HOME AUTOMATION SYSTEM

A

Project Report

Submitted for Partial Fulfillment of the Requirements for the Project Completion

of

Idea Laboratory

Under the Department of

Electrical Engineering

Submitted By:

Nisarg Shah (16BIT008)

Akul Agrawal (16BIT018)

Anmol Tripathi (16BIT007)

Under Guidance of:

Prof. P.N Kapil

Department of Electrical Engineering

Institute of Technology, Nirma University,
Ahmedabad – 382481

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DECLARATION

We do hereby declare that the technical project report submitted is original and is the outcome of the independent investigations/research carried out by us and contains no plagiarism. The research is leading to the discovery of new facts/techniques/correlation of scientific facts already known. This work has not been submitted to or supported by any other University or funding agency. We do hereby further declare that the text, diagrams or any other material taken from other sources have been acknowledged, referred and cited to the best of our knowledge and understanding.

9st April 2020

Place: Ahmedabad, Gujarat

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           Prof. P.N. Kapil
(Assistant Professor- EE, ITNU)

INSTITUTE OF TECHNOLOGY, NIRMA UNIVERSITY
ELECTRICAL ENGINEERING DEPARTMENT
IDEA LAB

Final Report on the work done on the Idea Lab Project:

1. Project Title: Home Automation System

2. Period of Project: 1 year

3. Name of Students: Anmol Tripathi (16BEE007), Akul Agrawal (16BIT018), Nisarg Shah (16BIT008)

4. Name of Mentor: Prof. P.N. Kapil, Assistant Professor, EE Dept., ITNU

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6. Total Amount Approved: 22,000 INR

7. Total Expenditure: 7926.80 INR

Brief Objective of the Project: The project is targeted to build a smart home switchboard and architecture as a whole that can provide a wireless interface to the user for accessing various electrical devices. It will facilitate the accessing of the switch board components, switches, fan regulator, tv remote, motor actuators for smart curtains all via the mobile phone interface using wifi. We store the current status of the accessible components and also provide the real time status to the user screen. Due to the attached micro controller unit with the extended switchboard architecture that we propose it becomes easy to fetch and push the values both ways from the switch board via a very lightweight messaging protocol, MQTT. This idea can be compared with the existing home automation systems in terms of performance and it is capable of designing smart switchboards along with open source messaging architecture for user interface at around 20% cost that the market leaders are currently providing.

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Students
16BEE007, 16BIT018, 16BIT008

_____

Prof. P. N. Kapil
Assistant Professor,
Electrical Engineering Department
Institute of Technology,
Nirma University

_____

Dr. Ankit Thakkar
Idea Lab Coordinator,
Institute of Technology,
Nirma University

_____

Dr. S. C. Vora
Head of Department,
Electrical Engineering Department
Institute of Technology,
Nirma University

_____

Dr. Alka Mahjan
Director,
Institute of Technology,
Nirma University

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ABSTRACT

Technology is the most important part of people's standard of living and with the automation of different technology life has become easier. In today's era Automatic systems are being preferred over manual systems. Smart home systems are at their peak because they offer comfort, better security and quality of life for people. Smart home systems facilitate centralized control of lighting, H.V.A.C. (Heating, ventilation, and air conditioning), audio or video operations, secure techniques, kitchen equipment and other appliances for home systems. The system is implemented with the help of sensors, controlling devices, and actuators. The sensors are capable of detecting the different physical elements like temperature, moisture, light, sound,etc. and send the data to the central device.Controllers could be personal laptops, smartphones and other electronic devices.

We have built a home automation device to control the lights and H.V.A.C. system of the home. The implementation is a marketable product and developed considering the Indian home automation market . The future work includes addition of voice controlled home automation using our own cheap voice device.

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1.1. Overview

With those of the globe's latest scientific advances, the domestic automated business has seen a boom in its industry. Households have been very electronics-equipped, much big thanks to sci fi movies in stimulating the human mind to create these technologies that might potentially lead to convenience and health.. Internet of Things (IOT) is the platform that brings in a transition in the robotics market. The Web has changed a number of lives, which is already a must. Offering communication at any moment is a remarkable function, thus combining detectors, transceivers and processors that helped build a new arena called IOT.

1.2. Internet of Things

IOT is an online service with many digital realm agencies. The clearest example of IOT is connecting stuff to the web via established procedures. In connection with the subject of discussion because several residential home machines access the internet in a connected home using routing protocols and conventional procedures is called a smart home on the Internet of Things(IOT)[1]

The Internet of Things (IoT) has increasingly gained its proportionate share of coverage as the environment is even more interactive. There is little question about the importance it has already created, and the ability to transform existence as we all understand it.

The Iot provides an ability to reshape culture and build a modern world designed to support not only human beings but civilization once more. Consumers will receive exclusive personalized incentives on request in this modern era, just though communities can profit from efficient usage of assistance and reduce awful effects on the climate. The Organisation for Economic Co-operation and Development (OECD) contrasts the value and widespread availability of IoT with the introduction of domestic energy, and sees it expanding beyond innovation and commerce to reimagine our financial, ethnic and friendships.

1.3.   Home Automation System

These are sensible infrastructures in reality feel encircling thus making secure, proficient and relaxed vibe round. The power proficient also protection function shows the significance these days globally that's surely a period of smart structures. Connected Home called Home automating may done through wire in addition to connectionless infrastructure. The era of creation of a home, wire installments were completed to offer home automating centers via wire and consequently make the installments simpler. While connectionless generation rely upon wire infrastructures at the private house consisting of strength strains and get in touch with lines even though their installation is a touch tedious procedure but it's far greater handy and little breach and affords good service taking into consideration the increase of clever telephones and domestic gadgets.

