CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The Internet of Things (IoT) is the network of physical objects—devices, vehicles, buildings and other items—embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data.

The Internet of things (IoT) is the extension of Internet connectivity into physical devices and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware (such as sensors), these devices can communicate and interact with others over the Internet, and they can be remotely monitored and controlled.

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. The 'thing' in IoT could be a person with a heart monitor or an automobile with built-in-sensors, i.e. objects that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention. The embedded technology in the objects helps them to interact with internal states or the external environment, which in turn affects the decisions taken.

1.2 IMPORTANT OF IoT

The "Internet of Things" (IoT) has the power to change our world. IoT will play an important role in the future and there is expected to be a significant amount of cash flowing through the market in the up-coming years. Over half of major new business processes and systems will incorporate IoT elements by 2020. The impact on consumers' lives and corporate business models is rapidly increasing as the cost of instrumenting physical things with sensors and connecting them to other things devices, systems and people continues to drop.

Rapid changes in IoT technology makes it a challenging task for the most experienced experts to anticipate the future of standardization in the field. For humanity, which is moderately muddled by nature, the Internet of Things is an extraordinary advancement. On the other hand, for individuals who esteem their security, the M2M helps in interconnecting different electronic gadgets. Basically, IOT means having each electronic gadget and numerous different things associated and associating progressively with the Internet by controlling via applications. It can be followed and observed in queries why do we need internet of thing. The thinking goes you'll have the capacity to sort out your life better by not expecting to pay tedious regard for your life.

The definition of the Internet of things has evolved due to convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", covering devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smart phones and smart speakers.

1.3 ADVANTAGES OF IoT

1.3.1 ENHANCE DATA COLLECTION

The more the information, the easier it is to make the right decision. Knowing what to get from the grocery while you are out, without having to check on your own, not only saves time but is convenient as well.

1.3.2 EFFICIENT RESOURCE UTILIZATION

If the functionality and the way that how each device works are known, it definitely increases the efficient resource utilization as well as monitor natural resources.

1.3.3 MINIMIZE HUMAN EFFORT

As the devices of IoT interact and communicate with each other and do lot of task for human, then they minimize the human effort.

1.3.4 SAVE TIME

As it reduces the human effort then it definitely saves out time. Time is the primary factor which can save through IoT platform.

1.3.5 COMMUNICATION

IoT encourages the communication between devices, also famously known as Machine-to-Machine (M2M) communication. Because of this, the physical devices are able to stay connected and hence the total transparency is available with lesser inefficiencies and greater quality.

1.3.6 AUTOMATION AND CONTROL

Due to physical objects getting connected and controlled digitally and centrally with wireless infrastructure, there is a large amount of automation and control in the workings. Without human intervention, the machines are able to communicate with each other leading to faster and timely output.

1.3.7 ACCURACY

IoT generates a large amount of data. The more the information analysed, the easier to make right decisions and do tasks accurately. IoT seeks to eliminate the errors caused by human thus promising a level of precision.

1.4 MOTIVATION

Internet of Things can connect devices embedded in various systems to the internet. When devices/objects can represent themselves digitally, they can be controlled from anywhere. The connectivity then helps us capture more data from more places, ensuring more ways of increasing efficiency and improving safety and IoT security.

IoT is transformational forces that can help companies improve performance through IoT analytics and IoT Security to deliver better results. Businesses in the utilities, oil & gas, insurance, manufacturing, transportation, infrastructure and retail sectors can reap the benefits of IoT by making more informed decisions, aided by the torrent of interactional and transactional data at their disposal.

1.5 PROBLEM DOMAIN AND SOLUTION:

In an existing system, there is a low data transmission rate and short distance coverage.

But the proposed system is to implement a reliable and scalable automation system that can be used to remotely switch on or off any household appliances using Raspberry pi3. It controls the home electronic appliances such as fan, light and air-conditioner.

CHAPTER 2

LITERATURE SURVEY

2.1 BLUETOOTH BASED HOME AUTOMATION USING ARM9

D.Naresh proposed the “Bluetooth Based Home Automation Using ARM9 in 2013. The paper proposed that home need electrical parameters are interfaced to the general purpose input / output ports of the microcontroller in an embedded system board and their status is passed to the ARM7 with Bluetooth device. This Home automation allows us to control household appliances like light, door, fan, AC etc. It also provides home security and emergency system to be activated. The main objective of this home automation and security is to help handicapped and old aged people who will enable them to control home appliances and alert them in critical situations. This paper put forwards the design of home automation and security system using ARM7 LPC2148 board. The design is based on a stand alone embedded system board ARM7 LPC2148 at home. Home appliances are connected to the ARM7 and communication is established between the ARM7 and ARM9 with Bluetooth device. The device with low cost and scalable to less modification to the core is much important. It presents the design and implementation of automation system that can monitor and control home appliances via ARM9 S3C2440A board.

