

Smart and Secured Home

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Abstract - We start our day by performing various routine activities like starting the water pump, watering the plants, etc. So the user has to look into them and see that these activities are done every day. Also when the user is out of town and wants to control these activities, then this process gets tedious, because it is not possible for the user to manage these activities remotely. Human interaction is necessary for such situations to control and monitor these activities. To avoid this interaction, we are integrating our daily routine activities with the technology called Internet of Things (IoT) for creating a smart home using a Raspberry Pi micro-controller. This system has various modules controlling various activities. Sensors are used for gathering data so that the data generated is accurate and activities are done without any burden to the user. Due to this, many tasks of the user are simplified. Also, home security is increased.

Key Words: Internet of Things (IoT), smart home, Raspberry Pi, micro-controller, sensors.

1. INTRODUCTION

We have used Internet of Things (IoT) which is the network of things i.e. devices which are connected to the internet. The devices have a unique ID, can store data and also can share data with various other devices. Experts forecast that by the year 2020[2], there will be total 50 million devices/things connected to internet. Also, the scope of IoT is not limited to connecting things to network but to allow communication between them, exchange useful information while executing meaningful applications. Applications on IoT networks extract and create information from lower level data by filtering, processing, categorizing, condensing and contextualizing the data [4]. This information is then organized and structured to infer knowledge about system, users, environments, etc. They have many characteristics like dynamic and self-adapting, self-configuring and unique identity.

They are dynamic and self-adapting i.e. IoT devices have capability to dynamically adapting itself with the changing contexts and take actions based on their operating conditions. IoT devices have self-configuring capabilities, allowing a large number of devices to be connected and work together to provide certain functionality. Also, each IoT device has a unique identity and a unique identifier which can be an IP address or else an URI. Due to this, IoT devices

allow users to query the devices, monitor their status and control them remotely.

All the day to day activities were done by the user i.e. checking the watering system, opening the door, switching the lights and fans on and off. So the user has to do these things manually and has to keep track of all these activities whether they are done or not. Sometimes, it is not possible for us to track each and every activity. Due to this, some activities can be left undone and missing those activities can create a problem. Also, remote controlling of house activities was also not possible. For example, the user wants to check whether the fans are switched off from the office. So remote controlling of home appliances was necessary. Maintaining security of our home was also a major aspect which required more attention. So we have proposed a system which will keep track and provide alerts to the user, so that all the activities are tracked and no task is missed. Security is also improved by adding various sensors, cameras, etc.

2. LITERATURE SURVEY

Lot of research is done on Smart and Secured Home Survey of research done till now is summarized below :

Roshmi Sarmah , Manasjyoti Bhuyan, Monowar H. Bhuyan [18] proposed in this paper, is a system called SURE-H system. It is designed to ensure the security of smart home with various modules like users, motion sensors, cloud server, moving object detection module, and alarm module. User authentication is used for controlling remotely. The system has been designed in such a way that it can reduce user's manual effort, save power and makes more secure. Any android device can be used to monitor the smart home environment for detection of any robbery. It has several features like this is a low cost system, minimum time, it is highly scalable. It also protects against man-in-the-middle and online dictionary attacks and needs minimum infrastructures. This system can be extended to the large-scale environment.

Akram Khan, Abdullah Al-Zahrani, Safwan Al-Harbi, Soliman Al-Nashri and Iqbal A. Khan [17] proposed in this paper, community-based design (IOT SHS) is implemented. This design covers the needs of normal, elderly and special needs of people. Due to this, technology is getting connected with the society to achieve the welfare of the society. This system is for controlling smart home through mobile,

infrared (IR) as well as with PC/Laptop remotely. WiFi based microcontroller is used as a controller. Temperature sensor is used to provide the room temperature and tell the user if it's needed to turn the AC ON or OFF. This system also provides remote controlling for the people who cannot use their phones to control their appliances. Thus, this system can benefit the whole society by providing advanced remote controlling for the smart home.

3. PROPOSED SYSTEM

3.1 Architecture

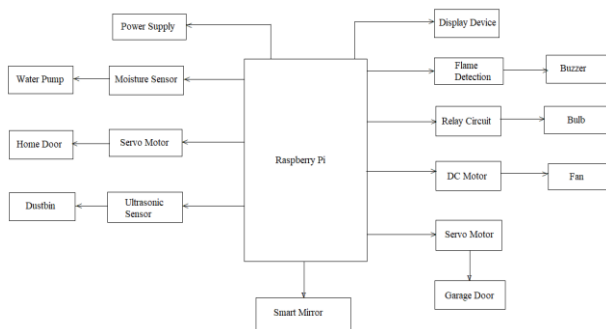


Fig 1 . Architecture Diagram

There are 6 main modules in our system which can be seen in above diagram fig 1.