The essential goal of home computerization structures is sparing vitality or vitality, as it is far generally perceived that a major amount of solidarity is being squandered each day only because of manual carelessness which can be checked just by creating the machine video show units area and precisely turns the devices while there might be no individual inside the room additionally joining of dht sensors gives a preferred position of oversaw yield from both gentle and fan steady with the temperature of the room .Now considering some other angle this is wellbeing because of the regularly developing vintage individuals and children's populace there is a requirement for the houses to be more brilliant one all together that it could offer progressively make sure about condition for them.

The discussion is on the different markets of the system. The report also contains the implementation of the system and setting up the whole system and taking the different market factors to design the implementation of the home automation system

2. Literature Review

Home automation is a tough one no longer most effective for coders however and the patron. the coder may select the thing as in line with the patron's needs. And thus because the consumer needs are not identical consequently ought to deal with prevailing merchandise.

They control via this module numerous gadgets thru internet site and additionally with apps. Two researchers of their paper In Arduino super, have added Zigbee modules from which they power systems. The use of numerous sensors OF diverse functions. They provide actual noti, comments on the internet wherein consumers could watch the occurrence of the house [1]. The assist good judgment gate , a R-pi, timers and flip-flops additionally gadgets can get accessed by application.

MQTT protocol is used for messaging as the system should always be in a definite state thus publish subscribe architecture is used. The connectionless transfer of data and also retain functionality added in the protocol reduces the complexity of maintaining a database at the server side.

Now considering some other angle this is wellbeing because of the regularly developing vintage individuals and children's populace there is a requirement for the houses to be more brilliant one all together that it could offer progressively make sure about condition for them.The next is defined by the room id which is subscribed by the window control Esp8266 and each switch board in the room are given a unique name.

The use of numerous sensors OF diverse functions. They provide actual notices on the internet wherein consumers could watch the occurrence of the house .

Protocol stack	1EEE	Net. Formation	Max Power Consumption	Data Rate	Max Range	Cost
Blue-tooth	802.15.1	One to Many	100	1 to 3 Mbps	10	Medium
Zig-bee	802.14.5	Star, cluster, mesh	3	20 to 250 kbps	100	High
Esp-8266	802.11	Star, mesh	100	1 to11 Mbps	150	Low

Table-1Protocol stack comparision

The findings from the given comparison suggests that Esp8266 deals with 802.11 convention while Zigg-bee utilizes 802.14.5 convention. Zigg-bee expends the lowest energy of 3.0mW while WiFi and Blue-tooth devours almost 100.00mW. However, on the off chance that we look at connectivity in Esp-8266 is the most extreme connection upto 11.00mbps yet Zigg-bee had just 250.00kb/s. Plainly esp-8266 router beats Zigg-bee also Blue-tooth at the price comparison as well as in connectivity [8]. Figure 1 gives a short thought regarding connection of microcontrollers , fringe gadgets just as sensors and what the engineering behind[12].
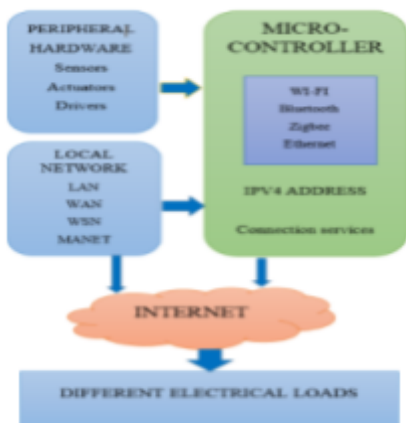

Figure. 1. Network Layers
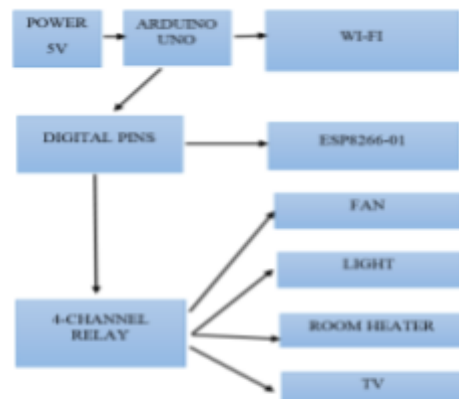
Figure 2. Block diagram of the system

3. Home Automation Market

3.1. Introduction

Smart home automates household operations by monitoring wireless devices and facilities via smart devices. Security system requires, though not restricted to, unified light regulation, house entry protection inspections / doors, Heating and air conditioning monitoring and many others.

An intelligent house offers consumers various benefits like decreased power consumption, safety against burglary and safety against unwanted entry to a house. In order to secure their investment properties such as offices, equipment systems and many others, the approaches are increasing prominence amongst businesses. The study maps out the strategic approaches for corporations in depth

Rising prices for energy-efficient solutions and growing protection issues propel the sector. Because of the heavy price of computerized residences the industry heads constraints. The smart home industry's development prospects are attributed to expanded acceptance of digital technologies, and environmental policies through policy benefits.