MERITS

Low cost.

Line of sight.

Scalable.

DEMERITS

It controls only certain ranges of 10-30metres.

2.2 HOME AUTOMATION USING FPGA CONTROLLER

Vinai Sagar proposed Home Automation using FPGA controller in 2012.It is designed using FPGA controller to provide intelligent home solutions. The controller interfaces to the mobile device through GSM network to allow monitoring and controlling devices. This system can be used anywhere as long as it in the range of phone network available. The system is SMS based which uses wireless technology to modernize the standards of living. This system provides ideal solution to the problems faced by home owners in daily life. The motivation is to facilitate the users having universal access to automate their homes.

The home automation system provides availability to develop a low cost solution which is affordable and allows home security. The system is capable enough to give feed back to user about the condition of the home appliance according to the user's needs and requirements. This system provides ideal solution to the problems faced by home owners in daily life. GSM module is a bridge responsible for enabling/ disabling of SMS capability. In this system number of monitoring and controlling devices is connected to central FPGA controller kit. The programmed FPGA board is connected to interfacing unit and GSM modem through serial port of the GSM modem. The number of sensors used in the interfacing unit which permits the central FPGA controller to make decisions and send the status of the electronic appliances are connected in home.

MERITS

More features.

High speed.

Multiple appliances can be controlled.

DEMERITS

Not preferred because it is high cost.

Design specific.

2.3 ZIGBEE BASED HOME AUTOMATION SYSTEM

Jitendra Rana proposed Zigbee Based Home Automation in 2010 embedded system with the ZigBee wireless network and indicated how to overcome by eliminating the complication of wiring in case of inter connected wired automation. his paper identifies the reasons for this slow adoption and evaluates the potential of ZigBee for addressing these problems through the design and implementation of a flexible home automation architecture. A ZigBee based home automation system and Wi-Fi network are integrated through a common home gateway. The home gateway provides network interoperability, a simple and flexible user interface, and remote access to the system. A dedicated virtual home is implemented to cater for the system's security and safety needs. To demonstrate the feasibility and effectiveness of the proposed system, four devices, a light switch, radiator valve, safety sensor and ZigBee remote control have been developed and evaluated with the home automation system.

MERITS

Set up-simple and easy.

Easy to monitor and control home appliances from remote.

DEMERITS

Requires knowledge of system for the owner to operate ZigBee compliant device.

Coverage is limited and cannot be used as outdoor wireless communication system.

2.4 WEB BASED REAL TIME HOME AUTOMATION SYSTEM

Subhajit Dey Proposed Web Based Real Time Home Automation System in 2015.It is a smartly automated way of controlling home electrical appliances via human involved communication as well as through smart control of the entire system is provided. Home Appliances control of Smart Security System using Iots uses

computers or Mobile devices to control basic home functions and features through internet from anywhere around the world. This security system differs from other system by allowing the user to operate the system from anywhere around the world through internet connection. With the implementation of Arduino Mega microcontroller as an Embedded device security system design was constructed with many sensors and web server database.

MERITS

It saves power.

DEMERITS

If it is not managed correctly it can go wrong.

2.5 UBIQUITOUS HOME CONTROL SYSTEM

Rajeev Piyare proposed Ubiquitous Home Control System. It presents a flexible home control and monitoring system with embedded micro-web server with IP connectivity for accessing and controlling devices and appliances remotely using Android based smart phone app. The proposed system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality. To demonstrate the feasibility and effectiveness of this system, devices such as light switches, power plug, temperature sensor and current sensor have been integrated with the proposed home control system.

The system consists of a micro Web - server based on Arduino Ethernet, hardware interface modules and the Android compatible Smart phone app. The aim of the proposed work is not to incorporate expensive components such as high end personal computers. This system allows authorized home owners to remotely control and monitor connected devices at home using any Wi-Fi or 3G/4G enabled Smart phone which supports Java. The smart phone app provides a graphical user interface (GUI) for accessing and controlling the devices at home through server real IP. The proposed architecture utilizes RESTful based Web services as an

interoperable application layer for communicating between the remote user and the home devices.

MERITS

Low cost and flexible.

DEMERITS

It consumes more energy and will have security issues.

CHAPTER 3

SMART HOME AUTOMATION REQUIREMENTS

3.1 INTRODUCTION

The Internet of Things (IoT) is the network of physical objects—devices, vehicles, buildings and other items—embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data.

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Devices and objects with built in sensors are connected to an Internet of Things platform, which integrates data from the different devices and applies analytics to share the most valuable information with applications built to address specific needs.

