

Raspberry PI 3 Based Control and Monitor Remote Machine Automation

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Abstract: As we see around the whole world is getting converted into automation and people are living their lives more comfortably and easily as many advanced technology appliances are available in the market. As the technology expands more energy is required to operate the appliances. So the energy conservation is the main need nowadays. So the appliances should be switched off when there is no need to conserve more energy. The machines which are at remote places need to be control and monitor from any other place. In the large industries machines are located globally anywhere and every time that person cannot go there to operate and monitor the machines. So this projects builds such a system which can control and monitor functioning of the machines globally with the help of internet i.e internet of things. Here Raspberry PI acts as main controller which obtains input from user through internet and takes appropriate action. Raspberry PI controller will be connected to the appliances and machines with the help of relays. Weaved cloud services enables a secure internet connection and a billions of user can connect to the internet and can access the remote place machines. Here weaved cloud service binds public IP address of raspberry PI with fix IP address provided by server.

Keywords: Raspberry PI 3, Iot(Internet of Things), Weaved cloud services, CNC machine.

[1] Introduction

In the 21st century, automation plays a very important role as rapid growth of advanced appliances at home, offices makes life easier and comfortable. Also smart phones and internet has becomes everybody's daily stuff nowadays which proves technology becomes very important. Every time person cannot enable to operate the machines as he has to travels from one place to another place. So the automation is very important to control these high tech machines. One important aspect of controlling these appliances is to conserve more energy as much as possible. As we see in big industries a person has to travel from one place to another for their daily work, so because of this busy schedule, he cannot go there to check the functioning and status of the machines. There must be some way that he can handle and operate these machines remotely. So this can saves more time and energy. Also in home, offices, many times because of human mistakes appliances remain in ON condition. So to make them in off condition automation is necessary. Also it avoids any harm and provide protection. The popularity of network enabled automation is growing day by day in recent years due to easy affordability and much simplicity. And also rapid expansion of internet network enables controlling and monitoring of such remote network enabled devices [1]. Therefore the concept of "Internet of Things" has been arises here in the automation. IoT stands for "Internet of Things" developed by internet through which things, objects can communicate and share an information from each other. It is estimated that up to 2020 there will be near about 0 billion internet devices are available. The most commonly machine automation systems used Bluetooth, Global system for mobile communication (GSM), Zigbee, Wi-Fi etc technology to exchange data and signaling between their components. Here in this paper automation of electronics machines are takes place with the help of Raspberry PI board, internet and relay board. Here Raspberry PI is itself a system

on chip inbuilt controller which takes input from user by means of internet and takes appropriate action and fed to the relay board. In this paper we are taking electronics appliances which to be controlled are lamp, fan, temperature sensor and CNC machine remotely. Automation is becoming an important thing in day to day life which offers very easy and comfortable life, and such automation systems are available in a number of variety. Firstly automation was introduces in the offices for easy use of machines and cost consumption. Nowadays home automation grabs importance and available in many varieties. Some of them are as: Raspberry PI based home automation system, survey of home automation system using raspberry PI through GSM, android based home automation system, automate and secure home using Zigbee technology, Raspberry PI based data sensing and logging systems using WSN and LAN, Design and Implementation of CNC Machine Remote Monitoring and Controlling System Based on Embedded Internet, design and implementation of CNC machine remote controlling and monitoring using embedded internet.

Raspberry PI is Broadcom BCM2836 small system on chip SoC Multimedia processor credit card sized board computer which is developed by Raspberry PI foundation in the UK. It has large number of input and output peripherals with HDMI, USB support. It has ARM11 inbuilt processor working on 700 MHz CPU. It has inbuilt memory upto 32 GB with 1 GB RAM. The most important feature is router port connection by creating ad-hoc networks and a wide range of wireless IEEE 802.11n high speed standard. The analog audio jack 3.5mm used for connection of headphone and speaker. Raspberry Pi works on Linux Operating System because it is free and open source and Python is the Programming for activation and deactivation of output load.