Figure 3: Home automation market growth in India

3.2. Affecting Elements

The elements affect worldwide marketplace of house automation encompass growth of imaginative & strength green computerized infrastructures, development in

the Internet of things market, bring house tracking value from faraway places, upward thrust in client consciousness associated with availability of clever 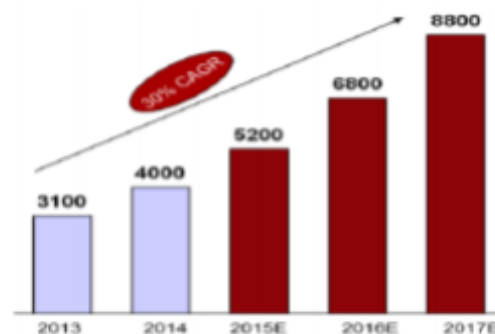domestic devices along with automated safety & lighting fixtures infrastructure, & rigid govt. policies. Domestic automating structures are expanding, and that owes the improvement which brings the demand of more effectiveness in clever houses. Domestic automating enterprise controlled using far off managed answers, as cell applications & different further method is high-priced in the undeveloped areas.

- Rise of Electricity Cost

    Rise of electricity cost has accelerated the budget of operation. Urban properties and hospitals are foremost stop customers. Rising in the cost of products, like charcoal, substantially increases the value of producing strength & it will increase the cease-consumer power price. Acceptance of domestic automating facilitates giving up customers to change utilization, and lowering power spending. Domestic automating control provides comparatively cheap power utilization & in addition lowers electricity intake, safety, and H.V.A.C. structures.

- Govt. Rules

    Strict rules have been applied through govt. to efficiently make use of and manipulate energy intake. Distinct rules made through officials including five-year plan of China objectives of power performance tasks & European's 2020 strengths target attaining zero energy consumption in public and personal homes. These rules are expected to reinforce the increase in adoption of smart automatic controls throughout the forecast period.

- Raise market perception

    A house & building holders are becoming more aware of the efficacy of automated checks at their properties. Clever electronic ballasts, automatic Heating and air conditioning systems, and protection structures make green use

domestic controls with reduced resistance intake. House builders are committed to novice activities to reduce total carbon dioxide pollution.

This rising emphasis is among the key elements increasing global acceptance of automatic control.

- Computational Growth

Technological advances as well as enhanced communication alternatives also improved the global acceptance of domestic automating controls.Installation of automated control systems has been simplified with the introduction of various wireless technology that includes zigbee and Wireless. With each distinction, specific specifications for house computerized controls such as EnOcean and Z-wave have enhanced the versatility with various additives. More enhancements of these automation systems are expected to accelerate their acceptance through exceptional categories of cessation-users..

- Large Return time frame

Large maintenance costs for smart home devices would increase the rate of return and thus restrict the implementation of those systems at many areas. The fall in product costs, such as regulated gadgets, sensors, and device gadgets, is anticipated to decrease the time horizon sooner or later over the projected era, thus leading to increased acceptance in the coming years.

Acceptance of domestic automating facilitates giving up customers to change utilization, and lowering power spending. Domestic automating control provides comparatively cheap power utilization & in addition lowers electricity intake, safety, and H.V.A.C. structures.

Figure 4: Market quotation in
India(1)

Figure 5: Market quotation in
india(2)

3.3.   Business traction

The demand for home automation systems is anticipated to see rise in the projected timeframe as technology progresses. The number of internet users has gone up rapidly over the past decade. The growing use of smartphones and the advent of IoT technologies are also major drivers of home automation market growth. However, lack of awareness of home automation products and high initial smarthome assets that hinder the adoption of home automation systems.

- Pilot: Steps that minimize costs allowed through smart home program

  Computerized devices that can be run on a timely basis and even from far-flung places are used by the home automation service.Smarthome items that include smart meters and clever thermostats measure the amount of electrical electricity in houses powered by electrical devices. Power usage is regulated in charging gadgets (kilowatt / hour), in which regular electric measurements produce billing cycles dependent on the electricity consumed for a cycle's duration. Citizens can practically understand the use of force above, instantaneous, and predicted by using a real-time system for power metering.

  Lightening regulations allow people to add synthetic light that depends on the standard. But synthetic lights no longer devour big quantities of power, the use of lighting manage merchandise still enables in saving sure units of power. Automated HVAC products also assist to lessen the power intake to a sizable extent. Several provider vendors and house owners testify that home

automation systems supply sizable gains, thereby decreasing the amount of electricity wasted and additionally the prices incurred.

- Restriction: A few of the smart home devices in developing nations to evolve

  Domestic automation product shipments are contingent upon owners' usage and specifications. Consumers typically prefer products which deliver comfort and quality in weight. Inside the financially developed international locations in Asia and the middle east the idea of smart home is not always new. Most of the North American nations' suburban neighborhoods are now made of smart gadgets. Over a long time, the majority of people have used occupancy monitors, smart meters, smart meters, H.V.A.C. monitors and regulates on lighting fixtures. Since the price of these goods is large, customers don't update them quickly after installation. And the nations of Europe, together with the UK. And Germany has a huge array of smart homes. Hence, the overall number of smart home devices that had a giant saturation rate throughout the previous couple of years is projected to see a slower boom rate throughout the market growth.

- Opportunity: Beneficial policy oversight for many nations

  Renewable energy has become one of many countries' main priorities for addressing climate change and power consumption. Governments within the U.S., Canada, and Mexico have always been selling an inexperienced environment that has led to North America's large variety of clever houses. In fact, the authorities of European external locations have taken steps over the last couple of years to implement force-efficient interventions around the region. At this place, the policies mentioned by the authorities are favorable towards systems of domestic modernization. Govt. in some of the Asian countries also help to a broad amount digitisation and eco-friendly initiatives.

