KNOCK CONTROLLED AUTOMATION SYSTEM

Abin Alias, Student, Fr.C.R.I.T, Vashi, India, abinalias6@gmail.com
Akshata Chikhale, Student, Fr.C.R.I.T, Vashi, India, akshatachikhle2804@gmail.com
Anitej Sengupta, Student, Fr.C.R.I.T, Vashi, India, anitejsengupta5@gmail.com
Anurag Singh, Student, Fr.C.R.I.T, Vashi, India, asingh050899@gmail.com
Tijo Joseph, Student, Fr.C.R.I.T, Vashi, India, tijojoseph98@gmail.com
Smita Chopde, Asst. Professor, Fr.C.R.I.T, Vashi, India, smita.chopde@fcrit.ac.in

Abstract: As technology is advancing, homes are also getting smarter. Modern homes are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. The objective of this project is to control home appliances remotely with the help of a knocking device. This device fastens onto tables, walls and doors. It then translates taps/knocks into controls for your IoT devices. It essentially turns particular surface to a remote control. For example, you can tap on a table three times to dim the lights. You can sync a device up to your smartphone so that knocking on a wall makes it ring and helps you find it. The simple system not only helps decouple smart home controls from smart devices but also is immediately accessible by way of its simplicity. It is very useful for elderly and handicapped people. In order to achieve this Wi-fi module ESP 8266 is used along with microcontroller, vibration sensor and relay circuit. It includes two circuits. First Circuit is on the AC switch board connected to a specific light/fan switch. The Second Circuit is on the table using which we want to control the appliance. Both circuits require controller and Wi-fi module. Wi-fi modules are connected to each other using TCP protocol. At the same time, TCP-Client app will be implemented where in when we send ON/OFF signal to Wi-fi module, it will read the data and send command to controller to turn ON/OFF the appliance.

Keywords — Control System, Internet of Things, Remote Controlled, Simplicity, Smart Home.

I. INTRODUCTION

Nowadays, development and changes of technologies is happening daily as well as continuous improvement of people's living standards are increasing. The smart gadgets are the inseparable part of human lives today. The mobile phone is the most important part of human lives today. With the help of this smart gadgets, human can do any work with or without internet like here we can make our home as well as organization smarter and also helpful for elderly or handicapped people.

The Internet of things (IoT) describes the network of physical objects— "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. In our application we are using IoT for developing an automation system which will be controlled by knocking on a surface acting as a remote. Presently, conventional wall switches which are in different parts of the rooms makes it inconvenient for the user to go near them to switch on/off any appliance. It becomes even more inconvenient for the elderly or the handicapped people to get up every time to use any appliances, like a light or a fan. System will consist of two devices. One device will collect the input from external sources in the form of knock (frequency of knock and time difference between two successive knocks). According to this input second device will control the home appliances. At the same time TCP-Client App will be generated for automation too. So, here we intend to implement an Automation system which will include the controlling of home appliances effectively. In a few words, "System activation will be just a knock away!"

II. LITERATURE SURVEY

For this proposed project, different research papers on home automation systems were studied as a part of literature survey. It was observed that some papers were related only to security systems, some of the applications were controlled by using an android application and some systems used sensors.

Electric switching ON/OFF of the electric appliances can be controlled using android operating system via Wi-Fi in his/her home or any other place [1]. Implementation of knock-based security system - This system is only for security purposes. When one knocks the door at a particular frequency, the door opens and a message is sent to mobile or tablet. It performs locking and unlocking of the door

 DOI : 10.35291/2454-9150.2021.0192

through patterns based on knocks [2]. Clap Switch Circuit for Devices using IC 555 and IC 4017- In this application, user can control electrical appliances by simple clapping. This circuit is mainly based on the two ICs i.e., NE555 timer along with CD 4017. The circuit of application is cumbersome as compared to traditional switch [3]. In our project, we have combined all the applications together i.e., usage of Wi-Fi module, android application and knocking for controlling home appliances and security purposes.