[2] Literature survey:

2.1 Home Automation Using Raspberry Pi through GSM:

Shrikrushna Khedkar proposed a home automation system

based on Raspberry PI controller and with use of SMS services. Here Raspberry PI is reasonably cost and system on chip programmable small computer having large no of peripherals and Ethernet connection for LAN. This system is based upon sensor web based service and the communication between remote user and home devices is implemented using restful based web services. For the communication they have used text message services using global system for mobile i.e GSM rather use of internet connection. RS232 pin used to perform serial communication between the controller and the outside world[2].

2.2 CNC Machine Remote Monitoring and Controlling System Based on Embedded Internet:

Zhai Wen-zheng and HU Yue-li proposed a network control CNC machine controlling and monitoring remotely system based on embedded internet. It is composed of field monitoring host, upper industrial PC, embedded Ethernet module for connection, remote monitoring and controlling host, application and database server. This system based on 3 layered architecture, on upper layer the web browser computers based on Internet handles human-machine interface such as system input and output interface, remote monitor and control, remote fault diagnosis, network communication. The second layer is application server used as execution of NC function modules and applications of the system. The lowest layer consists of Ethernet communication module, CNC machine tools, upper industrial control hosts and field monitoring hosts. The field monitoring hosts monitors all CNC machine tool, display machine status information. It also monitors communication between upper industrial control PC and machine[3].

2.3 Automate and Secure Your Home Using Zigbee Technology:

Nausheen Belim, Harshada Bhambure , Priyanka Kumbhar , Simranjit Tuteja designed a home automation system using GSM-Zigbee technology. They have used 8 bit PIC controller which takes input from the GSM via SMS. The controller will interprets the SMS command and take appropriate action to control the electronics appliances in the home. The controller is attached to the Zigbee transceiver and it communicates with each and every node in the home. As long as GSM phone is present on the range it can control all electronics appliances in the world[4].

2.4 Raspberry Pi Based Interactive Home Automation System through Internet of Things.

Soundhar Ganesh S1, Venkatesh S2, Vidhyasagar P3, Maragatharaj design the system home automation system through internet of things to measure temperature, humidity, soil moisture and status of rain in an agricultural environment. The aim of this project is to secure our home, reduce the wastage of water, etc. Here the communication takes place between user and Raspberry PI by means of email. The appliances to be controlled are interfaced with raspberry PI using relay circuit. The user sent a series of E-mails to the G-mail account of raspberry pi. If 'ON1' was sent to raspberry pi account from the consumer account then the algorithm will read the subject 'ONI' and turned ON the device 1 by blinking LED1 and instantly replied to sender by an email - 'Turning ON

switch 1' under the subject- 'Home automation activated'. The code also includes exception handling in case of invalid e-mail from the consumer. Similarly the same switch can be turned OFF by sending an e-mail with subject 'OFF1' to the raspberry Pi account[1].

[3] Proposed system

Many time people have to travel from one place to another place for their daily work or some business deals. So they cannot be there every time to monitor the electronics appliances or machines present in the house or in offices. There must be some control and monitor to all these electronic appliances to save the energy or any harm. Also in big industries every time that person is not able to go that place to monitor the remote machines. So to save the time and energy, also to access the remote machines this projects implements the idea of accessing such machines remotely by means of internet using Raspberry PI controller.

3.1 Proposed system feature

An automation system is proposed for the users to control electronic appliances with high mobility and security. A set of switches will be controlled by internet with the use of a Raspberry pi micro-controller board. A Raspberry pi micro-controller board obtains user input from a website which uses "HTTP (Hyper Text Transfer Protocol)". It is based upon client server model, in which client acts as Raspberry PI microcontroller board and server acts as user. Here we take virtual private server as a main server through which user can control and monitor remote places machines.

To get data from user we uses "HTTP GET" protocol likewise to send data we uses "HTTP POST" protocol. Here we uses weaved cloud service through which more than one billion users can connected to it very efficiently manner. Weaved cloud services provides large database to store users data and Weaved acts as your private firewall/VPN connection service to all your devices and desktops. Weaved creates secure connections on-demand, over the Internet. it shows the user a set of buttons that can be pressed. This service has been interfaced with the Raspberry pi and a bulb was lit.

3.2 System Architecture

As shown below this is the proposed systems block diagram which is same as client-server model. Here server acts as virtual private server(VPN) of Godaddy family which has 100Mbps rate which is sufficient for our project and the user is connected to this server by means of weaved cloud computing. Weaved cloud computing enable user to secure internet connection between user and remote machine.