  On 19th of Dec,Japan electronic industry development association, Japan business machine makers association ,Electronic industries association of

Japan, and the communications industry association of Japan established the voluntary control council for interference with the aid of information technology equipment to deal with disturbance problems due to non-public computers, which helps triumph over the troubles of digitalisierung. Moreover, the emphasis on the disruptive effects of climate change fuels the use of computerized house intensity control devices.

Hence, during the projected period, therefore, the house automate devices are expected to have a better integration rate.

- Challenge: Threat of malfunctioning equipment

Smarthome solutions are primarily based on specifications for computer connectivity, routing algorithms, and network technologies. The entire process of household automation products relies on all the systems being interoperable. The home automation device's atmosphere includes the operating systems, applications, and service segment. This is extremely necessary for all three components to work efficiently and together for the efficient and effective functionality of each single component. In phrases of importance and logical difficulties, the malfunctioning or disconnection of either of the segments results in some problems for a house owner. Therefore, eliminating the danger of equipment faulty and ensuring it is easy to run is a main concern for smart home device suppliers.

Lightening regulations allow people to add synthetic light that depends on the standard. But synthetic lights no longer devour big quantities of power, the use of lighting manage merchandise still enables in saving sure units of power. Automated HVAC products also assist to lessen the power intake to a sizable extent.
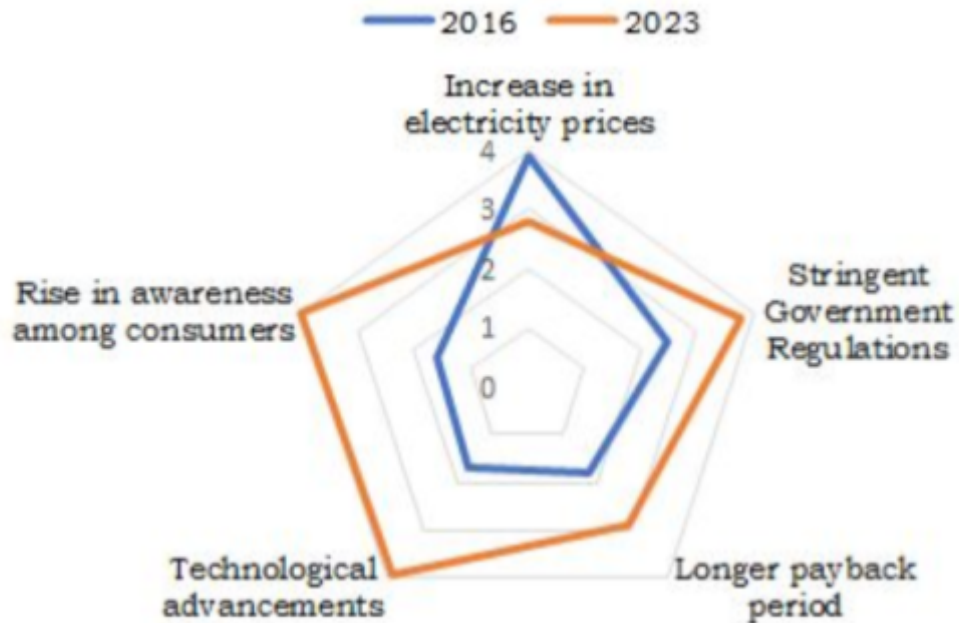
Figure 6. Top Impacting Factors of Home Automation Market

3.4. Business optimization of the home control services

The study report classifies the demand for smart home systems to estimate sales and evaluate the patterns in each of the sub segments below.

1. **Home Management Control Protocols**

   - Networking systems

       ○ C.D.M.A.

       ○ G.S.M.or H.S.P.A.

       ○ LTE Network

   - Tech Wireless Communication

       ○ Blue-tooth

       ○ Zig-Bee

       ○ WiFi

       ○ Zwave

- ○ En-Ocean

- ○ Thread

- Protocol and Norms

    - ○ Digital Multiple D.M.X.

    - ○ Building Automation and Control Network (BACnet)

    - ○ Black-box

    - ○ Power-Line-Communication (PLC)

    - ○ K.N.X.

    - ○ Digital addressable lighting interface D.A.L.I.

    - ○ Ether-net

    - ○ Mod-bus

2. Software & Algorithm at smart home device business:

- behavioral-system

- proactive-system

3. Demand for the smart home program, by Deliverables

- Lighting Control

    - ○ Dimmers
    - ○ Switches
    - ○ Accessories and Other Products
    - ○ Timers
    - ○ Daylight Sensors
    - ○ Relays

- H.V.A.C Control

  - Sensors

  - Actuators

  - Smart Thermostats

  - Control Valves

  - Smart-Vent

- Amusement & Others

  - Amusement Control

    - Playback and Digital media

    - home theater control

  - other controls

    - Internet-Connected meter

    - Internet-Connected plug

    - Internet-Connected hub

    - Internet-Connected lock

Figure 7. Market by Application

Figure 8. Market by Type

4. WIRELESS SYSTEMS

For home control applications wireless networks have also been the core of creativity. Wifi detector systems are node structures that should be systematized into a collaborative infrastructure by each device providing a computing capacity, various kinds of storage, a Radio frequency transceiver and energy supply[12].Wifi interaction can often be readily accessible as a consequence of enhancing the optimization of a device and thus it wouldn't compel any cabling. The wi-fi systems often become easy to work. Because a growing format of device setup is accepted globally it allows downloading and configuring simple. Connectivity architectures are distinguished by small data speed, low power consumption and less complicated guidelines.

