International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2019 IJSRCSEIT | Volume 5 | Issue 2 | ISSN : 2456-3307
DOI : https://doi.org/10.32628/CSEIT1952267

A Gesture Controlled and Cost Effective - Home Automation System

Mohit Malhotra[1], Raghav Mittal[2], Madhur Jain[3]

[1,2]I.T. Scholar, Bhagwan Parshuram Institute of Technology, Guru Gobind Singh Indraprastha University, Delhi, India

[3]Assistant Professor, Bhagwan Parshuram Institute of Technology, Guru Gobind Singh Indraprastha University Delhi, India

ABSTRACT

This paper presents a secure and reliable home automation system in order to make everyone's life simpler and fulfil the needs of the disabled or the elderly. The paper proposes a system based on efficient smart watch that uses arduino microcontroller which is embedded with a WIFI module and enables us to control a number of home appliances such as lights, fans and others using on/off relay. In our work, the appliances need not to be smart beforehand as arduino would be externally connected to them such that the system designed would be controlled by gestures i.e. users can control the working of the appliances by moving their hand in upward or downward direction over the screen. This system is comparatively efficient and cost effective than other proposed systems in terms of scalability and reliability. Also, the proposed system has been thoroughly tested and verified in various environmental conditions.

Keywords : Home Automation, Arduino Uno, Wifi, Wearable Computing, NodeMCU, Smartwatch, Android, IOT

I. INTRODUCTION

The technology has reached to a level where things with inbuilt systems and connections can perform from the most complex, difficult problems to ubiquitous ones from which the device which enable our tasks to get completed in few seconds with a go, with less workload and in optimised manner are termed to be as smart gadgets or devices. Out of which now a days, Smart homes has taken its growth and paved a way to enable common people to live a comfortable and secure life where, home automation is a term described as the usage of such systems that provide a sensible and proactive support which complements human activities. Furthermore, it had obtained its major impact over the elderly and the disabled humans, who faced problems in homes in their routine lives. This technology has helped them to perform from the basic tasks such as controlling the lighting devices used as the heating appliances of their homes without moving from their own place. Although, many mobile and computer-controlled applications are available in the market but their usage is limited to a selected groups only. To resolve this issue, we present an android based smart watch, which will be controlled by gestures where wearable computing is used to obtain its maximum results with reduced cost that tends to be more accepted by the population as it can be easily used and demands less human energy such that the watch can be used just by flicking the wrist and is a more viable option than the available mobile applications. Thus, our system would be specifically helpful to the visually challenged people who can now control the working

of the appliances themselves. In our work, we used one hand gesture to control single appliance and similarly different gestures were used to control different appliances. On the basis of research, there has been found no other method that is successfully working gesture controlled and cost effective smart watch available in the market. Many researches have been done on the subject because of the demand and development that is reaching at its maximum. It has become a necessity with time. In our proposed work, we address human-home interaction through gesture control by an android watch, for this functionality, gyro-sensor i.e. the device that works on the changes occurred in the angular velocity sensor which itself measures or senses the rotational angle per unit time as in [1], is present in the watch measuring and sensing the changes occurring in the orientation and in angular velocities during the process of usage. The project will be using Wi-Fi technology as it is a best and easily accessible option for establishing the communication with no cords running through home enhancing the mobility. Also, it covers wide range with economically feasibility for everyone. We are using Wi-Fi protected access so that our system becomes secure and reliable. In addition, we are using ESP8266 WIFI Module because it can be used as a Wi-Fi access point and as well as a Wi-Fi client. The device used for controlling the automation is an Arduino Uno, which reads the data and decides the switching action to be performed. Secondly, there is no need for the appliances to be smart beforehand because arduino will be connected to them manually. They will enable the switching action in electrical devices through relays.