III. SYSTEM DESIGN

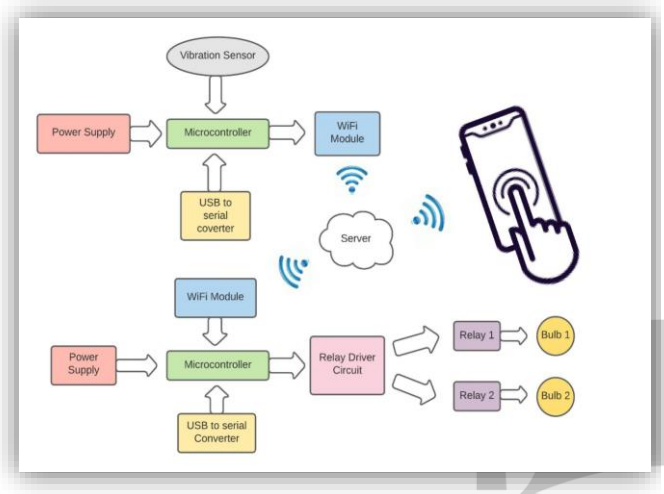


Fig. 1 System Block Diagram

In this proposed system, there are two devices. One device is used to detect the knocks from the user and second device is to control the appliances. In the first device microcontroller board is used to control all operations. The Wi-Fi module is connected to microcontroller through serial port and the vibration sensor is interfaced to ADC pin of microcontroller to detect the knock from the table. Second device also has microcontroller and Wi-Fi module connected serially. Also, relays are connected to microcontroller to control the appliances. USB to Serial converter is used to upload program to both microcontrollers. Wi-Fi modules are connected to each other using TCP protocol. Also, they are connected to local server through which appliances are controlled using smartphones along with the knock-controlled device.

The input threshold of voltage for vibration sensor is set to be 60 units. In Arduino UNO 1024 units correspond to 5 volts so 60 unit is equivalent to 0.29 volts. If the voltage equivalent of external knock/tap is less than 0.29 volts then the knock is considered to be invalid.

Following are the hardware and software requirements for the system to be developed.

A. HARDWARE DESIGN -

1. ESP8266

The ESP8266 is low-cost wireless module with a complete AT command library. This allows for easy integration with Wi-Fi network through wireless communication. ESP8266 works in two modes: Station mode (STA) and Access point mode (AP). AP mode allows it to create its own network and have other devices connected to it and STA mode allows ESP8266 to connect to a Wi-Fi network. In STA mode other devices get connected to Wi-Fi module ESP8266. Figure 2 shows an ESP8266 board [4].

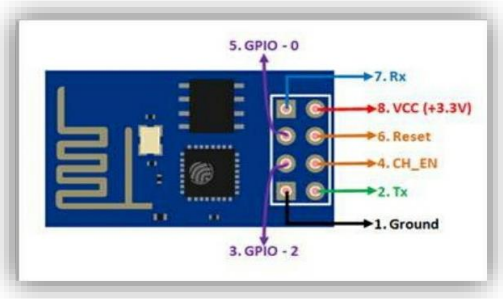


Fig.2 ESP8266 Board

2. Arduino UNO

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), 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 computer with a USB cable or power it with AC-to-DC adapter or battery to get started. Figure 3 shows Arduino UNO board [6].

Fig. 3 Arduino Board

3. Piezoelectric Sensor

Sensors are devices used to detect or sense the different types of physical quantities from the environment. The output generated is usually an electrical signal proportional to the applied input. This output is used to calibrate the input or the output signal is transmitted over a network for further processing. The sensitivity of these sensors normally ranges from 10 mV/g to 100 mV/g, and there are lower and higher sensitivities are also accessible. Figure 4 shows Piezoelectric sensor [7].

 DOI : 10.35291/2454-9150.2021.0192

Fig. 4 Piezoelectric Sensor

4. Relay Circuit

A relay is an electromagnetic switch that is used to turn on and turn off a circuit by a low power signal, or where several circuits must be controlled by one signal. It consists of an electromagnet and a set of contacts. Figure 4 shows the relay circuit.