4.1. Wireless Design

4.1.1. Net service

A key essential prerequisite of the home network architecture is that it will accommodate the various kinds of traffic flow because a device can be clogged up or empty at a certain moment and therefore the implementation of such a feature is a product testing method.

4.1.2. Indoor radio planning

There's many multipaths of specific mirrors throughout the apartment and they are usually distinguished by polished mirrors mainly.[14]. A reprimand however is the ineffectiveness and poor precision throughout the development strategies for wireless preparation but can still potentially cause large operations costs. Additional developments could be impractical to expand the signal strength owing to a huge amount of moving as it is often rather tedious.

4.1.3.   Minimal-duty phase design

After remote gadgets for the most part battery worked gadgets. Advancement is without a doubt required so as to spare battery.

4.2.   Wireless Residence and Infrastructure Security Configurations

Displays network management audit in smart home system

protocol	Merits	Demerits
Blue-tooth	Could link different devices in a geometry of stars	Includes pause on entry.
Zigg-bee	Less speed and implementations within limited scope. Cost efficient wireless connection..	Restricted usage of electronic equipment such as portable controls and indicators
Z-wave	primarily due to cluster connectivity methodology the entire path of the information transmission has been established	Unable to migrate vast volume of information. Information sharing is not feasible in full detail
En-ocean	Wifi machines which are operated by themselves. Configured to conserve electricity.	Forwarding is not effective. No System for Protection.
Insteon	Primary operator is not necessary for every system to send, accept and reiterate any complaints regarding messages	There aren't really any goods throughout the industry.
Waven-is	Service tracking and management Utilizes minimal energy transmitters.	Limited amount of tasks but only appropriate for mid range use.
KNX-(RF)	Heavy security of info The info distributed isn't really exposed to validity tests.	Never ideal for transmitting wireless signals. Hardly any System for Protection.

Table 2: Advantages and Disadvantages of Wireless Systems

The tabular portrayals show general review with respect to the different remote conventions utilized for house automate systems. Components reviewed when near analytics are: Spectrum groups, speed, tweak strategies, routing plans, topologies and afterward in the long run their benefits and negative marks. With the closing wisdom while contrasted with Zigg-bee scope of Waven-is higher but uses low force [11]. Due to the feasible dynamism of energy efficiency, reduced power usage & improved battery career, Z-wave could be deemed as an alternative for Zigg-bee. But most of the times Zigbee maintains the only really open traditional wireless framework with large levels of knowledge and pile scale across the different alternatives. Limited commitment, good value durability contributes to its accreditations but also allows it a rather preferred platform for the techniques of smart home.

5. Obstacles Met

When the technology gets increasingly complicated, the increasing number of transactions within the iot is a big problem confronting us. WWith the expanded use the communication issue emerges [12]. For networking reasons 3 G networks are required. For all these communication challenges, any moment the transmission is accessible is basically not feasible.

Main problems confronting IOT:

- Norms

    Program efficiency is a big problem. For a certain development a robust device helps a lot. The information must be forwarded with no mistake, postponement or failure from either the origin or the target.

- Confidentiality

    The system data should be kept secured and should not be disclosed to an end user which is not yet identified.

- Identification

    The server side of the system has very less security thus identification is a key problem in our system.

- Authentication

    The data sent or disclosed to an end user must have been authenticated to secure the system from attacks.

- Security

    The system must be able to reconfigure in the sight of possible attack and be secured..

- Incorporation

  Connecting of new devices each day not only increases the system complexity but also causes connectivity problems. So the system environment must be such that integration should not affect the performance of the system.

- Coordination

  The globally connected devices, processes etc. should have perfect coordination between them for data transmission and other works.

- Data storage

  In home automation system the problem of data storage is not a big deal. Though data analytics need each and every data to be sent to the server for further processing.

- Self-organisation of network

  The network should self organize itself that the data loss doesn't happen in the future due to network failure.

- Cost effectiveness

  The cost of devices used must be taken into consideration as the market of the project is India(As discussed earlier).

6. DESIGN AND IMPLEMENTATION

According to the considerations I had a basic schema ready to implement the Home Automation System.The different steps taken from idea to implementing are given as follows:

6.1. Choosing Schema

There were two different choices for schema.The options were compared a particular type was chosen for implementing.

DIY(Do it Yourself)	Hierarchical System
This was a model where smart switchboards could be sold in the market	The system needed to be set up and configured by the team.
The switch board could be directly manufactured without the involvement of the client.	The client requirements are taken into consideration to build this system.
User customisation isn't possible in this method	The entire system could be designed taking a specific customer into consideration
The end user must a basic knowledge to configure the board	The end user must only know to use the app for automation

Table 3:Comparison between DIY and Hierarchical Systems

From this table it was decided to use the Hierarchical System for implementing this project.

6.2. Application and Components needed

Firstly we want to limit the applications for deciding the going to market time. Following applications are mentioned and components needed to complete the task.

- Automating a Switch Board

We must automate 4 switches and a fan in a single module.So we need 4 digital pins to take input from the touch sensor, 4 digital pins for operating Leds displaying on/off on the switchboard and also 4 digital pins to operate the

relay.We do not have this many pins on esp8266 we might need 2.But the pins for relay triggering and Leds could be combined .We need a Tx pin for sending the step number to control the fan speed.We also need a step dimmer for digitally controlling the voltage sent to the fan.We need 4 relays to control 220V AC input.We also need a 220V to 5V step down transformer to give electrical input to the Esp8266.