II. RELATED WORK

The idea of constructing efficient home automation systems is very popular among researchers today. Many systems on different technologies have been proposed by them to fulfil this need but many more advancements can still be made to achieve the desired goal. Rahul Varma et al. [2] proposed a smart watch as an home automation system. The watch was implemented using a raspberry pi board, which used flask framework and python programming to communicate with the home automation application on the Pebble Smart watch. The home appliances could be controlled by the application in the smart watch but gesture control mechanism was not present in the work. Simultaneously as Luigi De Ruissis et al. [3] proposed the first cost effective working prototype as a wearable computing device, a smart watch, to control the home appliances. The preliminary user tests conducted by them gave many interesting aspects which involved both the willingness to adopt watch in the home and in the workplace and also the price of the device must be in the low range. Then, the Smart House Monitor and Manager, in which all actuators and sensors were connected by a ZigBee wireless network. A ZigBee controlled smart socket was developed by them. Personal computer or mobile can be used to control the appliances via wifi as proposed Shih-Pang Tseng et al. [4], where Vaishnavi S. Gunge et al. [5] discussed various home automation systems and technologies based on artificial intelligence. They presented a comparison table of different systems based on user interface, central microcontroller and communication interface. Many features of the different systems and their benefits are also presented. From here, different applications of the wifi based home automation system can be concluded such as in fire detection, motion detection etc. Mahalakshmi et al. [6] proposed an android based smart phone for home automation using Arduino UNO microcontroller. The system was capable of detecting any intrusion, using motion sensors and temperature, humidity, gas and smoke sensors were also present for environmental monitoring. Further, the system offered switching functionalities in home appliances using relay network. Their basic idea behind the project was to keep energy levels down while providing more reliable and automated systems.

Siddharth Wadhwani et al. [7] uses Arduino, interfaced with flex sensor, accelerometer, flame sensor, magnetic sensor and Wi-Fi module and proposes a home automation and home security technique. They propose that IOT applications can make our life easier and their work may lead to many new innovations. In their work, the flex sensor can control the appliances using finger gestures. Hardik S. Jayaswal et al. [8] compares different techniques used in home automation system based on hand gestures. After comparing all the available methodologies namely Wi-Fi, bluetooth, voice recognition and gestures , they concluded that the gesture controlled systems are more economical, hardware efficient and can be used to implement many real time applications. Considering these researches the systems lacked cost effectiveness of product which could have been obtained through the method we have proposed in the paper.

III. HARDWARE DESIGN

This section will discuss about the hardware used in the proposed work.

A. ESP8266

It is a low cost Wi-Fi microchip that can give access of any microcontroller to your Wi-Fi network. ESP8266 can be programmed in various development environments thus expanding their usage in different domains as in [9]. It is a self-contained SOC with integrated TCP/IP protocol stack and microcontroller capacity. ESP8266 can be programmed using the Arduino IDE and its programming language.

B. TRIAC Switching Circuit (AC Light dimmer)

This device is used for switching purposes of the alternating current and is bidirectional in nature. The brightness of the light and the speed of the fan can be controlled by varying the supply given to the gate terminal of the TRIAC circuit as in [10]. Here, our control circuit, arduino will need a separate DC power supply and TRIAC is responsible for switching AC power.

C. MPU 6050

It is a six axis IMU sensor which gives three values from the gyroscope and remaining three values from the accelerometer. MPU6050 can be connected to the 12C Pins of the Arduino only as in [11]. It is the most reliable, accurate and the cheapest IMU sensor available.

D. Buck Convertor

It is a DC-to-DC converter which is used to convert high voltage signals to low voltage signals. It is efficient because it conserves power and extends battery life thus, it is suitable for building smaller gadgets as in [12]. The switching transistor present between the input and the output terminal of the converter switches on and off at high frequency.

E. DHT11Sensor

It is a simple and inexpensive sensor which is used to digitally detect temperature and humidity as in [13]. The relative humidity in the area is calculated by measuring the electrical resistance between two electrodes. A chip is present in the sensor which converts analog signal to digital signal with the temperature and humidity. The moisture holding substrate in DHT11 includes a humidity sensing component with the electrodes applied to the surface.