These powerful IoT platforms can pin point exactly what information is useful and what can safely be ignored. This information can be used to detect patterns, make recommendations, and detect possible problems before they occur.

3.2 REQUIREMENTS

For this project, the requirements will fall under two categories,

- Hardware
- Software

3.2.1 HARDWARE REQUIREMENTS

The hardware components required for the implementation of smart home automation is,

3.2.1.1 RASPBERRY PI 3

Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Foundation. Raspberry Pi runs Debian based GNU/Linux operating system Raspbian. The board not only has tons of features it also has terrific processing speed making it suitable for advanced applications. PI board is specifically designed for hobbyist and engineers who are interested in LINUX systems and IOT A GPIO pin designated as an input pin can be read as high (3.3v or 5v) or low (0V). A GPIO pin designated as an output pin can be set to high (3.3v or 5v) or low (0V).Fig 3.3.1 shows raspberry pi 3.

Figure: 3.2.1.1 RASPBERRY PI 3

3.2.1.2 RELAY

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. Figure: 3.3.2 shows the relay.

Figure: 3.2.1.2 RELAY

3.2.2 SOFTWARE REQUIREMENTS

The software components required for the implementation of Smart Home Automation is,

3.2.2.1 RASPBIAN OS

Raspbian is a Debian-based computer operating system for Raspberry Pi. There are several versions of Raspbian including Raspbian Stretch and Raspbian Jessie. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS, it comes with over 35,000 packages, and pre-compiled software bundled in a nice

format for easy installation on your Raspberry Pi. The OS can be operated in either Console / Terminal mode or in graphical (GUI) desktop mode. In Console mode, commands are entered as text in a non-graphical, command line. Console mode requires familiarity with Linux commands. In Desktop mode, a graphical display of applications is shown and operated using a mouse and keyboard interface (think MS Windows / Mac). Figure: 3.4.1 shows the desktop of raspbian OS.

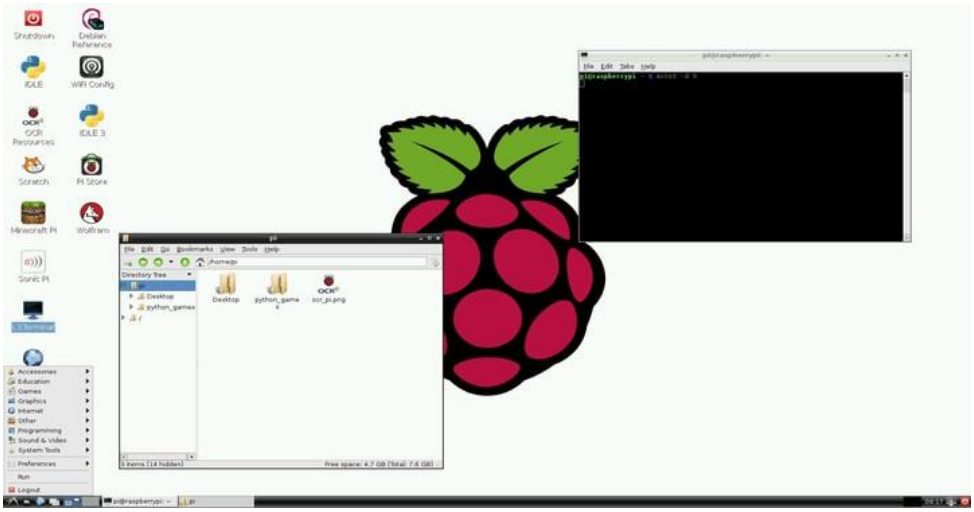


Figure: 3.2.2.1 RASPBIAN OS

3.2.2.2 CAYENNE

Cayenne is an online IoT dashboard that takes most of the complication out of creating hardware-oriented programming. Cayenne is a drag-and-drop programming system for the IoT that really does make it much easier. It not only makes it possible to build programs using drag-and-drop, it standardizes the connection of devices such as sensors and motors and makes sure that drivers are in place. In this sense it makes the programming and the hardware much easier.

Cayenne is one of the easiest and power IoT platforms for developing beautiful UI for IoT solution. Cayenne builds drag and drop UI for IoT, so with drag & drop UI and CE plug and play hardware you can build IoT solution within few

minutes. Cayenne supports master devices like Raspberry Pi, Arduino, and LoRa. Figure: 3.4.1 shows the cayenne mobile application.

Figure: 3.2.2.2 CAYENNE

CHAPTER 4

IMPLEMENTATION AND RESULTS

4.1 DESCRIPTION OF MODULES

In this project, three modules are implemented. They are,

- Interfacing Hardware Devices
- Monitoring the appliances
- Controlling the appliances
- Scheduling the appliances

4.2 IMPLEMENTATION

4.2.1 INTERFACING HARDWARE DEVICES

In smart home automation, both light and fan are automated. It can be implemented with the help of hardware devices such as relay and raspberry pi 3.

