Design and Implementation of Smart Home Network using Cisco Packet Tracer

Ananya Mishra[1], Jay Ghayar[2], Ritika Pendam[3], Shilpa Shinde[4]

[1,2,3,4]*Ramrao Adik Institute of Technology, D Y Patil Deemed to be University, Navi Mumbai, India*

Abstract: Technology has become a critical part of our daily activities and routine life in the present day scenario. The need of the hour is to devise a smart home that will be able to control the operation of electronic devices via a smartphone. This concept, while absurd to imagine, can be easily implemented efficiently using a package tracking software which includes IoT functions for control and simulation of a smart home network. IoT technology has had a huge boom in the tech industry in the recent past. IoT, better known as Internet of Things, can be applied to several real time scenarios, such as home automation, treatment, campus, office, etc. In this paper, we will be focusing on a safe home automation system that will be including modules such as: smoke detection, humiture monitoring, motion detection, temperature monitoring and solar panel controlling using smart battery. The aim of our research is to devise a simulation network of smart devices which will be in control of the end-user remotely and implement the concept of smart home automation. This project will make use of the Cisco Packet Tracer to monitor the IoT devices in the smart home network. Simulation results have shown that these smart devices can be connected in a network to the home portal and objects can be successfully monitored which proves that such a model can be used for real life implementation in the user's home.

Keywords—Smart Home, Automation, Internet of Things, Cisco Packet Tracer.

1. INTRODUCTION

The Internet of Things (IoT), which is made up of two components- web and things, is a system devised to interface everything to the web using remote sensor networks. This new and upcoming field has made ground breaking changes in the technical industry in the recent past. With the use of this technology in which billions of entities have sensors for measuring and determining their status, all linked by common or proprietary protocols over public or private networks, we are able to create a smart home network using the Cisco Packet Tracer software which has all inbuilt functions to provide the necessities needed to build the system. This Smart Home includes objects with specific functions designed to improve comfort, increase security and automate day-to-day activities, helping the user in monitoring the home environment with great ease. The most crucial advantage of devising a smart home network is to relieve users of the stress of having to individually operate components of their household. Through the IoT concept, the devices operate together by sharing consumer usage data with each other and follow an algorithm of automated actions as per the preference of the users of the system. Along with providing this comfort, these smart home networks aim to provide increased security through use of motion detectors and web cameras. This enables the users to monitor their homes without having the need to be physically present. The smart home system also aims to improve the consumption of energy by analyzing the conditions and controlling the electric network accordingly, switching off appliances when not in use.ent data.

2. MOTIVATION AND SCOPE

The simulation in our project is demonstrated through the use of Cisco Packet Tracer (Version 8.0.1), through which we have created a framework for a Smart Home automation system. The Cisco Packet Tracer is a system devised by the Cisco Academy to model networks without physical limitations. The interface of this application proves to be highly efficient as it provides the drag and drop function while configuring complex networks. It also operates as a hybrid network to combine real and virtual networks. The advantages of using the Cisco Packet Tracer application for the development of the project are –

- Practical IoT machine simulations and visualizations provided
- Planning, creation and customization of smart homes allowed
- Supply of array of smart objects for use during smart home creation
- Board for control of intelligent objects provided
- Exploration of concepts of IoT made easy for the user
- Sensor detectors provided

• Energy meter provided to keep track of user's energy consumption

• User given access to data in the form of readings through mobile application

The scope of the system would be to provide users with the opportunity to access, control and monitor their homes with just a few button clicks, making use of smart technology. Interfaces of sensors can be created in the homes using sensors to monitor motion, lighting, temperature and humidity among a few things and also enable toggling automation in the devices as per conditions provided by the user. Energy conservation, comfort of living, enhanced lifestyle and heightened security are some of the features that the network aims to provide. Integration of the system with these fields of home automation give us the opportunity to be able to extend its impact on a much larger scale by devising automation of offices and factories, too. This automation network sets a global standard for linking smart devices to the web through cloud technology. It enables the user to control appliances of the smart home among which are lighting, irrigation sprinklers, fire detection systems, solar energy panels and web cameras to name a few. The expandability of these smart devices to connect with other networks enables for ease of energy management and security solutions.