- Smart Mirror
- Controlling home appliances using website
- Fire alarm system
- Smart dustbin
- Smart plant watering system
- Automatic garage door
- Home door security

In this system, we are proposing remote controlling and monitoring of home appliances with Raspberry pi. We are using a website as an interface. System includes door security in which notification of door status will be sent to the user by an Email. Then there is an automatic watering system for plants where whenever soil is dry a notification is sent to the user to switch on the motor for watering the plants. A fire alarm system is also proposed which activates the buzzer whenever fire is detected. An automatic garage door system is included which will open the garage door when user wants to park his vehicle. We are controlling various home appliances like fans and lights using website. Smart mirror is an interesting feature in smart home which will display weather, date, day, news headlines, etc. Another feature is smart garbage which will help user to know whether dustbin is full or not and accordingly system will send an Email alert to the user that dustbin is full. Our proposed system architecture can be seen in fig 1.

3.1.1 Smart Mirror

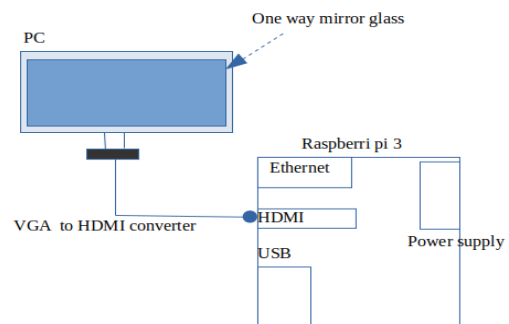


Fig 2. Structure of Smart Mirror

Smart Mirror, which is also called as a magic mirror shown in fig 2 is an important module of our project. It is same as our normal mirror but has extra features. Variety of information like day, date, time, current temperature, weather details and news headlines are displayed on it.

In this module, a one sided mirror or an acrylic sheet (30% transparent and 70% reflective) is placed in front of a display. Display can be a desktop or else a display module. Code of smart mirror is executed on our raspberry pi and with the help of Tinker library of python we as displaying its output. Weather api's are used for fetching latest weather forecasts. News are fetched online by using predefined URLs like websites of various new channels.

It can be used in two ways, as a mirror or as a display. As a Mirror, we can see ourselves while getting ready. It will behave like a normal natural mirror. As a display in which we can see variety of information like today's date, time, news headlines, etc. This provides an extra benefit.

3.1.2 Controlling Home Appliances using Website

In this module, we are controlling home appliances like fan, lights and the things connected to electricity through our website. Website is an attractive interface enhancing user friendliness to the user to control various modules of our project. On the website buttons are present for changing the status of appliances to ON or OFF. The diagram below fig 3 shows how the fan is connected to the raspberry pi using bread board.

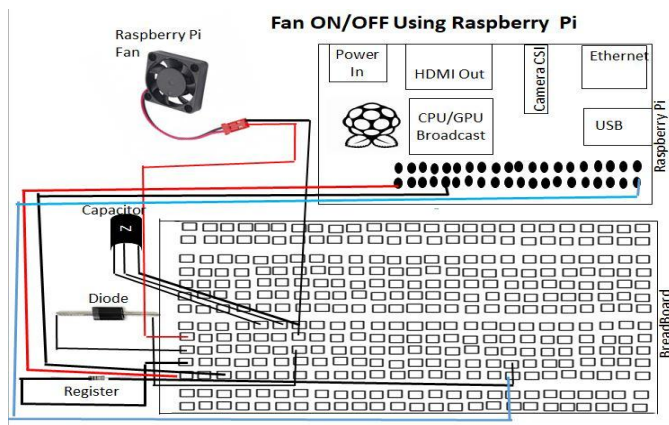


Fig 3. Connections for Connecting fan to our website

Similarly, we have connected bulbs to our system. Here we can see, two bulbs are connected to 2 channel relays and the relay is connected to raspberry pi. Due to this, we can control the bulbs with our website. This is shown in diagram below i.e. fig 4.

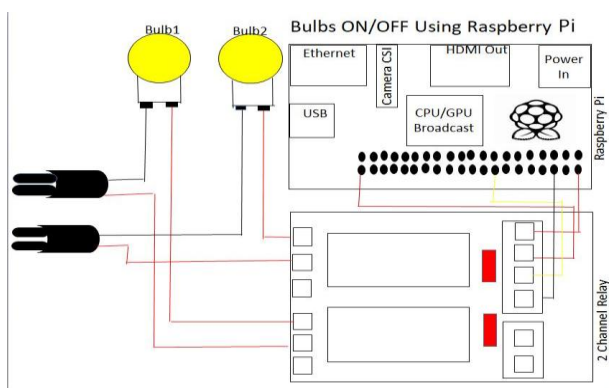


Fig 4. Connections for Connecting bulbs to our website

The wiringPi libraries[12] are a set of functions written in C. Due to this, it is easy to control the Raspberry Pi's GPIO pins. The functions in this library can be used to control GPIO pins in our program. We developed a website using HTML[13], CSS[14], JQUERY[15] and PHP[16] and provided the gpio inputs to control the state of fan and lights in PHP file. The shell_exec command is used to trigger the input to the raspberry pi. By mentioning pin number in the code and by either making it high using " gpio -g write PIN_NUMBER 1" or making it low by changing to " gpio -g write PIN_NUMBER 0" , where 1 indicates high and 0 indicates low we can control this. Also, create the PHP file as gpio.php and store it in "var/www/html" .