The positive and negative terminal of the LAMP is connected to the relay. The output of the relay is given to the raspberry pi 3 with the help of jumper wire (female to female). The three outputs of the relay are ground, VCC, IN. VCC is connected to pin 1 of raspberry pi 3.Ground is connected to the pin 6 of raspberry pi 3.IN is connected to pin 11(i.e. GPIO 17) of raspberry pi 3.

The positive and negative terminal of the FAN is connected to the relay. The output of the relay is given to the raspberry pi 3 with the help of jumper wire (female to female). The three outputs of the relay are ground, VCC, IN. VCC is connected to pin 17 of raspberry pi 3.Ground is connected to the pin 20 of raspberry pi 3.IN is connected to pin 16(i.e. GPIO 23) of raspberry pi 3.

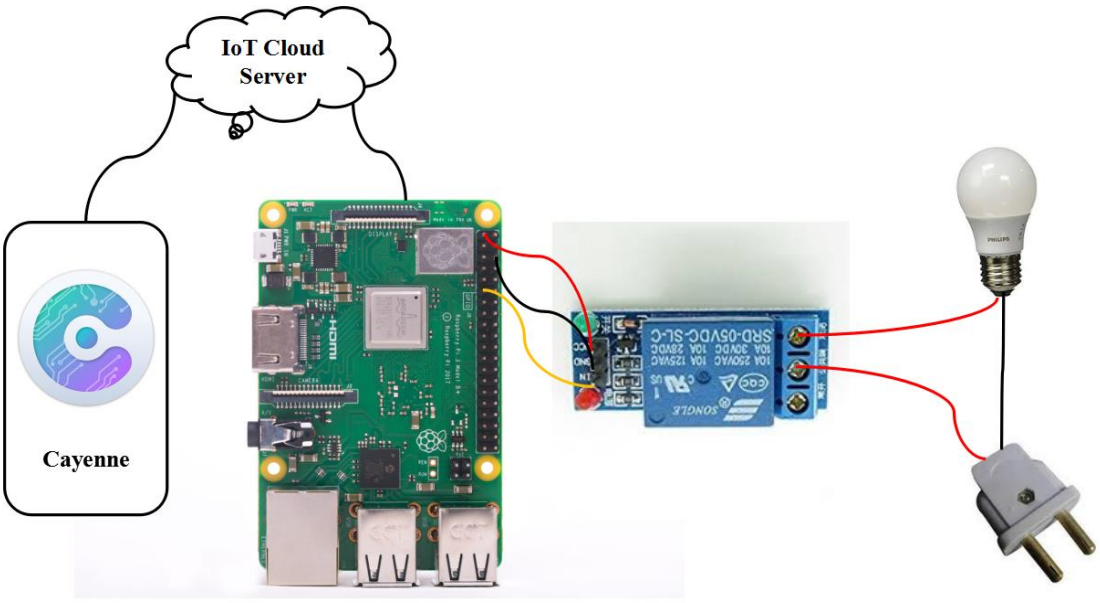


FIGURE 4.2.1.1 BLOCK DIAGRAM OF LIGHT

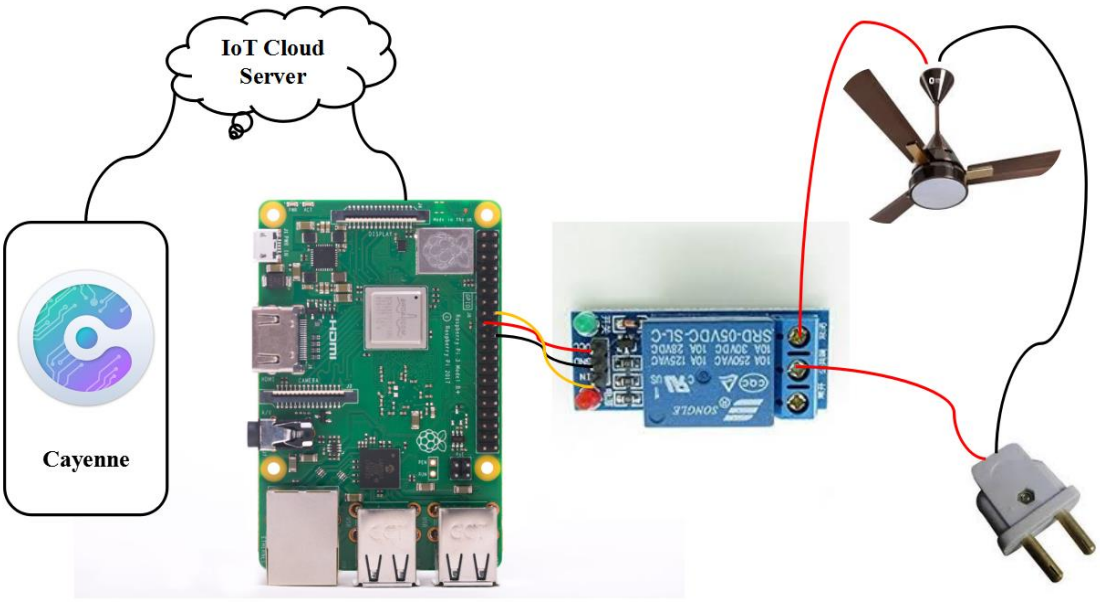


FIGURE 4.2.1.2 BLOCK DIAGRAM OF FAN

4.2.2 MONITORING THE APPLIANCES

In smart home automation, both light and fan are automated. The status of the light and fan can be monitored with the help of the mobile application CAYENNE.

Steps involved in monitoring the appliances:

- Download cayenne app in android phone.
- Create an account in cayenne
- Choose a device to start a project (i.e. Raspberry pi)
- Set up your Raspberry Pi
- Make sure your Pi is powered on and connected to the Internet. Connect raspberry pi with its IP address.
- Connect raspberry pi.
- Chose the actuators as light in cayenne dashboard.
- Select the device raspberry pi and the output channel of the raspberry pi
- Now the current status of the appliances should be viewed by the user in light widget.