- Controlling the Tv and all remote operated Appliances

The idea is simply to give the inputs to a appliance that are given by the remote from a IR blaster connected to our system.The remote should be displayed in our UI of the system and the inputs should be executed.This implementation needs only one Tx pin / digital pin of Esp8266 .

- H.V.A.C. (Heating Ventilation and Air Conditioning) control system

The main idea to implement in India is to open the windows when the Temperature on the outside is pleasant (mostly during the night) and turn off the AC.The motor should be operated using one digital pin for each motor and a input pin for DHT 11.

6.3.   Physical System Placement

According to the System designed there is need for a ESP-8266 board with every switch board so there is an assumption that wifi is available in all rooms. If not the repeaters could be added to have connectivity.There is a main controller added to the control center of the house.The devices can be connected to local wifi and have the system running or remote access could be given according to the plan selected.The initial diagram for device placements is as follows
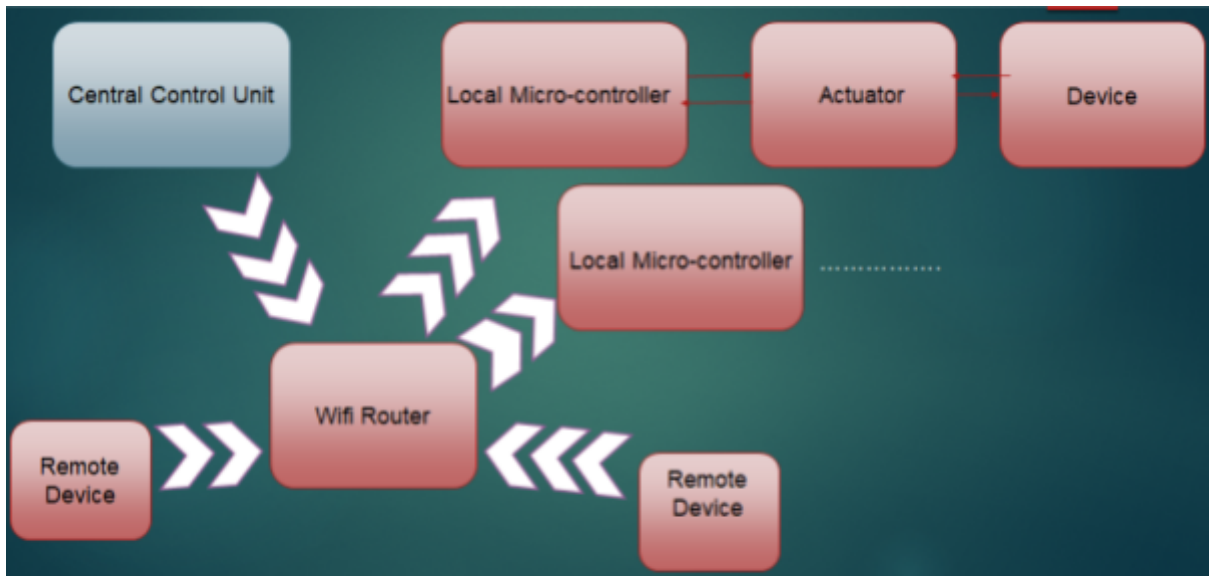
Figure 9. Physical Device placement

The router is the central system connected to all the components and the central controller is connected to the router always and controls the working of the whole system.

6.4. Connectivity and Protocol

The network connectivity used right now is wifi IEEE 802.11 for connectivity between the automation modules.This consumes high power but as the devices are also connected to power and the cost of power is also low.

MQTT protocol is used for messaging as the system should always be in a definite state thus publish subscribe architecture is used. The connectionless transfer of data and also retain functionality added in the protocol reduces the complexity of maintaining a database at the server side.

The naming of each switch would start with a client ID which is subscribed by the main controller only.The next is defined by the room id which is subscribed by the window control Esp8266 and each switch board in the room is given a unique name.

The msgs for temperature and all lights off are sent in the root name,and control of windows using the uniques room id and switching of lights and fan are

given using specific board id. The devices while subscribing also publish messages in the respective scope to pass important information.

The central unit has to have mqtt broker running for the plan of automation staying at home.Thus the central device is taken to be Raspberry Pi and the connections of remote operated devices are done by Raspberry Pi.

6.5.   Switchboard Automation

The switch board has 4 switching options and 1 fan option.The names of each switch can be changed in the user interface of the system.The component needed for doing this is   Esp8266. The Esp8266 is subscribed on the topic of switchboard the command comes to switch on/off light. To perform that operation the Esp8266 needs relays to switch on/off 220V devices.

To operate Fan there should be steps and if physical variable register is not to be used as it becomes complex thus we used a dimmer module for that.The module took in Digital inputs from D0 to D7 and accordingly had options for 256 steps.The requirement is only for 5-6 steps.

There are not enough digital pins for connecting all digital pins to the fan. We need 3 pins for having 8 steps and thus they are enough if connected to the most significant pins.
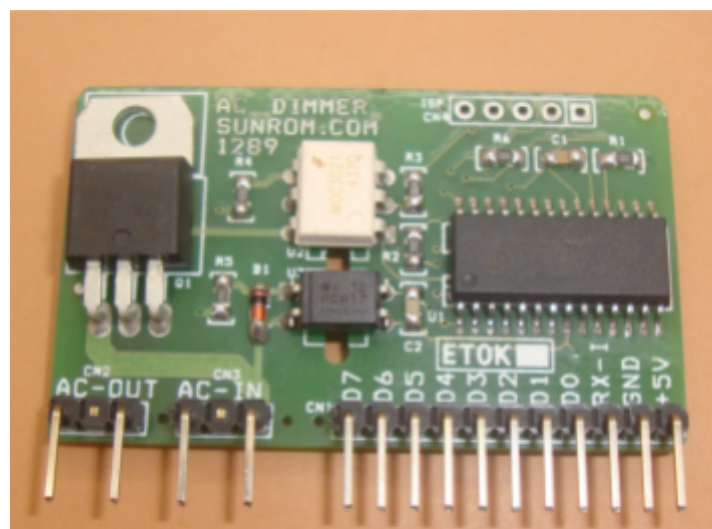