Raspberry PI Broadcom BCM2836 SoC Multimedia processor is basically System on Chip credit card sized device is the main advantage of our system. Raspberry PI is acts as microcontroller which controls all the action taken place to automate electronics appliances. Raspberry PI has Wi-Fi router connection and for LAN connection Ethernet port is given on board. To enable internet connection one modem device is required connected to Wi-Fi router of Raspberry PI. Raspberry PI has total 26 Pin out of which GPIO pins gives Vout 3.3v. The electromagnetic relay need a 5 V DC power supply. The output of the GPIO pin of Raspberry pi cannot supply enough voltage to the relay and hence the relay is used to boost 3.3 V to 5 V. All the appliances which needed to be automated are connected to relay circuit as shown in above diagram. The

Temperature sensor used here is LM 35 which is used to sense the temperature connected to the signal conditioning unit and out of signal conditioning unit is converted into digital by using analog to digital circuit. The one of the GPIO pin of raspberry PI is connected to ADC circuit. Raspberry PI is the main advantage which eliminates the unnecessary components like GSM, wireless sensor network which used in existing systems.

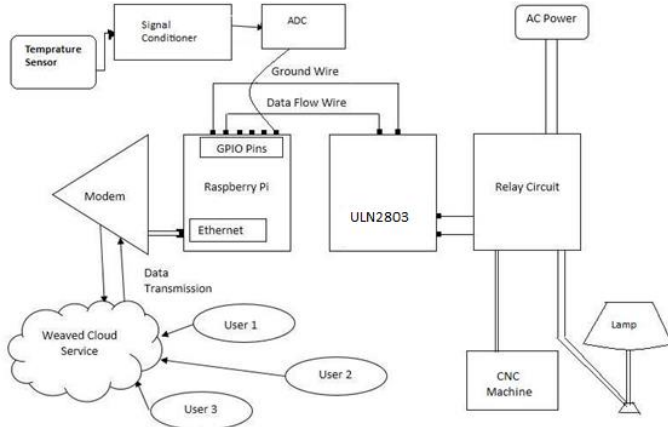


Figure1. Block diagram of System Architecture

To communicate between user and Raspberry PI controller via internet a fix IP address is needed. For that public IP address of Raspberry PI need to bind with static IP address provided by server. Weaved cloud service is used for this purpose. Static IP address access to the Webiopi framework of buttons. The signal is sent to the Raspberry pi by pressing the button with the help of cloud service. This signal is further transmitted to base station and then to Raspberry pi by triggering the GPIO pins.

3.3 Raspberry PI 3 Broadcom BCM2836 controller board

Raspberry Pi Broadcom BCM2836 is an ARM based credit card sized SBC(Single Board Computer) created by Raspberry Pi Foundation. Raspberry Pi runs Debian based GNU/Linux operating system Raspbian and ports of many other OSes exist for this SBC. Raspberry PI is basically a small computer which has inbuilt processor on which we can install several versions of Linux operating system. Raspberry PI is working on ARM 11 processor 900MHz working on 32bit. It is working on RISC architecture which makes it very fast and carries low power. The performance of the Pi 3 is roughly 50-60% faster than the Pi 2 which means it is ten times faster than the original Pi. It has on chip memory of 16GB which can be extended up to 32GB. It has 1GB RAM which makes raspberry PI very efficient. The main benefit of this device is it has on chip Wi-Fi router connection port. Another main advantage of this device is it has general purpose input output port i.e GPIO which gives 3.3v out. It provides HDMI support for both audio and video signal with resolution 1920x1200. It supports Wi-Fi(Ethernet) connections working on IEEE 802.11n protocol up to 300Mbps.