F. Smart watch

It is a gesture controlled android smart watch, which is the main component of the project as in [14]. The watch used has a LCD, a magnetometer, a vibrating motor, light sensors and gyro sensor. It can be

charged with a USB-cable. It is a bracelet like watch with sensing and controlling device. Feedback and notification system is also present in the wearable device.

G. ARDUINO UNO

The Arduino Uno board is an ATmega328 based microcontroller with 14 digital input/output pins. Inputs like light on a sensor, finger on a button are read by the arduino boards as in [15]. These inputs are then converted into corresponding outputs. Its function is to decide the switching action, which is to be performed in the electrical devices and therefore give out the results.

H. GYRO SENSOR

Gyro sensor is also known as angular velocity sensor or rate sensor and helps in sensing angular velocities. Gyro sensors present in the proposed system interact with the home electronic appliances using recognized hand gestures and sense the orientation and angular velocities as in [16]. On the other hand, linear acceleration based on vibration is measured by accelerometer.

IV. IMPLEMENTATION

As shown below, Automation system is divided into electronics units using Master Slave strategy. Master automation unit is the user watch that has the following functional components:

1) Arduino development board
2) Android based smart watch
3) MPU 6050 Sensor
4) Power unit (Batteries)

ATMAL 328 based development board is used to communicate with MPU 6050 for gesture detections on the basis of deviation along geometric axes whereas Android watch will be used as User Interface to control the targeted devices using the Homatic app.

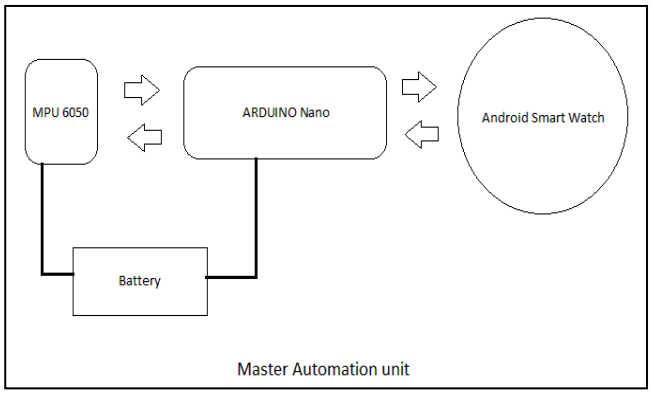

Figure 1. Master Automation unit: displaying the connection of whole of the units working in the system.

Slave automation unit is used at the device which needs to be automated. It is plugged inside the target device circuit. This unit is designed using components :

1) AC Light Dimmer Module
2) ESP 8266 / NodeMCU
3) Solid State Relays

ESP 8266 is programmed to provide communication terminal at the slave end and process the received commands from the master unit.

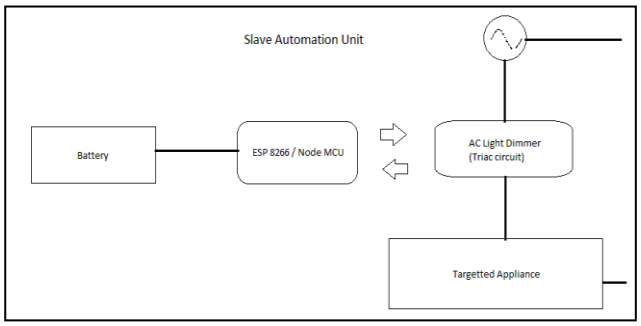

Figure 2. Slave automation unit

Master unit commands the slave with command structured with AID (Appliance Id) appended with ACTION that is being automated. Command structure is as follows:

Appliance ID (AID)	Automated Action	State

Figure 3. The command structure format

In this, *AID* is represent unique id for an appliance connected in the network which is used to identify which appliance is targeted by master for a specific command. *Automated* Action is described after processing the MPU output depending on the user gesture; it can be switching the power up and down or regulating the appliance whereas *State* represents the cached state at the master end for a particular AID. State is stored at master end to remember the appliance last state for a particular automation session.