3.1.3 Fire Alarm System

Here we are checking the rise in temperature in our home. If there is a rise, then alarms will start i.e. we have used buzzers in this system. We are using Flame sensor module. It detects flame when above 60° or light source of

wavelength in the range of 760nm-1100nm. So, due to this we can monitor our homes temperature.

3.1.4 Smart Dustbin

In this system, we have created a smart dustbin which tells us when the dustbin is full. These alerts are given to the users by emails. As this system is for a single home one Ultrasonic sensor is sufficient. The sensor used is HC-SR04 Ultrasonic Distance sensor. The main principle behind this is finding distance between the garbage and dustbin lid using sonar waves. When dustbin is 80% full our system will send mail to the owner of home saying "dustbin alert" so that it can be emptied by the owner.

This Ultrasonic sensor is placed at the top of the dustbin by making two holes in the lid. When any garbage is thrown inside the dustbin it calculates the distance from itself to that thrown garbage. If the distance is maximum then it is considered as empty or it allows the user to throw a garbage in but when the distance is minimum then it will send dustbin alert. To send a mail to the owner, coding is done in python. We took the measurement and calculated at what distance the garbage is 80% full and according to that alerts are sent to users. If the dustbin is empty no alerts are sent.

As this smart dustbin module is specifically design for a single smart home, GSM module is not required for location identification.

3.1.5 Smart plant watering system

In this watering system, we are checking the status of soil and if the soil is too dry then a notification will be sent to owner that the plants should be watered. Soil moisture sensor is used to check moisture of soil. Moisture sensor is kept in soil to check whether soil is dry or wet. If soil is dry then email notification is send to user. Then user will start motor and water will be supplied to the plants. If the soil is already wet then there is no need to water the plants so this system can be used for monitoring as well as for controlling i.e. we can set time limit for how long should the water be supplied to the plants. This system is necessary for effective growth of plants in home garden area based on environmental factors like weather and soil moisture, etc.

3.1.6 Automatic Garage Door

In this module, the implemented system is when the user wants to park his/her vehicle in the garage then the garage door will open automatically. IR sensor is used to detect the presence of the user's vehicle. If vehicle is in the range of IR sensor, the system will then automatically open the door of garage. To open the garage door automatically, servo motor is used. Servo motor is attached to the door due

to that door is opened in 90° and vehicle can be parked in garage. After that door is closed i.e. it returns to its initial state 180°.

3.1.7 Home Door security system

In Home door security module, we are checking any person that comes at our door. The image of that person gets captured through web camera which is placed at the top of the door. Then the captured image of that person will be sent by email to the home owner and owner is able to give the permission whether to open the door or not. If the person is known then the door will be opened for him. For opening door automatically, servo motor is attached to the door due to that door is opened in 90° and the person enters the home. This system provides security and also keeps track and record of people visiting at our home. It can be integrated with image processing where known faces will be authenticated by the system itself.

4. ADVANTAGES

Advantages are increased security which is aim of our proposed system. Human interaction is reduced as user can monitor and control many activities of our home and as sensors are used, accurate data is gathered which can be used for keeping track of activities. Users task are simplified as there is no need of memorizing various activities. Also, our system is user friendly as website is self-explanatory and easy to understand.

5. CONCLUSIONS

By using IOT in our day to day life, the limitations of existing systems can be reduced. In our proposed system, multiple tasks are being controlled through IOT devices. User friendly GUIs make our system more easy to use. Due to this system, home security is increased and the user can control home appliances using website i.e. away from home. So, by connecting Iot to our daily routine, we can achieve efficiency in the work as well as it makes our tasks easy and simple. Also we can integrate this system with voice, gesture recognition so as to make it more user-friendly.

6. FUTURE SCOPE

In future, our system can be extended with the help of machine learning algorithms. Various machine learning algorithms can be used where the machine will learn from the data generated every day and based on that data will generate various results. Due to this security of house can be increased. Image processing can be used in smart mirror and home door security system to increase more features like security, user authentication, etc. For instance, the users face will be checked every time for verification while entering the house. Also cameras can be added in our smart mirror to

enhance the security. When no one is at home it can be using as a monitoring device. We can also add voice and gesture recognition for controlling our system. Due to this, our system will be more user friendly.

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