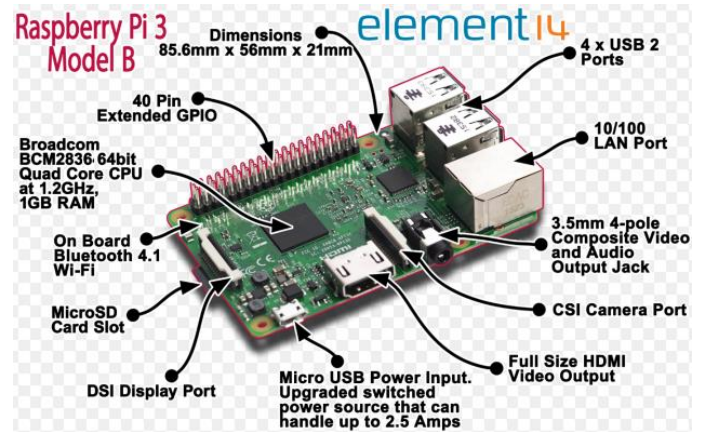


Figure2. Raspberry PI 3 controller board

The GPIO is General Purpose Input and Output pins on the Raspberry Pi are as shown in below figure. Raspberry Pi Model in this paper; consist of total 40 pins out of which each row include 20 pins. As shown in figure the first row contains the even-numbered pins, and the other row contains the odd-numbered pins. The function of GPIO pins can accept input and output commands. They are used for controlling hardware such as LEDs, motors, and relays are all outputs. Raspberry Pi can read the status of switches, buttons and dials, or it can read sensors like light, temperature, proximity sensors or motion detector.[2]

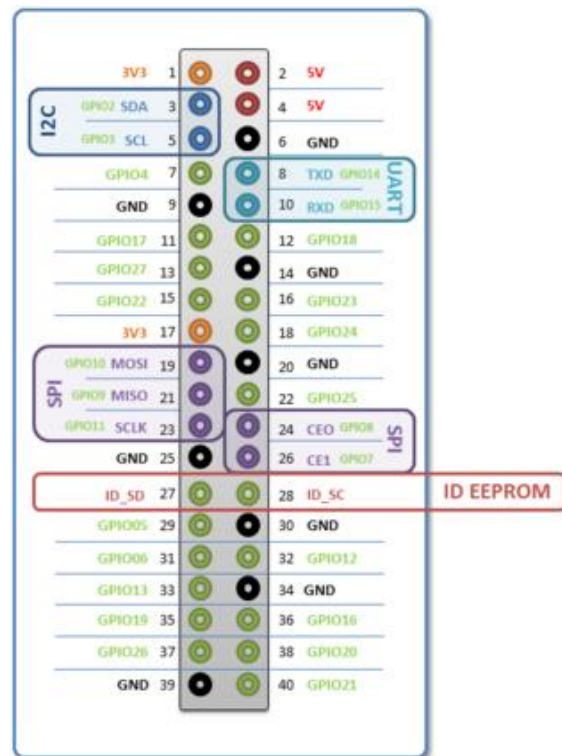


Figure3. GPIO Pin diagram of Raspberry Pi

3.4 Relay circuit

As shown in below figure one of the pin of Raspberry PI is connected to the relay circuit. The main purpose of relay circuit is to control a circuit from a low power signal. Electromagnetic relay switches are operated by electromagnetic action. Relay uses an electromagnet to operate a switch mechanically. A relay is an electrically operated switch. Relays are used where it is necessary to control several circuits are must be controlled by one signal. Basically a relay is an electrically operated switch.

An electromagnetic relay made up of a coil of wire wrapped around a soft iron core and a metallic switch. When current passes through the coil, a magnetic field is induced by the coil, hence closing the metallic switch. When no current is present, the switch is opened and circuit is disconnected. This relay circuit was built by using a transistor and an electromagnetic relay. Here the output of Raspberry PI is given to the relay circuit through ULN2803 Darlington arrays. Because the output voltage of GPIO pins of Raspberry PI is not enough to carry relay input. So to amplify the output 3.3V from 5V, Darlington arrays used and as per the controller action corresponding the relay will turn on and further it will make device turn on. The circuit was built by using one single relay, but as per the user requirement can be extended to number of relays.

