components, and a mobile smart device running Android application. Distributed cloud platforms and services of Google are used to support messaging between the components. Distributed cloud platforms and services of Google are used to support messaging between the components. Such a design of service and data distribution through public and free Google platform makes the system cost-effective.

In [4], model includes soil moisture, temperature and pressure sensors to monitor the irrigation operations. Specifically, we take into account the case where a system malfunction occurs, as when the pipes burst or the emitters block. Also, we differentiate two main traffic levels for the information transmitted by the WSN, and we use an adequate priority-based routing protocol to achieve high QoS performance. Simulations conducted over the NS-2 simulator show promising results in terms of delay and Packet Delivery Ratio (PDR), mainly for priority traffic.

In [5], system has a distributed wireless network of soil-moisture & temperature sensors placed in root zone of plants. Gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of sensors that was programmed into a microcontroller-based gateway to control water quantity.

In [6], the research field of wireless sensor network power efficient time is major issue which can be overcome by using ZigBee technology. The main idea is to understand how data travels through wireless medium transmission using WSN and monitoring system. Design of an irrigation system which is automated by using controllable parameter

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such as temperature, soil moisture and air humidity because they are the important factors to be controlled in PA(Precision Agriculture).

In [7], it proposes a technique of real-time spatial interpolation using nearby ASW to predict real-time local weather parameter. Also proposes a correction technique by using sparse WSN with soil moisture sensor installed in it.

III. SYSTEM ARCHITECTURE

The paper presents a home automation system (HAS) based on Raspberry Pi 3 and android device using Wi-Fi Router. The main objective of the smart home automation is to provide comfortable, a convenient user interface by sensing and controlling home environment and to improve the energy efficiency by controlling and monitoring the home appliances. The figure1 shows the system architecture of HAS which consists of Raspberry Pi 3, camera, IR sensor, temperature sensor, gas sensor, LDR sensor, relay circuit, android application and home devices.

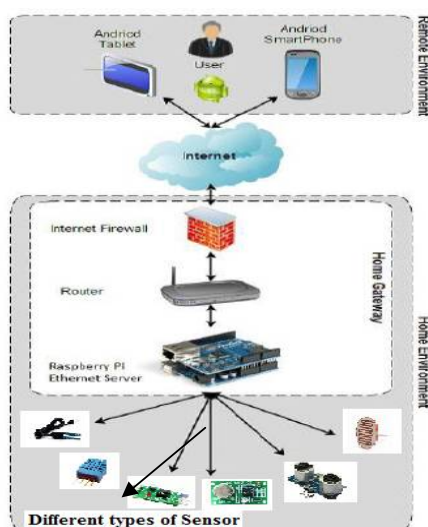


Figure 1: Architecture of Home Automation System

3.1 Sensors

Sensors are the devices which convert the physical parameter into the electric signal. The system which is shown in figure 2 consists of

- Soil moisture sensor - used to measure the moisture content of the soil.
- Ultrasonic sensor - used to measure the water level in the water tank.
- IR sensor - used to detect motion of any object entering the home.
- LDR (Light Dependent Resistor) - used to detect the variation in intensity of the light and helps in controlling on/off light.
- Gas sensor - used to detect the presence of abnormal gases in the home, used as a part of safety system.
- Temperature and Humidity sensor - used to keep track of temperature in the home environment and to control on/off fan.

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Figure 2: Types of sensor used

3.2 Raspberry Pi Model B

Raspberry pi: For this paper, of course you will need a Raspberry Pi board. The version of the board or the model (A or B) doesn't really matter, but keep in mind that you will have to connect it to your local network, so you will need a Wi-Fi dongle if you are using the A model which doesn't have an Ethernet port. In this paper, we used a Raspberry Pi model B with the Wi-Fi dongle.

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage.



Figure 3: Raspberry Pi Model B

3.3 Garden Watering

If the soil moisture value is less than 4000 and temp is greater than 35, water will be supplied for 2 secs. If the soil moisture value is less than 4000 and temp is less than 35, water will be supplied for 1 secs. If the soil moisture value is greater than 4000, no water supply takes place



Figure 5: Garden Watering System

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3.4 DC motor

DC motor in simple words is a device that converts direct current (electrical energy) into mechanical energy.