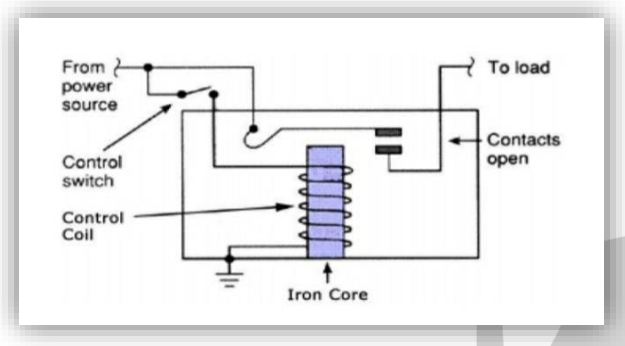


Fig. 5 Relay Circuit

An iron core is surrounded by a control coil. As shown, the power source is given to the electromagnet through a control switch and through contacts to the load. When current starts flowing through the control coil, the electromagnet starts energizing and thus intensifies the magnetic field. Thus, the upper contact arm starts to be attracted to the lower fixed arm and thus closes the contacts causing a short circuit for the power to the load. This force will be almost equal to half the strength of the magnetic force. [9].

5. TCP/IP Protocol

TCP/IP can be used to provide remote login over the network, for interactive file transfer, to deliver email, to deliver webpages over the network and to remotely access a server host's file system.

TCP/IP uses the client-server model of communication in which a user or machine (a client) is provided a service (like sending a webpage) by another computer (a server) in the network. Collectively, the TCP/IP suite of protocols is classified as stateless, which means each client request is considered new because it is unrelated to previous requests. Being stateless frees up network paths so they can be used continuously. The transport layer itself, however, is stateful. It transmits a single message, and its connection remains in place until all the packets in a message have been received and reassembled at the destination [10].

B. HARDWARE IMPLEMENTATION

1. INTERFACING OF PIEZOELECTRIC SENSOR WITH ARDUINO

Piezoelectric sensors have two output pins one is positive potential and other is at negative potential means ground. Positive potential pin connected with pin 3 analog channel of Arduino and negative potential pin connected to ground. A resistor of 2 mega ohm connected between them for protection purpose. A led connected to digital pin zero to check working of sensor output. A threshold value of 100 is set to the circuit so that the sensor is not activated for vibrations less than the threshold. Using this, we can eliminate unwanted small vibrations. When the output voltage generated by sensor element is greater than the threshold value the LED changes its state i.e., if it is in the HIGH state it goes to LOW. If the value is lower than the threshold LED doesn't change its state and remains in its previous state [11]. Figure 6 shows the interfacing of Piezoelectric sensor with Arduino

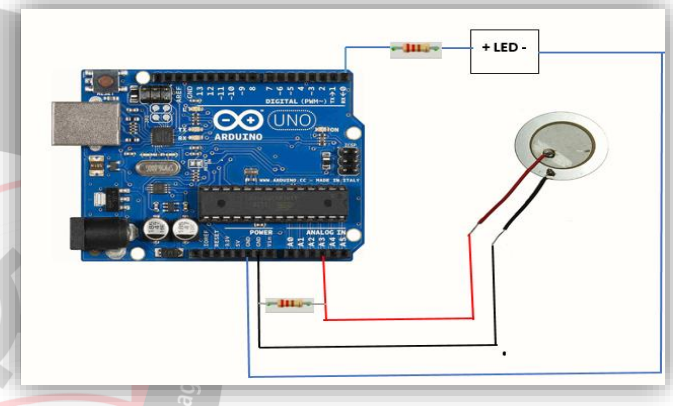


Fig. 6 Interfacing of Piezoelectric sensor with Arduino

2. INTERFACING OF ESP8266 WITH ARDUINO

To communicate with the ESP8266 Wi-Fi module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 Wi-Fi module using UART having specified Baud rate (Default 115200). Connect the Arduino's 3v3 (3.3V) output to ESP8266. The ESP8266 works with 3.3V and not 5V, so this is necessary. Connect the RES or RESET pin, when you ground the reset pin, the Arduino works as a dumb USB to serial connector, which is what we want to talk to the ESP8266. Connect the RXD pin of the Arduino to the RX pin of the ESP8266. Connect the TXD pin of the Arduino to the TX pin of the ESP. When we want two things to talk to each other over serial, we connect the TX pin of one to the RX of the other (send goes to receive and the opposite). Figure 7 shows the interfacing of ESP8266 with Arduino board [12].