3. LITERATURE SURVEY

This section describes the methodology adopted for the literature review. These papers represent an exploration of the contributions that have already been made in the home automation field.

Title and Year	Author	Survey
[1]"Designing Smart Campus using Internet of Things", 2018.	Ahmed Abdi	In this paper, research was conducted for the creation of a smart university to utilize technology to design a campus where components were to be replaced with smart devices to provide automation in the workplace with the help of cloud technology. The smart office was designed using IoT gateways to provide a link between devices in the office and internet, making use of the cloud.
[2]"Enabling communication between wireless sensor networks and the Internet of Things - ACOAP Communication Stacks", 2014.	Alexandria Olaisi	In this paper the author states the relationship between IoT and wireless sensor networks from ACOAP transport network is described, proving that there is compatibility between network of things and remote sensing systems over protocols as studied. The work done made use of communication constrained protocol (COAP) for the implementation of a smart campus
[3]"Design and Implementation of a WiFi based Home Automation System", 2010.	Miluzzo Chodhury and A. T. Campbell	In this research, the work was primarily done on the smartphone sensor which is considered to be the most important sensor today. This sensor consisted of various modules such as measurement of temperature, pressure, humidity etc. They worked on making the smartphone interface for creation of smart devices linked to sensors which can be controlled through the smartphone.

4. EXISTING SYSTEM

The existing systems studied demonstrate the use of smart networking for applications in campus and offices. Our project aims to demonstrate smart networking applications in a home system. We will be making use of the Cisco Packet Tracer which provides several built-in features of smart home automation networks as opposed to Raspberry Pi and Arduino incorporated with NRF modules that were used by researchers previously. With the help of Cisco tools, authentication and validation of wireless connections are attained with ease and interactive environments are made use of for creation of virtual network worlds to understand concepts and protocols for explanation, experimentation and exploration of technologies of Network Engineering. While the previous systems have been more hardware focused, making use of microcontrollers, our system focuses majorly on software networking, making use of wireless network connections to automate the control of smart home devices.

5. PROPOSED SYSTEM METHODOLOGY

Various smart objects are connected to the Home Gateway with the use of sensors. The Packet Tracer provides us with a programming environment to control these smart devices. The control mechanisms are enabled through registration of the objects on the Home Gateway. The components of the IoT are able to directly register with the IoT service on the Home Gateway or the network database.

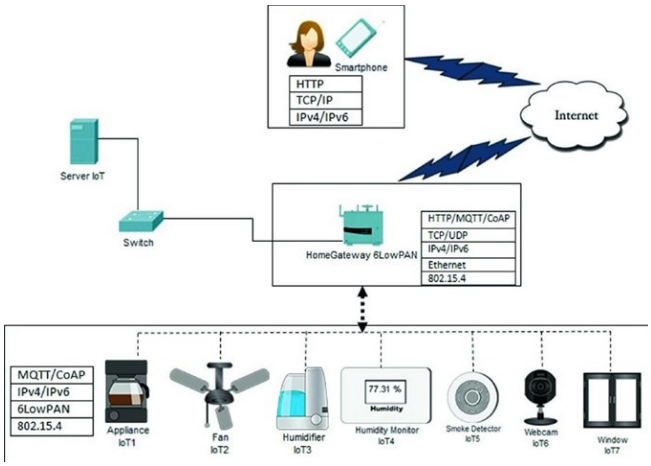

Fig. 1. System Design

HOME GATEWAY: The home gateway is equipped with 4 ethernet ports. It also has a wireless contact point on its channel 6 to enable us to make wireless links and connections through the SSID. The home gateway connects to the internet by making use of the WAN Ethernet port. This proves to be the interface which helps in the management of the automation network. Wireless connections and Ethernet cables aid in the control of devices both locally and remotely. Home gateway can be reached via its internal IP address as well as that on the internet. It also serves to be a DHCP server, thus assigning IP addresses to its connected devices. The list of devices that are registered and regulated by the gateway can be accessed and controlled.

The Algorithm of the Smart Home Automation System can be explained as follows

Step 1: The project is started on the Cisco Packet Tracer tool.

Step 2: Files with the extension .pkt can be opened and saved.

Step 3: Required components are added in the workspace, chosen from an array of inbuilt components provided by the Packet Tracer.