4.2.3 CONTROLLING THE APPLIANCES

In smart home automation, both light and fan are automated. The status of the light and fan can be controlled with the help of the mobile application CAYENNE.

Steps involved in controlling appliances:

- Open an application CAYENNE
- Open the dashboard and the status of the appliances is visible in the dashboard.
- If the lamp is in ON state, then the widget for lamp is in GREEN color. The status of the lamp can be switched to OFF state by clicking the widget of lamp and the color of the widget is changed into GREY and also lamp is switched ON.
- If the lamp is in OFF state, then the widget for lamp is in GREY color. The status of the lamp can be switched to ON state by clicking the widget of lamp and the color of the widget is changed into GREEN and also lamp is switched ON.
- If the fan is in ON state, then the widget for fan is in GREEN color. The status of the fan can be switched to OFF state by clicking the widget of fan and the color of the widget is changed into GREY and also fan is switched ON.
- If the fan is in OFF state, then the widget for fan is in GREY color. The status of the fan can be switched to ON state by clicking the widget of fan and the color of the widget is changed into GREEN and also fan is switched ON.

4.2.4 SCHEDULING THE APPLIANCES:

In this project, the Cayenne also allows to create scheduled events.

Steps for Setting up the Schedule Events:

- Open an application CAYENNE
- Open the dashboard and the status of the appliances is visible in the dashboard.
- To begin creating an Event, open the feature by selecting **Add New** and then **Event**.

FIGURE 4.2.4.1 ADDING NEW EVENT

- The Create New Event screen appears.

