Design of Raspberry Pi based Home Automation through Android Application

Vaishnavi S. Gunge
Walchand Institute of Technology, Solapur, Maharashtra, India

Pratibha S.Yalagi
Walchand Institute of Technology, Solapur, Maharashtra, India

Abstract- Automation is a technique or system of controlling a process by electronic devices with reducing human involvement to a minimum. This paper presents a design of monitoring and controlling home automation system from an android application based on Raspberry Pi. A system uses Wi-Fi technology as a communication protocol to connect system components. A home automation system consists of two main components; the first part is android application that can give orders to units that one wishes to control by locally or remotely and a second part is Raspberry Pi that has an appropriate interface to sensors and appliances of a home automation system and communicates with an android application through wireless technology. The home automation system can have a vital role in reducing the total energy consumed by home appliances.

Keywords – IOT, Smart home, Raspberry Pi, Android application, Sensors, Wi-Fi.

I. INTRODUCTION

The concept of smart home automation is becoming popular by including various features. It refers to the control of home appliances and domestic features by local networking or by remote control. It provides comfort for private home and commercial building by allowing centralized control of heating, ventilation, air condition and lighting. Hence, home automation system contributes to reducing cost and wastage of natural resources like water, energy which are the main issues today. Internet of things (IOT) grant to people and things to be connected anytime, anyplace, with anyone, ideally using any network and any service [1]. Home automation is another important application of IoT technologies and use of Raspberry Pi is increased in IOT products [1]. It is the monitoring of the energy consumption and the controlling the environment in buildings, schools, offices and museums by using different types of sensors and actuators that control lights, temperature, and humidity[2].

A wireless sensor network (WSN) is a network contains sensors are used to monitor physical or environmental conditions of distributed devices such as light, temperature, etc. Home automation could be improved through developments of a communication network that uses, radio signals or an internet Protocol as standards. The home automation system includes a central controller, sensors, mode of transmission, User interface. Many smart appliances or devices became capable of communicating with one another through the Internet. For example, users can now control their smart TVs through their mobile phones. With the rapid expansion of the internet, the quality of life has been improving [1]. The Smart home is known as house automation with the use of new technology, to make the domestic activities more convenient, comfortable, secure and economical [12].Different challenges were discussed faced by home automation system [3]. These barriers are high development costs, high installation costs, additional service and support costs, consumer unfamiliarity with technology, and complex user interfaces.

II. RELATED WORK

The field of home automation is expanding and it has been researched by experts and industrialist. There are a number of do-it-yourself (DIY) platforms available that allow creating home automation system quickly and easily with low cost and high performance e.g. Raspberry Pi, Arduino, other microcontrollers .Various smart systems have been proposed where the different communication protocol was used e.g. DTMF, Bluetooth, email, and Wi-Fi, the Internet or SMS etc.[4].

Home automation control through email where the received email is read by the developed algorithm on raspberry Pi [5].A system can access and send emails to the consumer with the use of MODEM (Modulator-Demodulator). Memory space required is ejected by email based home automation system because it simply uses the already existing web server service provided by G-mail and this technique is better than DTMF (dual tone multi-

frequency) based home automation system [5]. A drawback of DTMF based home automation is that the number of appliances is limited by the number of keys in the keypad. An ordinary phone usually has 12 keys only. SMS (Short Message Service) has been used as a communication protocol to control residential features.AT-commands has been applied and homeowners will be able to send and receive SMS and control home appliances from user's mobile phones. Disadvantages of home automation using SMS are costs for the SMS and SMS depends on the networks [6]. An interaction between Arduino BT board and cell phone has been done through Bluetooth [7]. Python script supported mobile phone enables the user to access and control commands for the appliances. Bluetooth is password protected to ensure that the system is secure from any intruders. The Bluetooth has a range of 10 to 100 but access is limited to within the Bluetooth range.