Step 4: Devices in the workspace are connected with the use of cables.

Step 5: Internet Service Router is set up and the devices are configured.

Step 6: The Home Gateway is added to the network.

Step 7: Smart Devices are connected to the wireless network.

Step 8: An end user device like the smartphone is added to the network.

Step 9: An application is developed to keep track and provide control of the smart devices.

Step 10: The project is completed and can be modified to meet the end user's needs.

As depicted, all the smart devices are connected to the Home Gateway with either wireless connections or through Ethernet Cables. The Home Gateway is connected to the Switch which allows it to set an IP address on the interface level. The IP addresses of the smart devices can be assigned through the Home Gateway. The Switch in turn is connected to the IoT Server which allows for linking of the smart devices in the LAN network which can be accessed by the user. Furthermore, the list of the connected devices can be linked with the smartphone to provide access to control the devices remotely through the smartphone by the end-user through the medium of the internet.

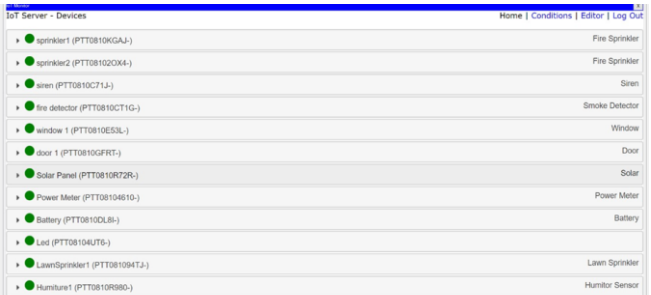

Fig. 2. Depicts the list of devices on the IoT Server that are connected to the network.

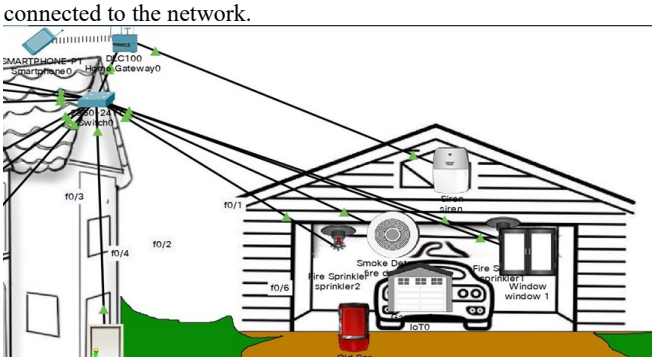

Fig. 3. Depicts the connection of the devices with the Home Gateway

FIRE DETECTOR: In the event of a fire, as the smoke level will rise, the siren will ring, the fire sprinkler will get switched on to sprinkle water and the window of the garage will open. the conditions upon which the fire detector will operate are as follows -

• If the level (L) detected by the fire detector is greater than 0.1 then the garage fire is set to be ON.
• When garage fire is ON, the Sprinkler will turn ON, Siren will turn ON, Window will OPEN and door lock will UNLOCK.
• If the level detected by the fire detector is lesser than 0.1 then the garage fire is set to be OFF.
• When garage fire is OFF, the Sprinkler will be OFF, Siren will be OFF, and Window will be CLOSED.

$$If\ L >= 0.1\ ;\ Status = True \quad (1)$$
$$If\ L < 0.1\ ;\ Status = False \quad (2)$$

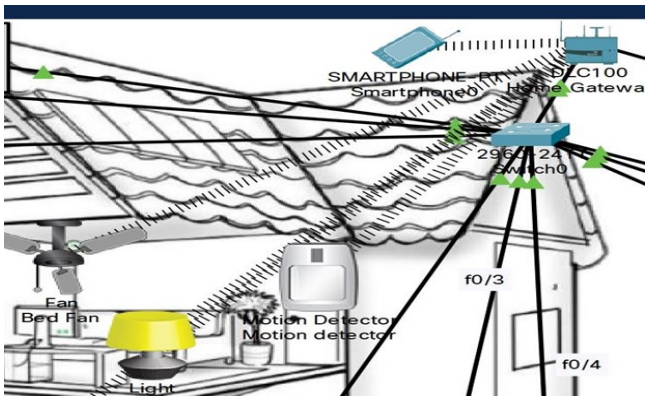

Fig. 4. Above shows the connection for the motion detector

MOTION DETECTOR: This sensor detects motion as soon as a person enters the room and the lights and fans switch on and off accordingly, thus promoting energy conservation when not in use. The conditions upon which the motion sensors will operate are as follows -

• Motion detector set to ON.
• If motion detector shows TRUE, fan status set to HIGH, and light status set to ON.
• If motion detector shows FALSE, fan status set to OFF, and light status set to OFF.