 DOI : 10.35291/2454-9150.2021.0192

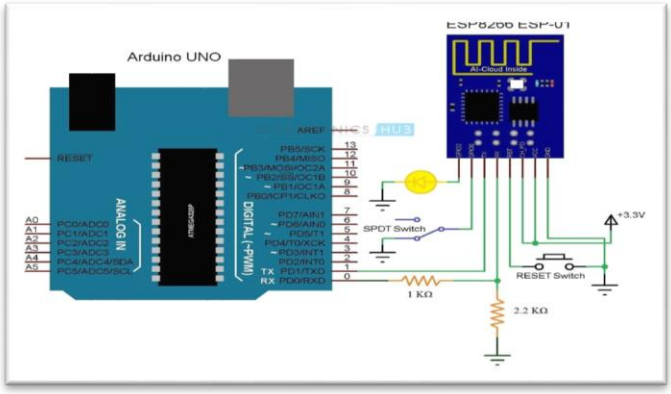


Fig. 7 Interfacing of ESP8266 with Arduino

C. *SOFTWARE DESIGN*

FLOW CHART

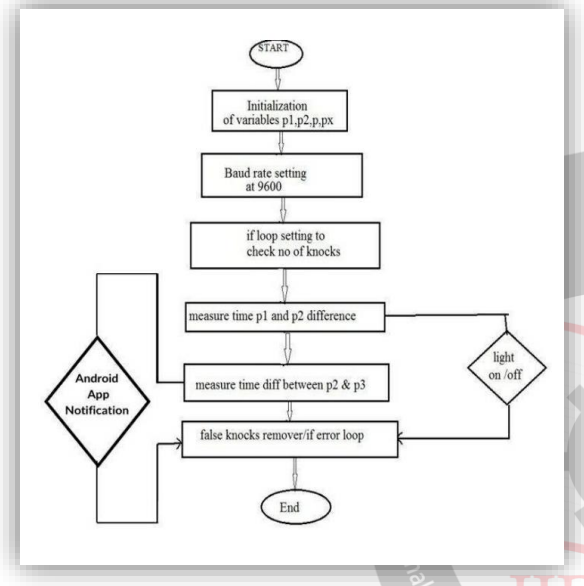


Fig. 8 System Flow Chart

When someone knocks on the surface where the vibration sensor is kept, it will initialize that time of the knock/knocks into variables p1, p2, p. So, what happens is when the micro controller is ON it starts counting the time in milliseconds and when it detects a knock it stores the value of that time in the variables. Baud rate of the devices is set at 9600 for proper transmission of data, after that number of knocks is checked by an if else loop. According to the number of knocks, the time difference between the knocks is stored in the variable px. So, if there are 3 knocks then the difference between the 3rd and the 1st knock and the 2nd and the 1st knock if there are 2 knocks, is stored. If the difference between the knocks is the same as the threshold, then it will be considered as a valid knock and the required action that will be done otherwise the knock will be considered invalid and no action will take place. At the same time, it will also check for a command from the mobile application and if there is a command it will perform the required action. For this application if the time difference between two successive knocks is 300-450 msec then fan turns on/off. Similarly, for light this time difference is 450-600 msec. If someone by mistake knocks on the surface and the next knock is not received in 1 sec then the knock is considered to be invalid.

IV. APPLICATIONS AND FUTURE CHALLENGES

A. *APPLICATIONS*

1. Residential Houses

This device provides facility to remotely switch ON/OFF any home appliance like ceiling fan, Tube light, etc. It contributes to increasing quality of life as well as safety. It will help elderly as well as handicapped people to operate any appliance.

2. *Corporate Offices*

This system/device can be fastened to any surface like walls of cabin, tables, working desks, etc. from where the individual is able to control appliances, where there is no need for any movement from one place to another.

B. *FUTURE SCOPE*

Server-side circuit can be modified to increase the number of appliances controlled. Instead of using switch boards in a room we can use this device to control any appliance.

V. RESULT & OBSERVATION

The threshold for the time difference between the knocks can be set up depending upon the end user and can be changed very easily with a few changes in the code. The threshold of the time difference between the knocks was set by using the trial-and-error method. The end user was asked to knock twice at his own pace for a number of times, the timing of all the events were recorded and the average of all these times was set as the threshold which was 300-450ms for two fast knocks and 450-600ms for two slow knocks.