3.5 Android Application

The android application is the mobile operating system installed in the user smart phone. A remote user can monitor and control the home appliances from its android application and communication is done via locally or remotely. When the threshold value of the sensor reaches maximum level the android application for smart home automation system instantly alerts the user to remotely monitor the home appliances. An android platform is used as it has a huge market and cost effective due to the open source. Besides that, android development application tools are free to download and provide flexibility to developers to easily edit and extend the source code.

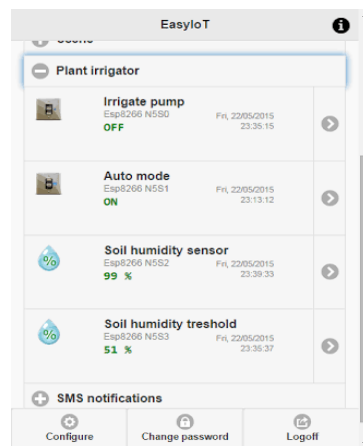


Figure 4: Android Application for HAS

IV. METHODOLOGY

The proposed method consists of different sensors like temperature, gas, motion, soil moisture, ultrasonic and humidity. Initially the Raspberry Pi 3 connects to the internet through Wi-Fi. When the connection is established it will start reading the parameters of sensors. The threshold levels for the required sensors are set. The sensor data are sent to the web server and stored in the cloud. The data can be analysed anywhere any time. If the sensor parameters are greater than the threshold level then the respective buzzer will be raised and the required actuation is done for the controlling of the parameters. In the proposed model the temperature, gas leakage, motion in the house is monitored. The temperature and the motion detection are stored in cloud for analysis. If the temperature exceeds the threshold level then the cooler will turn on automatically and it will off when the temperature comes to control. Similarly when there is a leakage of gas in the house alarm is raised giving the alert sound. The required lights are turned on/off automatically by detecting the light outside the house. Enhanced features are improved power consumption, increased connectivity and greater IO which made this powerful, small and lightweight ARM based computer. The Raspberry Pi cannot directly drive the relay. It has only zero volts or 3.3V. It needs 12V to drive electromechanical relay. In that case it uses a driver circuit which provides 12V amplitude to drive the relay. Sensors connected to the Raspberry Pi board give a resistance variation at the output. This signal is applied to the comparator and signal conditioning circuit which has potentiometer to decide the moisture level above which the output of comparator goes high. This output signal is given to the Raspberry Pi board. If the soil moisture value is above the moisture level then the 3 phase induction motor will be OFF, whereas if the moisture level is low motor will be ON through the relay. For monitoring the farm at night LDR is used which controls the light automatically.

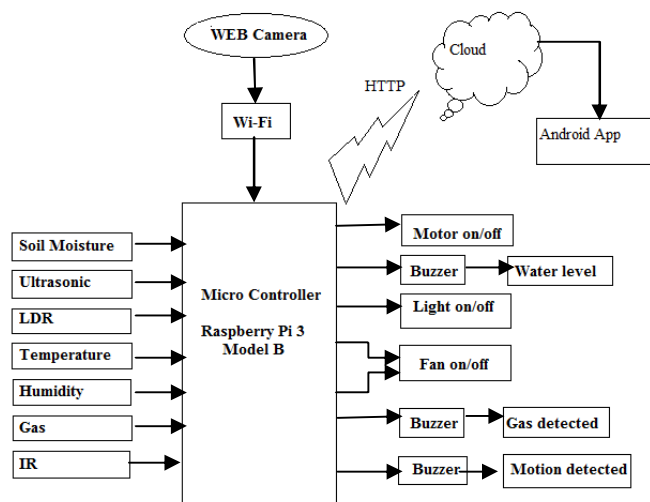


Figure 6: Block diagram for home automation system

V. CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the cloud (Gmail) in a timely manner. This will help the user to analyze the condition of various parameters in the home anytime anywhere.

Such a system can easily be made and it is not very costly. With the improvement of sensor technology, the system will become more efficient and useful. For instance, a more accurate weather forecast can help better decision making in supplying water and reducing water wastage. If soil nutrition measuring instrument can be installed, then the system can be re-engineered to make it able to supply fertilizer to the land precisely. Using this system, one can save manpower, water to improve production and ultimately increase profit. The automated irrigation system is feasible and cost effective for optimizing water resources for agricultural production. The system would provide feedback control system which will monitor and control all the activities of plant growth and irrigation system efficiently.

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