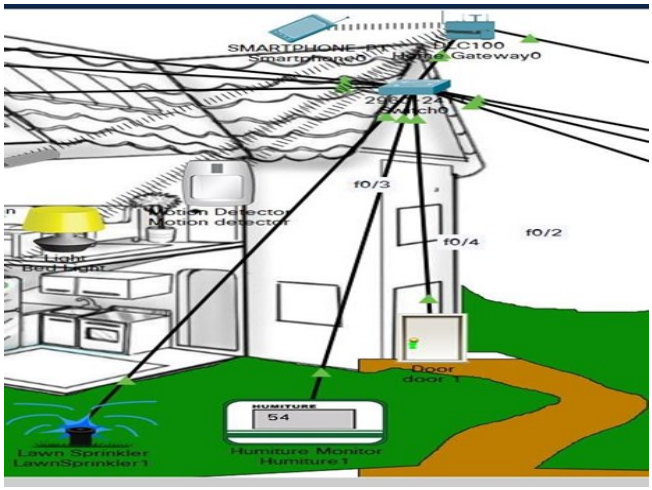

Fig. 5. Above shows the connection for the humiture monitor

HUMITURE MONITOR: This sensor detects the outdoor temperature and humidity of the environment and turns the lawn sprinkler on and off accordingly. The conditions upon which the humiture monitor will operate are as follows -

• If the outdoor temperature (t) is equal to or above 50 degrees, the lawn sprinkler will be turned ON.
• If the outdoor temperature is lesser than 50 degrees, the lawn sprinkler will be switched OFF.

$$If\ t >= 50\ ;\ Status = True \quad (3)$$
$$If\ t < 50\ ;\ Status = False \quad (4)$$

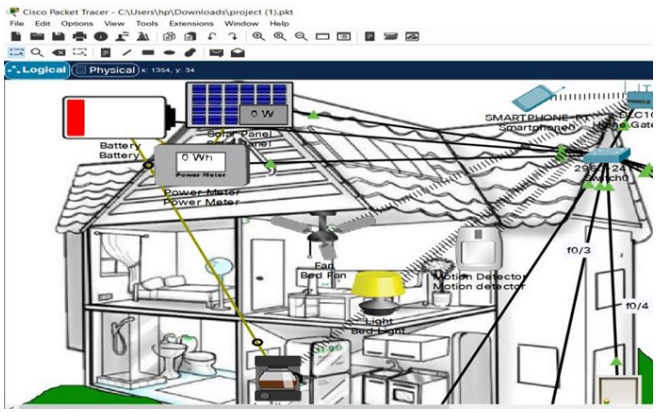

Fig. 6. Above shows the connection for the solar panel

SOLAR PANEL: This solar panel sensor detects the battery present in the solar panel and turns the coffee machine on and off accordingly. The conditions upon which the solar panel sensor will operate are as follows -

• If the available battery power (β) in the solar panel is greater than 60% then the coffee machine will be turned ON.

$$If\ \beta >= 60\ \%\ ;\ Status = True \quad (5)$$
$$If\ \beta < 60\ \%\ ;\ Status = False \quad (6)$$

6. RESULT ANALYSIS

Dataset taken from sensors is displayed through an Android application interface. The data is recorded through the use of Arduino connected to the sensors and the readings from the sensors are stored in the SQL database. These readings are reflected back to the user.