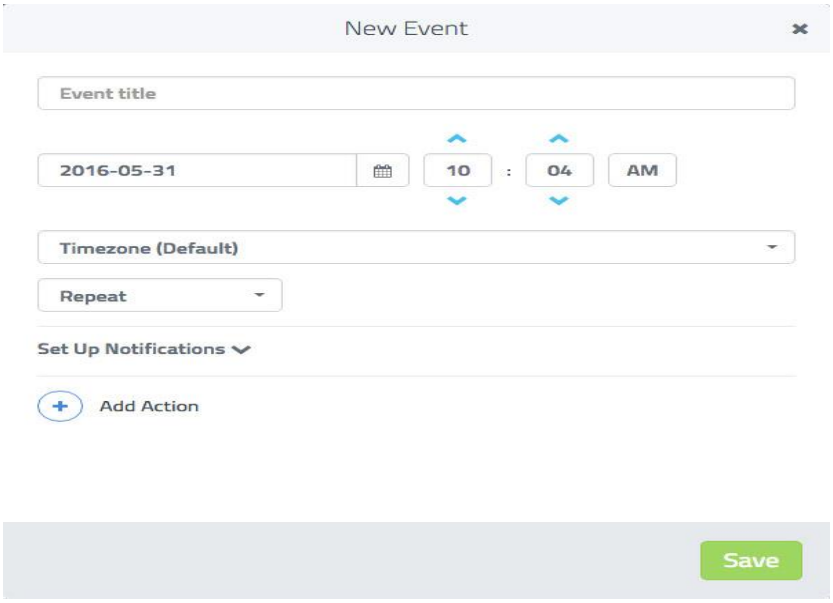


FIGURE 4.2.4.2 SCHEDULING NEW EVENT

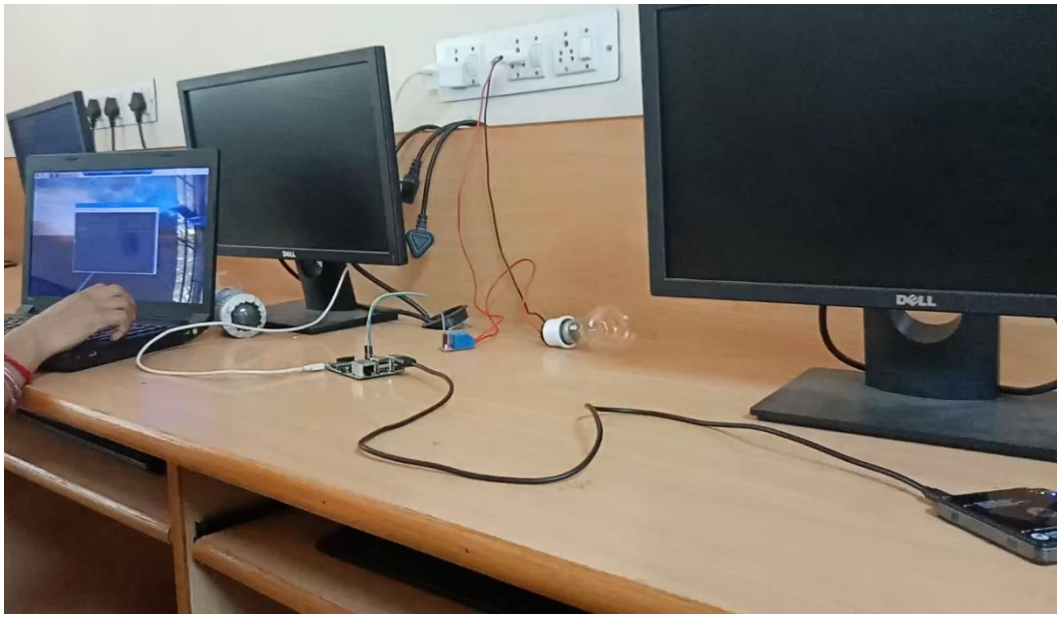
- Fill all the details required for creation of the scheduled event. Enter the Event Title Field i.e. **"At 10 pm, Turn off Light and Fan"** and in the Date and Time fields, enter the date for starting the scheduled event and the time.
- Select the Time zone of when to run the scheduled event. By Default, the scheduled event runs in the **Default Browser Time zone.**
- Select how often the scheduled events have to occur. By default, the scheduled event only occurs one time.
- There is an option to receive notifications whenever this event runs. Events can be delivered by email and/or text message by giving the email-id or mobile number.
- To complete the scheduled event, add the action to occur at the scheduled time.
- Click the **+ Action** button to create a new event.
- Click **Save** button.

4.3 ADVANTAGES OF MONITORING THROUGH CLOUD

The advantages of monitoring the electronic appliances using cloud are as follows,

- Cloud monitoring provides real time data and status from any device connected to an internet, cellular or Wi-Fi connections.
- Cloud application can be accessed from any location from any devices.
- Cloud service providers maintain the system maintenance of the servers.
- Greater levels of application and network security.
- Simpler implementation of business continuity plans and the ability to begin proactively tackling risk mitigation.
- The ability to reach and maintain peak application performance.
- Improved service availability due to more rapid reporting of issues, leading to faster resolution.
- It offers Service Level Agreement which guarantees 24/7/365 and 99.99% availability.
- Users can select from a menu of prebuilt tools and features for monitoring electronic appliances from the cloud.