Figure 10. Multi-step Dimmer

Parameter	Pin
AC-input	80-250V AC
AC-load_current	12-amp
AC-load_type	bulb-1000 watts fan-100 watts
Frequency-of-mains	50-60 Hz
Control-input-voltage	5V DC

Table 4.   Specifications of Dimmer

Thus controlling AC voltage for fan was solved but fan also needed 3 digital pins for controlling dimmer and 2 additional pins for Touch sensors to control the speed of fan from the physical position.So the touch sensors used are capacitive touch modules based on touch-sensing IC (TTP223B).

Figure 11. Capacitance touch sensor

We solder the pins to this and added to our module.Now the components like dimmer and Esp8266 need 5V DC to operate so we order 5V-1A AC-DC-220V-5W

but the smps burned and stopped working as the Watts increased the specified limit so we bought the higher version with better specifications. The new component used was 12V-3.5A AC-DC-220V-40W.

Figure 12. SMPS

The components and all was set so we made the demo on the breadboard and the setup worked.Though the design had to be finalized and thus we did start building a PCB where the component could be fixed. We gave our design and after satisfied design we gave the order of 10 PCB. The PCBs are ready and printed but due to Covid-19 and lockdown they couldn't be delivered.

The design of PCB is made using the measurements of the different components. Esp8266 has a universal dimension and has a module that could be directly used in the designing of the PCB. The components like our dimmer for fan and SMPS are custom built by the company and don't have universal dimensions so we got the pcb measurements for each component and sent those designs to our PCB designer.
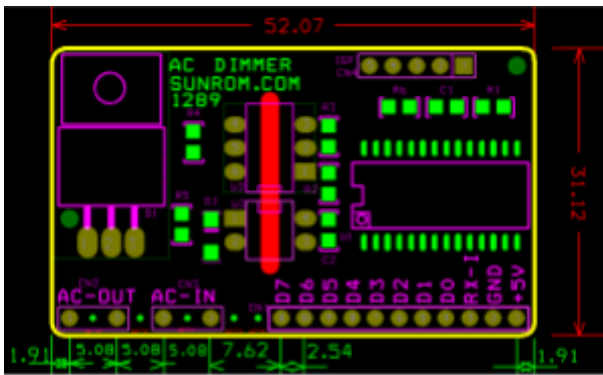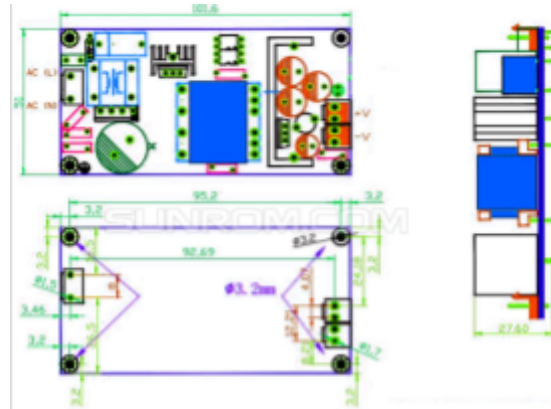
Figure 13. Dimmer PCB Dimension
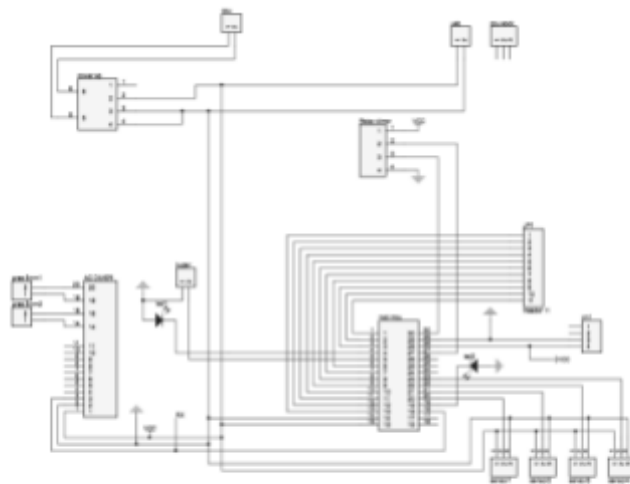

Figure 14. SMPS PCB Dimension

Figure 15. PCB Design

6.6.   Automating IR input Devices

The Devices in which ir remotes are used (i.e. Tv,Ac) work on a simple basic rule.They have predefined codes for each and every button on the remote which is blasted by the IR blaster when pressed. The receiver gets the signal and accordingly. Each and every company has its own encryption technology to send data from IR.

Thus we designed two sets of modules in which the first module has a IR sensor which will sense the code sent by the remote and using those code we hardcoded them in the second module and operated the Sony Tv as Sony's encryption was open sourced.Here is an image of operating the tv with the blaster

Figure 16. IR Blaster model   .

In the implementation IR blaster must be sticked to the device's sensor and the input can be given from the central Raspberry Pi in the control region and the wires could be added with the electrical wires and can easily be hidden.