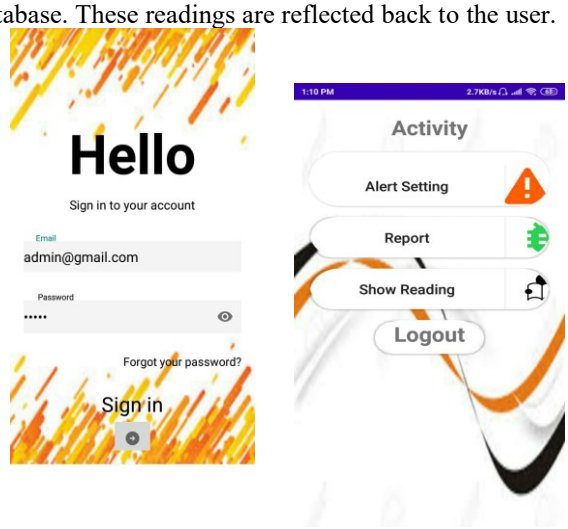

Fig. 7. Interface of the Android Application

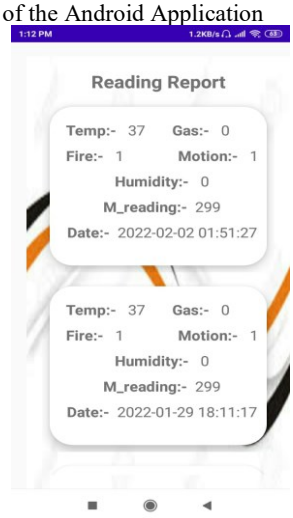

Fig. 8. Readings from the sensors are displayed to the user

	r_id	r_temp Temperature reading	r_humidity 1 or 0	r_fire 1 or 0	r_gas 1 or 0	r_meter_reading 3 digit number	r_motion 1 or 0	r_time time of reading
Edit Copy Delete	1	37	10	1	0	299	1	1643459856
Edit Copy Delete	2	37	0	1	0	299	1	1643459883
Edit Copy Delete	3	37	0	1	0	299	1	1643460008
Edit Copy Delete	4	37	0	1	0	299	1	1643460077
Edit Copy Delete	5	37	0	1	0	299	1	1643746887

Fig. 9. Readings from the sensors is stored in the SQL database

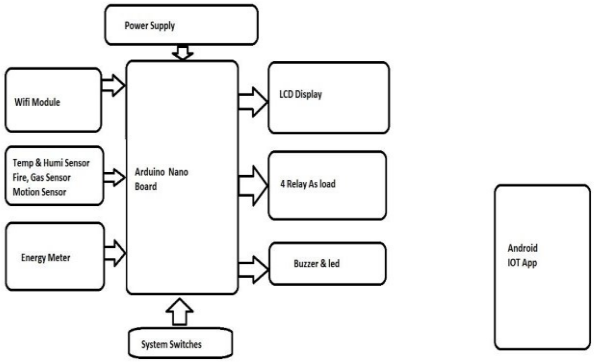

Fig. 10. Hardware model using Arduino connected to the sensors

The sensors will detect the change in environment and record the readings. These readings will be available through the interface of the app to the user. The user is able to generate a monthly report of the readings that are fetched from the database. Through this report generation module, the user is able to keep track of his/her energy consumption as well as observe the trends in the readings and therefore be informed.

A certain threshold value for each of the sensors is determined by the user. If the sensors detect a value above the threshold, alert mechanism is activated. The alert setting module on the application is equipped to send out a notification to the user as soon as the threshold value is crossed and keep sending out notifications until the readings go back to normal range. This ensures that the user is able to keep track and stay alert in case of any mishaps.

7. CONCLUSION

The idea behind this project is to explore the concept of home automation using the principle field of Internet of Things which enables us to interconnect gadgets with the assistance of web association. IoT has the power to enable 32 detection of the smart objects remotely which not only provide the user with enhanced comfort but also assist in natural resources conservation and a save in energy consumption. The question of increased security has also been covered by this Smart Home Network which provides security solutions with remote access. This gives rise to the future scope of this project which can be expanded to a large scale to cover multiple homes, office spaces and even entire industries as a whole.

Through integrating the Cisco Packet Tracer, we are able to provide a simulation which furthers the understanding and accuracy while developing a network for the Smart Home. The mobile application allows the user to have full access and control of the happenings in their environment and personalize the settings to tailor-suit their needs. Furthermore, the energy consumption module plays a vital role in promoting the need of the hour to use resources carefully and sparingly and cut costs that come along with wastage. The alert module of the mobile application will also prove to be successful in helping users avoid at-risk situations and thus enhance the quality of solutions for safety concerns regarding smart home automation.

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