

Android Based Smart Home Automation System Design Using Raspberry Pi3

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Abstract:

Automation plays an important role in today's human life and people's life is gradually changing with smart living due to modern technology development and Android Smartphone. This paper presents a low-cost Smart Living System, which uses Android based User Interface for control of home appliances. Connection to the smart living system can be made from the designed app via Bluetooth or internet connection. It also integrates home security and alert system. Also, the smart home concept in the system improves the standard living at home.

The main control system implements wireless Bluetooth technology to provide remote access from PC/laptop or smart phone. The design remains the existing electrical switches and provides more safety control on the switches with low voltage activating method. The switches status is synchronized in all the control system whereby every user interface indicates the real time existing switches status. The system intended to control electrical appliances and devices in house with relatively low cost design, user-friendly interface and ease of installation.

Keywords

Smart Living; Automation; Android Smart Phone; Bluetooth.

1. Introduction

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors, Microcontrollers.

Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output.

In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result. In this project we use RF

module as well as the DTMF decoder for communication. Now when we dial the numbers in the mobile phone from the controlling side then it automatically recognizes which number has been recorded and it follows with the corresponding next step to be taken i.e., movement of the robot in water.

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Almost every household has one, and tens of millions of them are used every day, but very few people realize that a processor and software are involved in the preparation of their lunch or dinner.

The continuous growth of mobile devices in its recognition and functionality has led to an increase in the demand for advanced ubiquitous mobile applications in people's daily lives. Smart phones are more than just phones in today's life having a broad range of applications, such as education, healthcare, and entertainment. Smart homes aim to provide enhanced convenience and comfort, energy efficiency, security and surveillance. It is claimed by market researchers that majority of homes will be outfitted with home automation systems in the very near future. Various smart home systems have been proposed where the control is via Bluetooth, internet based while some researchers have proposed voice controlled smart home system based on Microsoft speech recognition and microcontroller based voice activation (voice recognition module is used).

2. Proposed system Architecture

In this scenario, Raspberry PI is a server that handles all requests. It is used to receive information from the sensors, process that information and deliver processed data to mobile device. Also, Raspberry PI is used as a server in the other direction, when user uses mobile phone to send commands and change the environment in our smart home.

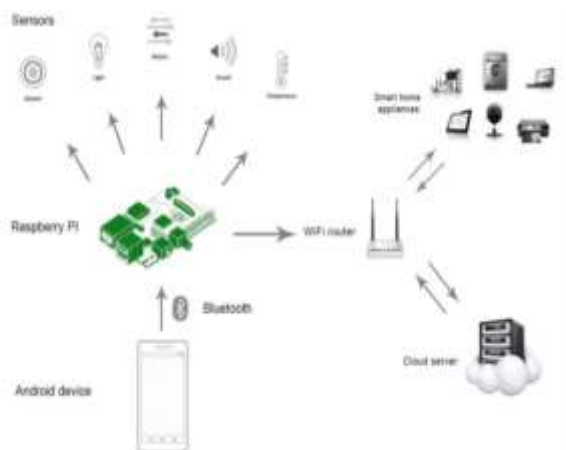


Figure 1: Connectivity between Raspberry Pi 3 and Wi-Fi Router

If any of the temperature, fire and smoke sensors detect the change in the threshold the sensors have to be activated and the changes to the raspberry Pi 3 which would in turn when connected to a Wi-Fi router or Mobile Data(in mobile phone)can warn the end user by sending the email to the registered Mail ID.

a) Challenges

A recent study by different researchers determined that the top four barriers to wider adoption of smart homes are the issues associated with linking disparate systems, poor manageability, high cost of ownership, and difficulty of integrating security systems.

i) Linking disparate systems

The smart home market is fragmented, at present. Many competing manufacturers are developing disparate smart home systems and technologies. It's easy to integrate devices made by the same vendor, but that requires, in many cases, consumers to buy replacement devices.

ii) Limited functionality

Integrating devices from disparate vendors often results in limited functionality and unreliable service. Further, many systems on the market have complex interfaces that limit the functionality of smart homes. Finally, app-based smart home systems, while cheaper than fully custom integrated systems, have more limited functionality than full systems.

iii) Costs

Fully integrated custom systems are expensive and often require a consultant to install them, and structural changes to the home, both costs of course tacked on to the price of the system itself.

b) Hardware Implementation

1) Raspberry pi unit: For programming, communication and controlling the HC-05 Bluetooth module and different sensors connected to it.

2) HC-05 Bluetooth module

3) Transformer to transfer electrical energy between two or more circuits.

4) Relay 5V

5) LCD Screen

6) Regulated +5v Power supply

7) MOC3021 for driving TRIACs.