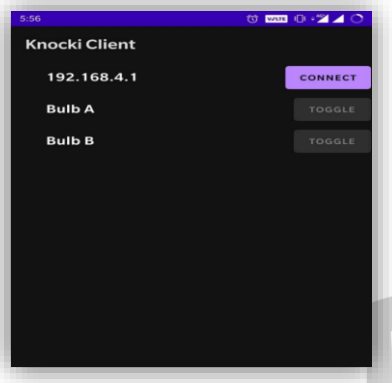
(a) If time difference between two successive knocks is 300-450 milliseconds(msec) then fan turns on and for turning off the fan we have to knock again in the interval of 300-450 msec

Fig. 9 Fan on (after knock)

(b) Similarly, if the time difference between two knocks is in the interval of 450-600 msec then light turns on/off.

 DOI : 10.35291/2454-9150.2021.0192

Fig. 10 Light on (after knock)



(c) Below figures show the connect and disconnect buttons of an application and the toggle button is activated only when you press the connect button.

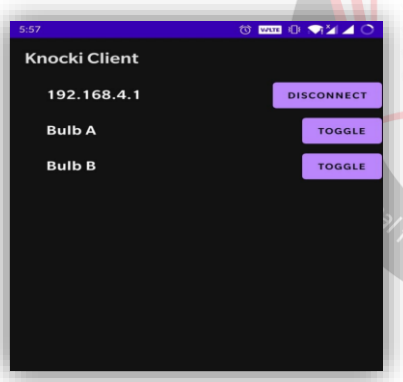


Fig. 11 Home page of application

(d) If the user is not able to find the phone, then by tapping thrice on the surface notification ring/music is generated by phone which helps user to find his/her phone.

Fig. 12 Notification for finding phone

(e) If someone knocks at the door, notification will be sent directly to user's phone.

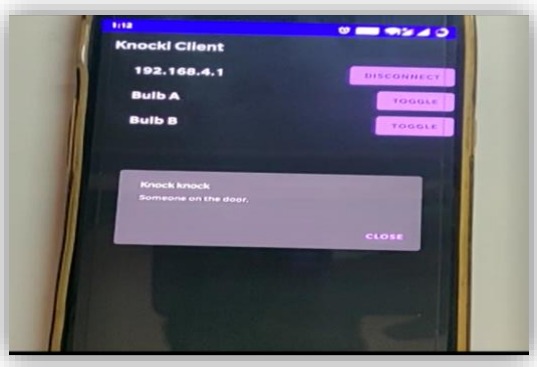


Fig. 12 Notification when someone at door

VI. CONCLUSION

Whole application is less costly as compared to other home automation system because it does not require installation of smart devices. User can change frequency and time period of knocks according to his/her convenience. It is also very useful for elderly and handicapped people to control the appliances.

REFERENCES

[1] Dandge Jagruti, Shirwadkar Rashmi, Gite Priyanka, Odhekar Nikitaa, Kakad Chanchal.

– "Electric switch ON/OFF system using android app via Wi-Fi", published in International Research journal of engineering and technology, March, 2016.

[2] Jewani Gunjal, "Implementation of Knock Based Security System", published in International Journal of Innovation Research in Computer and Communication Engineering, April 2015.

[3]https://www.instructables.com/Two-Clap-ON-Clap-OFF-Circuits-555-IC-4017-IC - Clap based circuit using IC 555 & IC 407.

[4]https://www.electronicwings.com/sensors-modules/esp8266-wifi-module - Datasheet of ESP8266.

[5]https://www.electronicwings.com/sensors-modules/esp8266-wifi-module - Working of ESP8266.

[6]https://components101.com/microcontrollers/arduino-uno -Datasheet of Arduino UNO.

[7]https://www.elprocus.com/what-is-a-piezoelectric-senor-circuit-specifications-and-applications - Datasheet of Piezoelectric sensor.

[8]http://sensor-works.com/how-do-piezoelectric-sensors-work/ - Working of Piezoelectric sensor.

[9]https://www.circuitstoday.com/working-of-relays - Working of Relay circuit.

[10]https://www.fortinet.com/resources/cyberglossary/tcp-ip - TCP IP Protocol.

[11]https://robu.in/interfacing-of-piezoelectric-sensor-with-arduino - Sensor & Arduino interfacing.

[12]https://www.electronicshub.org/esp8266-arduino-interface - ESP & Arduino interfacing.

 DOI : 10.35291/2454-9150.2021.0192