WI-FI technology as a communication protocol to connecting system components [8]. Components are a web server to control users home using LAN (Local Area Network) or the internet and Second part is Arduino board. IDE (integrated development environment) comes with the Arduino microcontroller itself. Arduino software track status from connected sensors, then apply an action to actuators [8] [10].Wi-Fi technology has a capable solution by controlling remotely .WI-FI based system has security and effectiveness as compared to Bluetooth and DTMF. The application has been developed based on the android system. Java programming language using the android Software Development Kit (SDK) has been used for the development and implementation of the smart home application [9] [10]. The application has been installed on an android Smartphone, a web server, and a raspberry pi card to control the shutter of windows. Android application on a smartphone issue command to raspberry pi card. A Recent development of the Raspberry Pi minicomputer has applied in a vast number of areas e.g. home automation. Raspberry Pi system has unique advantages, this technology holds great promise for providing solutions within the developing world. Use of GPIO (General Purpose Input/Output) which allows automated data acquisition and producing simple digital control systems [9].Wireless ZigBee and wired X10 has been used as a communication protocol to control home with smart task scheduling [11]. Shih-Pang Tseng et al. [12] proposed Smart home system based on the ZigBee, all sensors and actuators are connected by a ZigBee wireless network. Simple smart socket designed, which can remote control via ZigBee. PC host has used as a data collector and the motion sensing, all sensing data are transferred to the VM (virtual machine) in the cloud. The user can use the PC or Android phone to monitor or control through the Internet to power-saving of the house.

III. System Architecture

This paper presents a smart home system based on Raspberry Pi and an android device with use of the wireless router. The objective of smart home automation is to provide comfortable, a convenient user interface by sensing and controlling home environment and to improve the energy efficiency by monitoring and controlling the appliances. Figure 1 shows interaction among different components of home automation system.

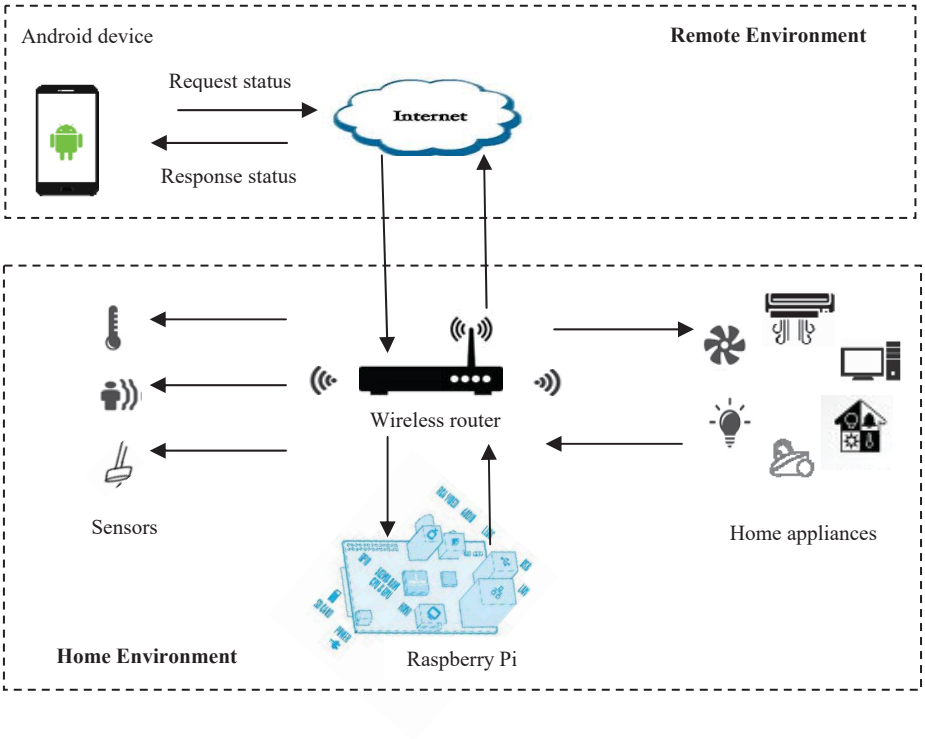

Figure 1.Architecture of Home Automation System

Raspberry pi: Raspberry Pi is a credit-card-sized single board computer developed in the UK by Raspberry Pi foundation [5]. It is used to eliminate the use of a personal desktop keeping the cost of the overall system to a Minimum. Raspberry Pi is used to control flow between android device and sensors. Raspbian OS is used on Raspberry Pi and the server running on Raspberry Pi device is written in Python. Raspberry Pi has Python already installed on it. MySQL database created on Raspberry Pi that contains sensor information.

Android application: The application has installed on a Smartphone. A remote user can monitor and control the home environment from its android application and communication is done via locally or remotely.

Router: A wireless router facilitates the communication between the internal network and the external network. Communication between the Raspberry Pi and home appliances is done over Wi-Fi network.

Sensor: All home appliances generate information about current status. Status information is generated by a sensor integrated with the device. A sensor can sense things like the presence of person for lighting control, movement, temperature etc. There are different sensors according to the respective devices.