3.5 ULN 2803 Darlington Arrays

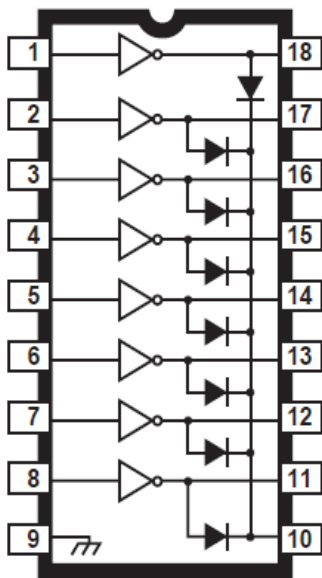


Figure4. ULN 2803 Darlington Arrays

As shown in above figure ULN2803 the output of the Raspberry pi is 3.3 V and must be boosted to supply enough voltage to the relay. So, a Micro Controller board is needed to perform this function. The ULx2803A, ULx2803LW, ULx2823A, and ULN2823LW have series input resistors selected for operation directly with 5 V TTL or CMOS. The outputs are capable of sinking 500 mA. This device takes input 3.3V from GPIO pins of Raspberry PI and gives output as 5V supplies further to the relay. These devices will handle numerous interface needs particularly those beyond the capabilities of standard logic buffers. The boosting is done by the ULN2803 on the board.

3.6 Weaved cloud services

Weaved cloud server is used to transfer data from the user to the Raspberry pi. It provides a secure connection between user and Raspberry PI. Weaved acts as private firewall/VPN connection service to all your devices and desktops. When billions of user wants to connect to the Raspberry PI, there is online cloud server through which these user can connect and share the information. Ultimately these users can access the electronics appliances at a time with the help of weaved cloud server. This cloud server has large database to store the information which will be needed to the user to transfer data to Raspberry PI. The cloud server has a website through which user can get a simple user id and password

criteria. Thus service has been interfaced with the Raspberry pi. Likewise the controller gets the commands by blinking a bulb. We can defined weaved as a software that you can install on your raspberry pi that let you connect from anywhere to raspberry pi over the internet. Weaved services provides a secure connections on-demand, over the Internet.

4. Comparison of existing system and proposed system.

Currently many automation systems are available such as home automation, industrial automation etc. and existing systems has got number of limitation which will overcome in our proposed systems. Existing systems are implemented through large number of unnecessary hardware which results in installation and maintenance of the system and also requires a lot safety and security. These become less efficient in working and utilization of systems and devices. 1) The idea proposed for home automation is based upon mail service per action of user and Raspberry to send and to retrieve the data through Raspberry PI on Gmail account. This Automation implement through web based consumes more space for web server storage. 2) The idea proposed for home automation using GSM uses GSM service to send and retrieve the data that is SMS based then in DTMF call drop is the major problem and also it requires large bandwidth. 3) The idea proposed for NC-RMCS system in which controlling and monitoring host is required. Also high computation overhead and bad extensibility in matrix weighted fusion method, also large database is required to store which it fails. 4) The automation system designed using GSM-Zigbee technology uses both GSM and Zigbee technology. GSM service ,to send and retrieved data they used Zigbee module which allows communication to limited range of distance. Also fails in efficient use of bandwidth. Because GSM requires large bandwidth and Zigbee requires very less bandwidth. 5) The idea proposed for Raspberry PI based Data Sensing and Logging WSN and LAN[5] uses wireless sensor network which requires large number of nodes. Because each device is connected using a single node. So if there are billions of devices requires connecting then billions of nodes are required which creates traffic and may jams the system.

Discussions

Advantages of proposed system:

- Highly efficient
- Conservation of energy
- Provides Secure Communication
- Provides global access
- Saves money and time
- Less manual control
- Less efforts

5. Conclusion

As discuss above we can efficiently design a system based on Raspberry PI 3 which very efficient and powerful than previous systems. Now a day's everything is dependent on information technology and internet. So this project builds such a system which can control and monitor functioning of the machines globally with the help of internet i.e internet of things. Here Raspberry PI acts as main controller which obtains input from user through internet and takes appropriate action. Raspberry PI controller will be connected to the appliances and machines with the help of relays. Weaved cloud services enables a secure

internet connection and billions of user can connect to the internet and can access the remote place machines. Here weaved cloud service binds public IP address of raspberry PI with fix IP address provided by server. Hence the Raspberry Pi proves to be a smart, economic and efficient platform for implementing the home automation by using internet. By using The implemented automation system provides an efficient, comfortable and flexible user interface for controlling electric appliances. Also it provides secure communication, saves more energy, time and money.

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