4.4 OUTPUT



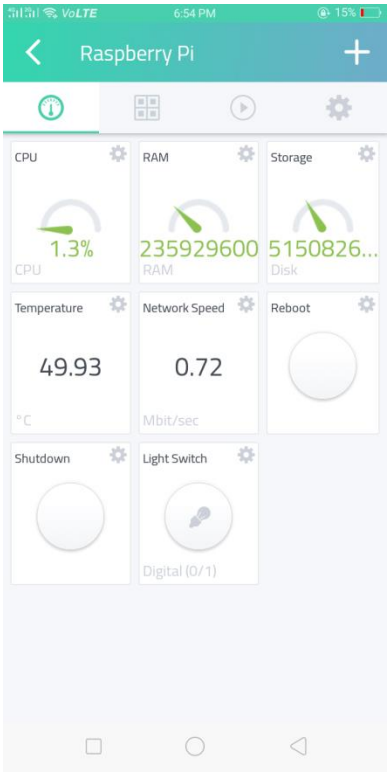
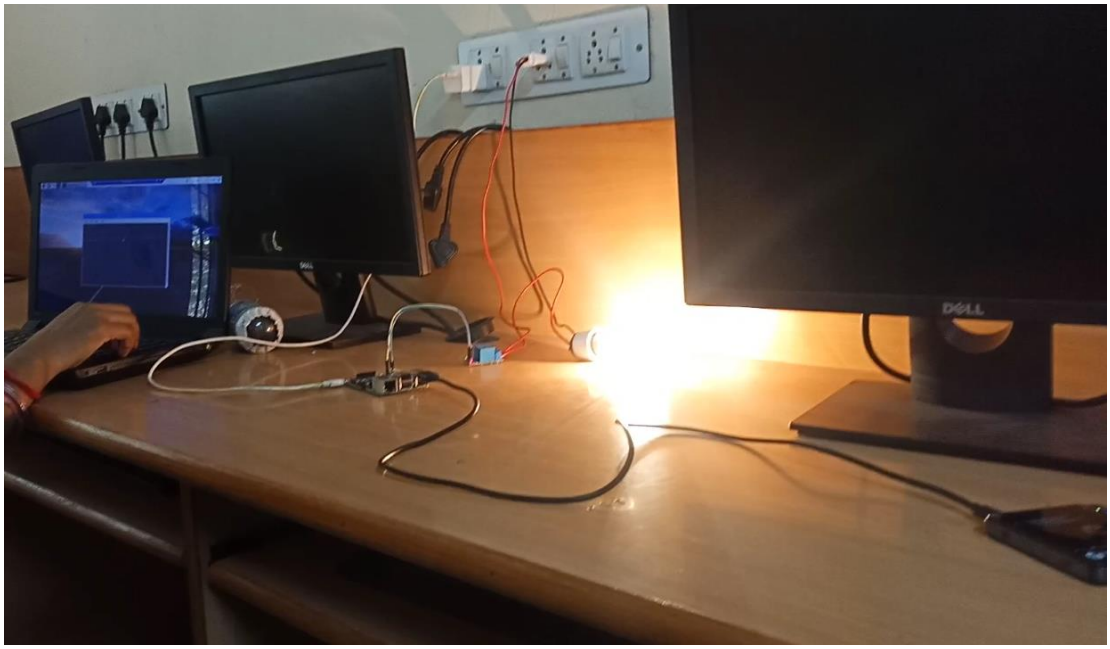