V. CONCLUSION

This paper proposed a more flexible way to control the home appliances by a gesture control smart watch. It is better than home automation by smart phones and computers as it eliminates the need of searching the mobile every time you need it. The system proposed is very reliable, secure and can be used easily by all the age groups. Also, it is very useful for the physically and the visually challenged people. In future, additional sensors can be added to each room so that whenever the person will enter or exit the room, the appliances can sense the motion, and turn ON or OFF the light and other appliances accordingly. Further, the watch can be used to calculate the energy used by the appliances.

VI. REFERENCES

[1]. Suzushi Kimura, Hiroshi Yamaguchi, "Angular Velocity Sensor", US Patent 4,671,112, 1987

[2]. U. Rahul Varma and A.V.S.S.Bharadwaj, "Home Automation Using Smart Watch", International Journal of Computer Science and Software Engineering (IJCSSE), Volume 5, Issue 10, October 2016.

[3]. Luigi De Russis, Dario Bonino and Fulvio Corno, " The Smart Home Controller on Your Wrist" UbiComp'13, September 8-12, 2013, Zurich, Switzerland.

[4]. 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.

[5]. Vaishnavi S. Gunge and 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)

[6]. G.Mahalakshmi and M.Vigneshwaran. "IOT Based Home Automation Using Arduino" International Journal of Engineering and Advanced Research Technology (IJEART) .ISSN: 2454-9290, Volume-3, Issue-8, August 2017

[7]. Siddharth Wadhwani, Uday Singh, Prakarsh Singh and Shraddha Dwivedi. "Smart Home Automation and Security System using Arduino and IOT" International Research Journal of Engineering and Technology (IRJET). Volume: 05 Issue: 02, Feb-2018.

[8]. Hardik S. Jayaswal, Mit R. Thakkar and Ronakkumar K. Patel. "Proximity Hand Gesture based Home Automation System using Arduino and APDS-9960" International Journal of Computer Applications (0975-8887). Volume 181 – No.3, July 2018.

[9]. Christopher Grant, Using the ESP8266 WiFi Module with Arduino Uno publishing to Thing Speak, https://medium.com/@cgrant/using-the-esp8266-wifi-module-with-arduino-uno-publishing-to-thingspeak-99fc77122e82

[10]. Triac Configuations, "https://www.electronics-tutorials.ws/power/triac.html"

[11]. Jian Huang." Design of Angle Detection System Based on MPU6050". Advances in Computer Science Research (ACSR), volume 73 7th International Conference on Education,

Management, Information and Computer Science (ICEMC 2017).

[12]. Mousumi Biswal, Sidharth Sabyasachi."A study on recent DC-DC converters". International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 .Vol. 2, Issue 6, November- December 2012, pp.657-663

[13]. Ashish Sharma , Gaurav Tiwari , Durvijay Singh." Low cost Solution for Temperature and Humidity monitoring and control System using Touch Screen Technology". International Journal of Latest Research in Engineering and Technology (IJLRET) ISSN: 2454-5031 www.ijlret.com‖ Volume 2 Issue 1‖ January 2016 ‖ PP 10-14.

[14]. K AL-Nasser, "Smart Watch", US-Patent 8.725.842. 2014

[15]. Sunen Soni , Mayank Thanvi , Shivam Sharma , Sunil Yadav , Mr. Vikas Singh. " Home Automation System using Arduino". IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661,p-ISSN: 2278-8727 PP 34-38.

[16]. Abhijit M. ,Anjana Nair , Jikhil John , ShabasBasheer , Munna Basil Mathai. " Hand Gesture Based Home Automation ". International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering. Vol. 6, Issue 3, March 2017

Cite this article as :

Mohit Malhotra, Raghav Mittal, Madhur Jain, "A Gesture Controlled and Cost Effective - Home Automation System ", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 5 Issue 2, pp. 1033-1038, March-April 2019. Available at doi :
https://doi.org/10.32628/CSEIT1952267
Journal URL : http://ijsrcseit.com/CSEIT1952267