8) BT136 for controlling AC loads.

c) Applications

i) Home automation

Home automation is the residential extension of building automation and involves the control and automation of lighting, heating, ventilation, air conditioning (HVAC), appliances, and security. Modern systems generally consist of switches and sensors connected to a central hub sometimes called a "gateway" from which the system is controlled with a user interface that is interacted either with a wall-mounted terminal, mobile phone software, tablet computer or a web interface

ii) Machines controlling system in industry

Smart homes also have the potential to be greener and cheaper. Water and energy-monitoring tools, and programs to optimize energy consumption, could impel us to lower our water and energy usage, which could, in turn, lower our bills and reduce our carbon footprint.

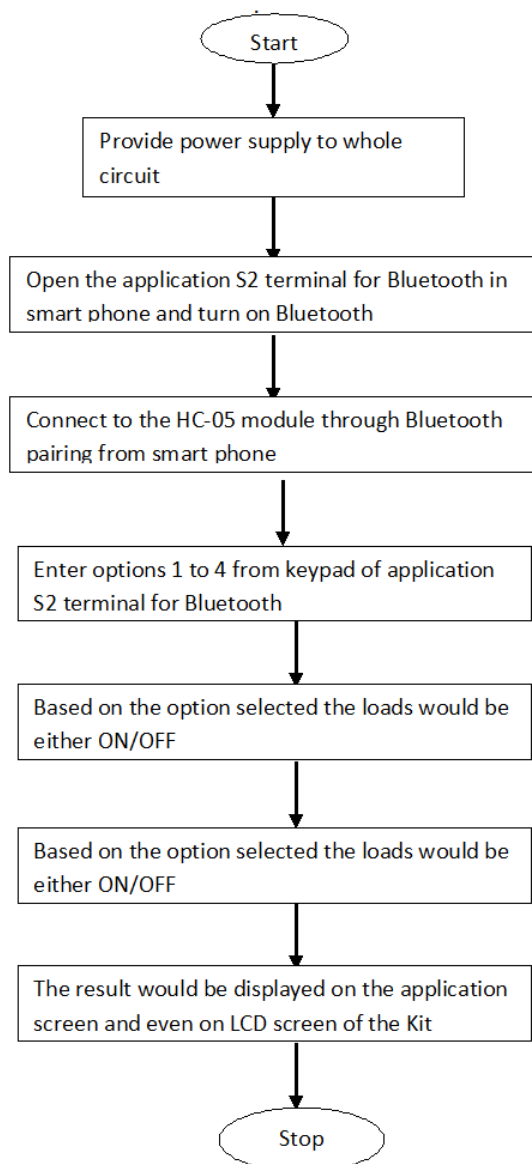
iii) Door access control system

The door locks are the primary type of access control devices used for security purposes. These door locks can be used in houses, offices and places where the security is the main purpose.

3. Methodology and Implementation

The methodology of this project design can be divided into two sections; hardware and software implementations. The hardware implementation consists of the development of the main controller (Raspberry Pi3), sensor networks and the smart home while the software implementation focuses on the programming of the Raspberry Pi 3 using Python.

The implementation of Smart home automation system using Android application and internet connectivity is as follows:



- Option 1: Both loads light and fan are ON
- Option 2: Light is ON and Fan is OFF
- Option 3: Both loads light and fan are OFF
- Option 4: Light is OFF and Fan is ONs

We have used Raspberry pi 3 module as a processor. The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache. In the designed prototype Programming is Code for Raspberry pi unit using Python Language.

For internet connectivity, the user has to enter the IP address and a password whereas for Bluetooth connection selecting the device and entering a password is required.

Every user United Nations agency is full-fledged within the existing system might imagine of a system which will add additional flexibility and run with some common applications like humanoid. The

projected system is meant in such how to avoid the restrictions of the prevailing system. The projected system supports additional flexibility, comfort ability and security. The projected home automation system is functioning with very humanoid phones having chiefly 3 components; the humanoid enabled user device, a LAN router having a decent ascendable vary, and a raspberry pi board. Here the users have provision to regulate the house appliances through humanoid enabled device. This can improve the system quality since there no would like for a wired association, net etc. The directions from the user are transmitted through the LAN network.

The raspberry pi board is organized in step with the house system and will change the relay circuit as per user request. The relay circuits will management the house appliances additionally. We will add appliances to the system can also add extra security measures. The main objectives of the projected system is to style associate degree to implement an inexpensive and open supply home automation system that are capable of dominant and automating most of the house appliances through an humanoid device.



Figure 2: Hardware implementation of proposed system

For this home automation and security system we are targeting Android platform since it has huge market and open source. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. The Android OS is based on Linux. Android Applications are made in a Java-like language running on a virtual machine called 'Dalvik' created by Google. A Smart phone is a mobile phone based on a mobile operating system, with more advanced computing capability and connectivity than a feature phone.

Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Android, by simple definition, is an operating system for many mobile phones. Android

is a customizable platform that can look and feel very different on every different handsets. Android gives us tools for creating apps that looks great and take more advantage of the hardware capabilities available on each device. Android is mainly based on Linux operating system which uses java- like languages for running applications. The main purpose of using android is to send the control signals from smart phone through Bluetooth.

4. Results and Discussions

The S2 terminal for Bluetooth application would be displayed with the fire, temperature and smoke values.



Figure 3: Results obtained on Bluetooth app



Figure 4: Results obtained on LCD Display

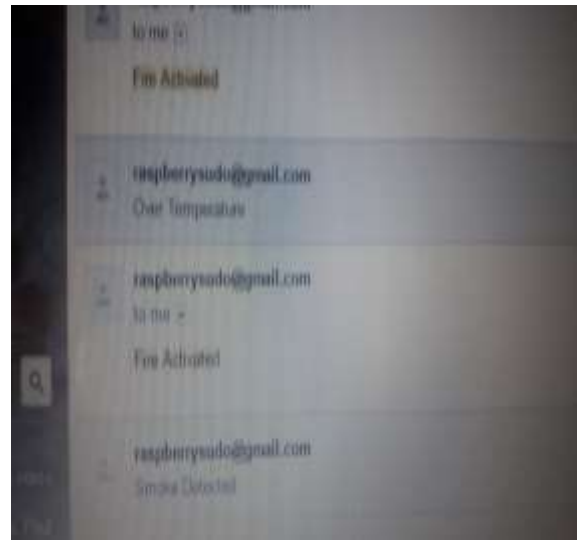


Figure 5: Results obtained to our mail id 1

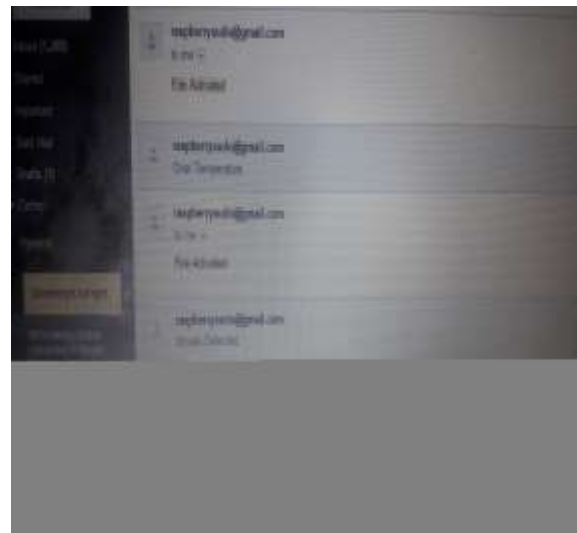


Figure 6: Results obtained to our mail id 2

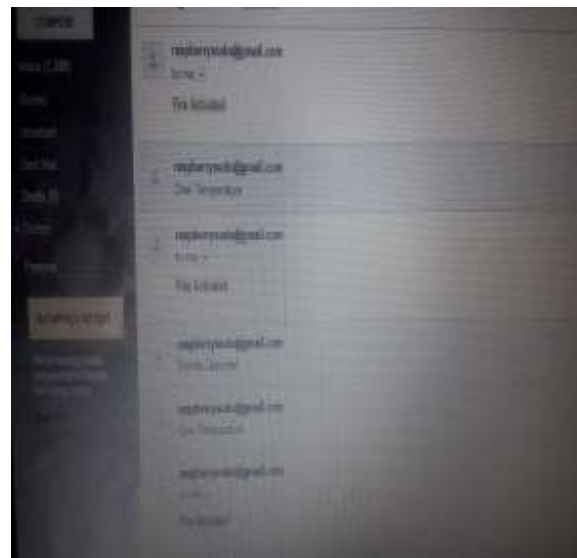


Figure 7: Results obtained to our mail id 3

5. Conclusion

In this paper, a novel architecture for low cost and flexible home control and monitoring system using Android based Smart phone is proposed and implemented. Any Android based Smart phone with built in support for Wi-Fi can be used to access and control the devices at home. When a Wi-Fi connection is not available, mobile cellular networks such as 3G or 4G can be used to access the system. The proposed smart home system and the smart home app has been successfully developed and tested. Devices such as light switches, temperature sensors, gas sensors, motion sensors and alarms have been integrated in the system to demonstrate its feasibility and effectiveness. Features such as low cost, user authentication, voice activation, security and surveillance, and automatic control make the proposed system unique.

6. Future scope

Future scope for the home automation systems involves making homes even smarter. Homes can be interfaced with sensors including motion sensors, light sensors and temperature sensors and provide automated toggling of devices based on conditions. More energy can be conserved by ensuring occupation of the house before turning on devices and checking brightness and turning off lights if not necessary. The system can be integrated closely with home security solutions to allow greater control and safety for home owners. The next step would be to extend this system to automate a large scale environment, such as offices and factories.

7. References

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