FIGURE 4.4.1 When light is **OFF**



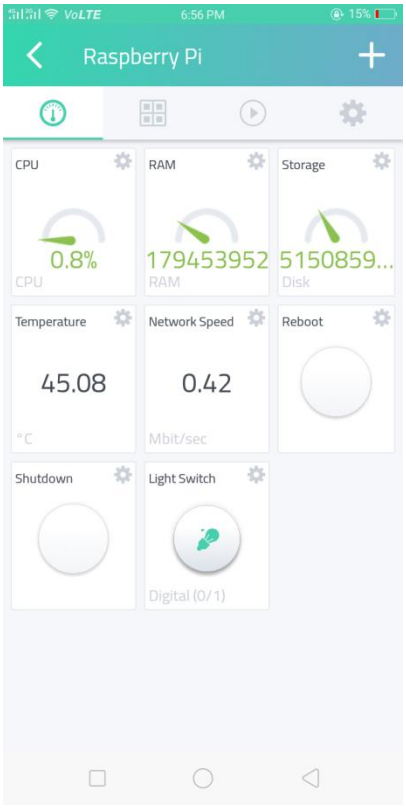


FIGURE 4.4.2 When light is **ON**

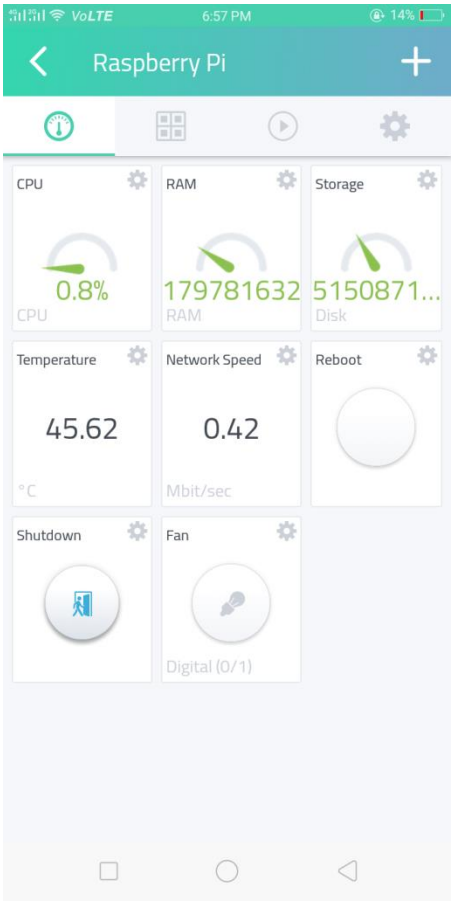


FIGURE 4.4.3 When fan is **OFF**

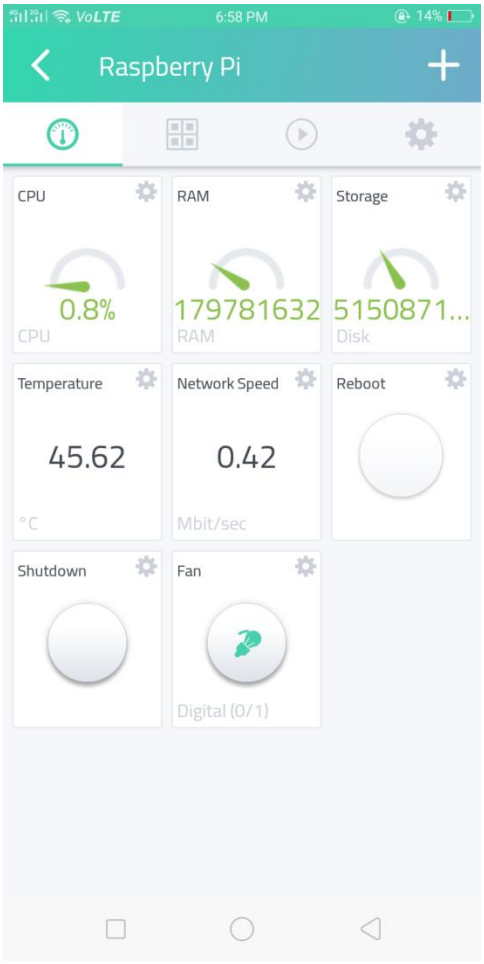


FIGURE 4.4.4 When fan is **ON**

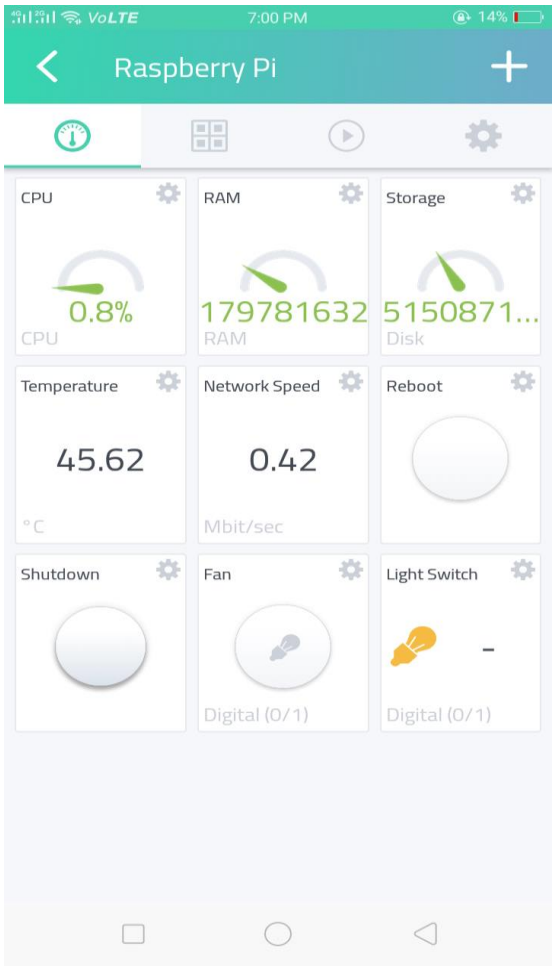


FIGURE 4.4.5 When light is **ON** and fan is **OFF**

CHAPTER 5

CONCLUSION

5.1 CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the home appliances but also control the appliances such as light and fan. This work will be carried forward by integrating relays to Raspberry pi board for controlling home appliances using cayenne application from a remote location in a real scenario. It makes human life easy and comfortable. It is possible to operate home appliances from any part of the globe.

5.2 FUTURE WORK

In this project, it only connects and control few devices in home appliances. In future it will be able to connect multiple devices such as AC, Water heater in order to control it from all over the world. This system can be expanded by sending alert notifications to the user when the appliances are in ON state within the period of time. And also the appliances can be turned ON and OFF based on the presence of human in the home using PIR sensor.

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