Device: Devices such as light switches, power plugs, appliances of the house, which is compatible with the transmission mode, and connected to the control system.

Home automation system contains the following functionality:

1. Users can monitor and track status that is read via sensors. Raspberry Pi device is collecting values that are read by the sensors. These values are sent to the android application on the mobile phone and stored in a MySQL database. If a mobile phone is within Wi-Fi range from the Raspberry PI device, Wi-Fi is used for communication between these two components of a system. If a mobile device is not within Wi-Fi range, then Raspberry Pi is communicating with an android application via the Internet.

2. Users can control home appliances via an android application. Users can communicate to the home appliances and other actuators via Android application. Users are allowed to completely control smart home system only using an android application which is on user's mobile phone. Whole communication among system components is done with the use of a wireless router.

IV. CONCLUSION

IoT-based smart home systems will bring more convenience and comfort to people's lives. The android-based smart home application communicates with the Raspberry pi via an internet. Any android supported device can be used to install the smart home application. Using android application user can control and monitor the smart home environment. Raspberry Pi provide an economic and efficient platform to implement the smart home automation system. Advantages of a home automation system are user can operate devices using the internet from far distances. A system can be used to communicate to a number of devices and smart environments. It will use to minimize wastage of electricity. It is less time consuming and helps to old and disabled people. .

REFERENCES

[1] CHARITH PERERA1 , CHI HAROLD LIU2 ,SRIMAL JAYAWARDENA1 , AND MIN CHEN3 ," A Survey on Internet of Things From Industrial Market Perspective", 2169-3536 2015 IEEE.

[2] Andrea Zanella, Nicola Bui, Angelo Castellani, Lorenzo Vangelista, and Michele Zorzi, "Internet of Things for Smart Cities", IEEE INTERNET OF THINGS JOURNAL, VOL. 1, NO. 1, FEBRUARY 2014.

[3] A. B. Brush, B. Lee, R. Mahajan, S. Agarwal, S. Saroiu, and C. Dixon,"Home automation in the wild: Challenges and opportunities," in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '11, (New York, NY, USA), pp. 2115–2124, ACM, 2011.

[4] Vaishnavi S. Gunge, Pratibha S. Yalagi," Smart Home Automation: A Literature Review", International Journal of Computer Applications (0975 – 8887) National Seminar on Recent Trends in Data Mining (RTDM 2016).

[5] Jain Sarthak,Vaibhav Anant and Goyal Lovely ,"Raspberry Pi based Interactive Home Automation System through E-mail.",IEEE transaction,2014 International Conference on Reliability, Optimization and Information Technology ICROIT 2014, India, Feb 6-8 2014.

[6] Rozita Teymourzadeh, CEng, Member IEEE/IET, Salah Addin Ahmed, Kok Wai Chan, and Mok Vee Hoong ," Smart GSM Based Home Automation System", 2013 IEEE Conference on Systems, Process & Control (ICSPC2013), 13 - 15 December 2013.

[7] R.Pivare, M.Tazil,"Bluetooth Based Home Automation System Using Cell Phone", 2011, IEEE 15th International Symposium on Consumer Electronics Singapore, pp.192.

[8] Ahmed ElShafee, Karim Alaa Hamed," Design and Implementation of a WiFi Based Home Automation System", International Journal of Computer, Electrical, Automation, Control and Information Engineering Vol: 6, No: 8, 2012.

[9] Hayet Lamine and Hafedh Abid , "Remote control of a domestic equipment from an Android application based on Raspberry pi card", IEEE transaction 15th international conference on Sciences and Techniques of Automatic control & computer engineering - STA'2014, Hammamet, Tunisia, December 21-23, 2014.

[10] Shiu Kumar," UBIQUITOUS SMART HOME SYSTEM USING ANDROID APPLICATION ", International Journal of Computer Networks & Communications (IJCNC) Vol.6, No.1, January 2014.

[11] *Kim Baraka, Marc Ghobril, Sami Malek, Rouwaida Kanj, Ayman Kayssi*," Low cost Arduino/Android-based Energy-Efficient Home Automation System with Smart Task Scheduling ",2013 Fifth International Conference on Computational Intelligence, Communication Systems and Networks.

[12] Shih-Pang Tseng, Bo-Rong Li, Jun-Long Pan, and Chia-Ju Lin,"An Application of Internet of Things with Motion Sensing on Smart House", 978-1-4799-6284-6/14 2014 IEEE