Design and fabrication of home automation

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Abstract. The objective of this project is to control all electronic device in the house, remotely and to automate some parts of the house like pipes, garage using Arduino or raspberry pi. The raspberry pi is a microprocessor which can be used for multiple purposes like getting input signal, based on the signal the output is calculated and sent to the actuators. Here we use raspberry pi board, few dc motors (this motor works on dc using permanent magnet), LED lights and a model of 3d model of the house. The prototype model build using 3d printer and electrical bulb, doors, fan and washing machine are demonstrated. This project will be a real-world model which will have the ability to perform task of operating devices, remotely. This project will help the people to keep an eye on their house when they are not home and help to on or off some of the appliances when they are away from home.

1. Introduction
Now a day’s home automation system is the growing technology. People making their lives more advanced and easier, for this fast-moving era home automation is one of the supporting hands which makes the people’s life more productive. Home automation system need the power supply and maintenance in many research going on the power supply for home automation and adaptive system used in many home [1]. Home automation system enables you to perform control operation on any device in the home [2]. For collecting the data from the home and it is stored in the cloud [3]. There are many controls used in the home automation like WIFI and Bluetooth. WIFI control used to monitor in home any were from the world. Bluetooth system used only a limited range [4]. In the home for monitoring the power supply adaptive control system used for the monitoring the power [5]. Recent development of mobile application the influencing to use the wireless technology to use the mobile phone to control the home. The monitoring of the home is done by using wireless communication dives like GSM, Bluetooth and Wi-Fi dives [6]. the network system used to connect the smart phone to the cloud and control the various home appliance using the wireless technology. The control is like remote control of lighting, live video stream, security camera, real time monitoring. Based on the application many type of microprocessor were used in the system.

2. Methodology
We can connect different devices together through the internet and actually controlling them over the internet through a web/mobile application built using Ionic Framework. Different ways and services were explored including setting-up port forwarding on the router. Setting-up port forwarding will change the configuration of the router and expose one port of the private Local Area Network (LAN) to the public [7], which is considered a security vulnerability that has to be managed carefully. Some of the services that were explored and considered to allow the communication of the web/mobile application with the Raspberry Pi connecting different devices [8]. By using some electronic switches, we can control those devices.

3. Components
Electronics and electrical there are many components to make use in this project work. One of the main components is raspberry pi it is brain of the whole system. The controller board used in this no
need any extra boards. As Arduino and other controller board need some hardware boards for WIFI and Bluetooth in the raspberry pi it has the inbuilt hardware. It acts as the minicomputer CPU. It has a provision to connect HDMI, key board, monitor, power supply cables, and SD card support. SD Card used to store the program.

3.1 Mechanical
A.C. motors are used mostly here because house hold current is alternative. The mechanism used to open the door is hold open hinges or rack and pinion or roller figure 1. Here the locks can also be controlled by the system not the man door lock for safety purposes the below given door is called swing door.

![Figure 1: Rack and pinion mechanism](image1)

3.2 Raspberry pi
Using Raspberry Pi for IoT. Low priced Raspberry Pi is a credit card sized computer. It can be connected to a computer monitor or a television through HDMI cable and HDMI port found in the Raspberry Pi4. It has four USB ports, allowing the connection of different peripherals to it such as keyboard, mouse, memory stick or Wi-Fi dongle that allows its connection to wireless internet. As any computer, the Raspberry Pi needs an Operating System (OS) to run on it, to allow the interaction between it and the user. Different OS choices that can run on the Raspberry Pi are available such as Raspbian, Linux and a Windows 10 special version for the Raspberry Pi. The OS is downloaded to a micro SD card and mounted to the Raspberry Pi’s SD memory reader. It also has Ethernet port that allows its connection to the internet through Ethernet cable from a router. Raspbian or some other operating system will be installed on a micro SD card that was mounted to the Raspberry Pi that allowed writing Python scripts. The needed hardware, such as sensors and LEDs, were connected, using jumper wires, to GPIO pins and the python script is written in the pi, which allowed controlling and monitoring the connected hardware for testing. The figure 2 show the image of the raspberry pi.

