

Smart Home & Workplace Automation

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**Hardware**

1)**Raspberry Pi 3 model B+:** It is at the heart of the whole system, its is a single board computer which is also QUIET POWERFUL. It has a 64 bit ARM cpu which makes the board fairly powerful. It is no different from a PC or a laptop and can run a full fat Operating System. Unlike PC or mac it runs on Linux, there is a variety of Linux operating system both GUI (graphical user interface) and CLI(command line interface) some of them are Raspbian Linux which is a OS made by Raspberry Pi developers for the Raspberry Pi. Other light weight Linux like Ubuntu mate can also be used. There is also another option which is Windows 10 IoT core, but basically that is only for multimedia application. Which means that it cannot be used as a full fledge operating system. And the best part about this is that everything is open source from hardware to software. Except for the Windows 10 IoT core as it is made by Microsoft. Because of the open source concept any user can obtain the source code and can edit it. As per his or her need. Due to open source nature we can also obtain the circuit for the Raspberry Pi and it can remade by anyone and he or she can sell it.

2)**Relay circuit:** A relay is a electrically operated isolated switch. It uses a electromagnet to actuate a metal switch. This also ensures that the AC (mains supply) and DC (low voltage signals from Pi) are isolated. It is coupled with the Raspberry Pi to operate large appliances. Its working is also quite simple it has an electromagnetic mechanism which can move it can be moved by passing current from the coil which is built in. which later moves the metallic Pin which work as a switch.

**Software**

1. **Raspbian OS:** It is the main operating system on which the Raspberry Pi is working. It is the platform on which everything is working. It is a operating system just like Windows or mac but they have their own kernel where on the other hand Raspbian OS runs the Linux kernel we can also say that Raspbian OS is a Linux OS. It is developed by the Raspberry Pi developers which was specially made for the Raspberry Pi. The Raspberry Pi can also run on other lightweight Linux distros both GUI (graphical user interface) and CLI (command line interface). Microsoft has also developed an operating system for the Raspberry Pi which is Windows 10 IoT core it is a free operating system but it cannot work as a full fledge operating system because it is made to work as a multimedia OS. Linux is an open source software unlike the Windows 10 IoT core its source code is available so anyone can obtain the source code and can make changes there. The Raspbian OS is still under active development from worldwide developers.
2. **Programming:** We have used C language to program the Raspberry Pi GPIO Pins. For making the server page we have used PHP, jQuery, AJAX, Bootstrap. The GPIO Pins are programmed in such a way that the server can be accessed from any device which is connected to the Raspberry Pi’s network. The working is further elaborated in the further topics.

**Working**

In this project we have used a Raspberry Pi. Since Pi is a computer we installed a HTTPD (web server) and used it as a simple GUI for AC switch control.

We have tried to make the cheapest possible home & workplace automation system using the cheapest and most efficient components available in the market.

Its working is also quite simple as discussed in the followings-

In this project we have created a web server. We used Lighttpd (pronounced Lightly) to create the web-based GUI. Since the GPIO controls need to be operated at the Pi (server) when command is received from the user (Client), a server-side interpreter need to be used. For this we used PHP, the most popular server-side scripting language. On the client side we used AJAX to send data to PHP in real time without reloading the page. We used Bootstrap CSS framework to create the GUI. The PHP, when receives the commands executes the applications which turns the GPIOs on or off. The application is created using C language and for GPIO support BCM2835.h library was used. The source codes were compiled and the executables are run using the aforementioned method.

To use the automation system the Raspberry Pi should be connected to any wired or wireless network, it can be anything a wireless WIFI network or a LAN network. After connecting it to the network now the Pi can be controlled from any device that is connected to the same network.

The greatest feature of our solution is it is fully open source, from the hardware to the software everything is open source. Which means that anyone can make changes in them. Anyone with knowledge of programming can manipulate the functioning of the whole system as they wish. The open source nature also ensures the protection of privacy of user. If anyone suspects our system stealing personal information, they can just check the source code. Initially we have created four ports (programmed for three) for connecting appliances to the Pi. Easy addition of more appliance control is under development right now.

To set the product up it has to be connect to a LAN network or a WIFI network after that it can be controlled from any other device that is connected to the same network. To do so just type in the Raspberry Pi’s default IP address in any browser. If the user wants to use the system from outside the home too, they can do so by buying a domain and link it to their local network. Then no matter where they are as long as they have an internet connectivity they can access the control centre and control the connected appliances.

Since the Pi is a computer in itself, we have the VNC Server enabled so that if one wants to use Pi they can do so by installing VNC Viewer in their device of choice (PC, Laptop, Smartphone, Tablet, etc.) and connecting to Pi using it’s default IP eliminating the need of connecting mouse, keyboard and HDMI cable to it.

In case the user accidently messes up something with the codes he or she can download the code from our online library with which he or she can fix the problem easily.

We have a SMB file server installed in Pi. This is another useful feature that we have implemented in our system. Say, the user has an external hard drive. User needs to access some files from it for their work, but at that very moment another person at home is using the hard drive to watch movie. Our solution eliminates this dilemma by making the files available to all the devices connected to the same network as the Pi. Now both the individuals can access the files simultaneously without the need to connect it to a particular device.

Our project is in a very early development stage.

The possibilities on Pi is endless.