![Figure 2. Raspberry pi 3](image2)
3.3 Android application
Using Ionic framework for web/mobile application Ionic is a free and open source SDK, built with SASS and optimized for Angular JS. It offers a library of mobile-optimized HTML, CSS and JS tools and components for developing interactive platform applications are the applications that run on different platforms such as web browsers, IOS and Android. It was used in this project to build web/mobile application to monitor and control the home model mentioned before

4 Calculations
DC motor will be used here. The simple calculation of motor is given below

4.1 DC Motor
Speed and voltage are described in the below
30 RPM, 12 VOLT, 18 WATT
MOTOR TORQUE
P = 18 kW, N = 30 rpm.
\[
\text{Torque} = \frac{(P \times 60)}{(2 \times 3.14 \times N)}
\]
\[
\text{Torque} = 5.72 \text{Nm}
\]
\[
\text{Torque} = 5.72 \times 10^3 \text{Nmm}
\]

4.2 Rack and Pinion Calculation
Pressure angle of rack and pinion (p) = 20˚ full depth system
Pitch of the rack and pinion (P) = 10 mm
Addendum (a) = 1 / P
\[
\text{Addendum (a)} = \frac{1}{10} = 0.1 \text{mm}
\]
Dedendum (D) = 1.25 / P
\[
= \frac{1.25}{10}
\]
\[
= 0.125 \text{mm}
\]
\[
D_p = N_p / P_d
\]
No of teeth on gear (Z)
\[
= \pi D / P
\]
\[
= \pi \times 90 / 10
\]
\[
= 28 \text{teeth}
\]
\[
D_p = 28 / 10
\]
\[
= 2.8 \text{mm}
\]
\[
\sigma = F_t / (b_a \cdot m \cdot Y)
\]
\[
Y = \text{Lewis form factor} = 0.352
\]
Module of gear = m = 1 / D_p
\[
= 1 / 2.8
\]
\[
= 0.357
\]
Gear face width (b_a) = 10 mm
Gear bending stress = 110 Mpa
110 x 10^3 = F_t / 10 x 0.357 x 0.352
\[
F_t = 136 \times 10^3 \text{N}
\]
W = Ft x v / 1000

Gear velocity = v = \pi x D x N / 60 x 1000

Where

D – 90mm
N = 250 rpm

= 1.178 m / s

W = F_t x v / 1000

= 136 x 10^3 x 1.178 / 1000 = 152 watts

4.3 Model

The design given below is the design of the model house which we are going to automate. There are two bedrooms, one living room the doors of the living room and other rooms can be controlled the mechanism given above the swing door. Fig 3 show the building layout.

The proposed system of architecture is given below in the figure 4. The controller connected to the output and the input. Based on the customer input the controller gives the output

Type of system based on network
Figure 4. Proposed System of Home Automation

Raspberry pi comes within built communication system which we can connect to our android or IOS phone by having an android or ios app in our we can control the appliances and the doors of our home. By using this technology can also control the temperature of our house. The temperature can be controlled using thermostat

4.4 Result and discussion

In this system we can control six devices and two doors via our smart phones. This device uses different method to control devices and this device has more spec than other system. By using raspberry pi we connect devices via internet.

| Table 1: Type of connecting method |
|-----------------------------------|
| **System** | **Cost** | **Speed** | **Real time** |
| Bluetooth | Low | High | Yes |
| Voice Recognition | Low | High | Yes |
| ZigBee | Low | High | Yes |
| GSM | High | Slow | No |
| Internet, Wi-Fi | High | Slow | Yes |
| EnOcean | Low | High | Yes |

The above given table refers to the many type of connection method. Bluetooth cannot be connected to the system more than 1 km. voice recognition won’t work some times. ZigBee is a website-based method which is not safe. Internet is used in the system because connectivity and other
The prototype model of home automation system is shown in figure 5. It shows the electrical part assembly. Raspberry pi used for control other relay module used for control the motor. Figure 6 shows the complete prototype model which used in the project. The model which demonstrated is only Proof of concept it is implemented in the real time without any changes.

![Prototype model of door and window system automation](image)

**Figure 6.** Prototype model of door and window system automation

In this paper discussed the home automation system. In this system the user can operate the entire home with smart phone in his hand via android or ios application the user can interface with the appliances in the home. This system can be more helpful in the modern world. The user is completely monitor their home in the mobile application. The user is controlled using the mobile app. The future work of this paper is convert into product.

5 References

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