The final work should look like this:

Figure 17. IR Final Product

6.7.   HVAC(Heating, Ventilation and Air Conditioning) control system

The system is developed for India where the temperature drops during night to be pleasant enough without the Air Conditioning. Thus the system is designed to measure the Temperature on the outside and open the windows without the user instructions to save energy and have natural air.

We have DHT11 sensor which measures the temperature around the house and publishes in the root topic where the controller has subscribed and initiates the actions required.The windows of the same room have subscribed to a single topic and if the controller publishes a msg to open the window then all windows of the room are opened and AC is turned off automatically.

The temperature could be set by the user at which the ac should be turned off and windows to be opened.There also an option of using a timer to do these operations. This option could be turned on/off according to the need of the user.

Figure 18. Window automation demo

This is the prototype made to test the motor and its strength to operate the window with a spring. Right now the design can only open the window (using spring to open) so we need to add a touch sensor to toggle the latch. So to lock the window user has to close the window and touch the sensor to lock the latch.

6.8. User Interface

User Interface was designed using a platform named 'Node Red' where the representation is very good and the backend connectivity and logic could be directly programmed and thus reducing the complexity of building a User Interface.The platform is shown below:
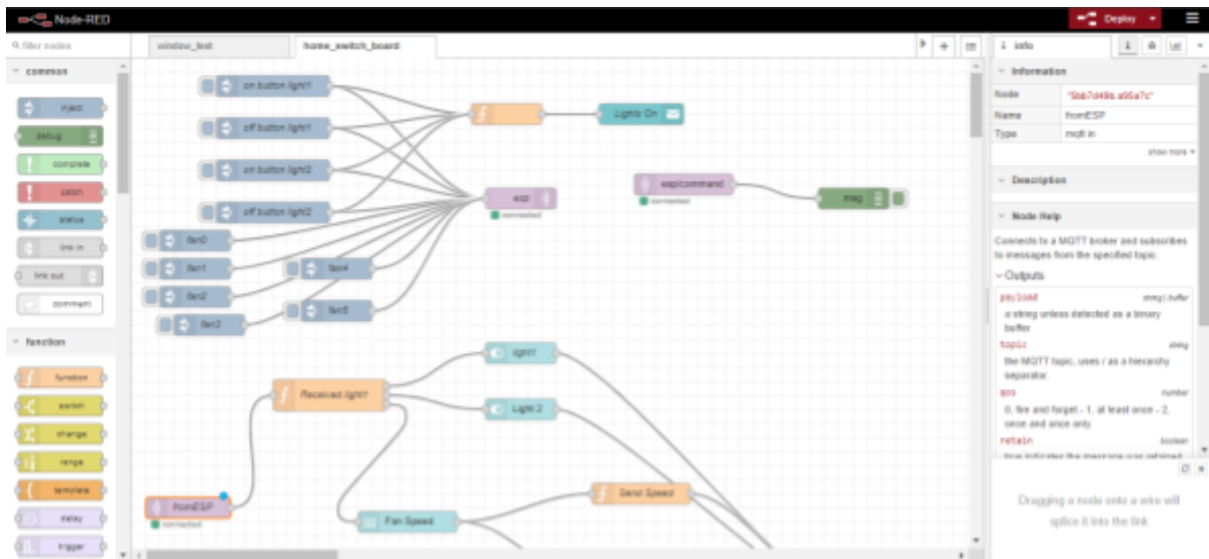

Figure 19. Node Red Flow page
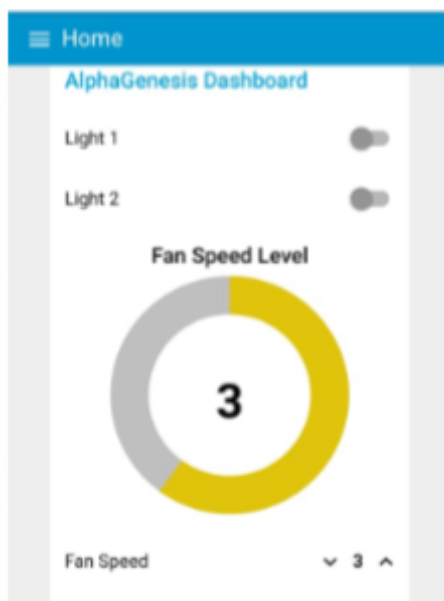

After deploying this modules we can view the UI in the browser of the phone.This infrastructure supports multiple users at once and has satisfactory results for the development and testing phase.The UI in the phone looks like this.

Future plan of the UI is to develop a mobile application to directly communicate with the mqtt server.

Figure 20. User Interface demo

7. Future Work

By this report with both the aid of Esp-8266 we concentrated on various methods of centrally running or monitoring electromagnetic and computer devices. This process of managing such programs is called automate. The exploratory layout we engineered focuses on managing various home electrical items that deliver 100 per cent productivity. Wi-Fi connections are readily available in all locations such as apartment, office complex and manufacturing construction attributable to technology advancement, so suggested routing protocols are easily manipulated using Wi-Fi channels. The price of cabling is cut. Because the connectors necessitate less cabling. It often reduces within the house electricity usage while the modules was in down situations.. This framework is also a separate network enabling any internet client to link to ESP-8266 onto any device.

The next step is to build a marketable switch board and demo models to start the sales. The priority task is to build a user interface in a mobile application and have a marketable solution to present to the client.The hardware for opening the window,the switchboard and the IR blaster should be designed and manufactured in a presentable manner.The working of the system is tested and has good results.

The Future functionality to be added is automated door function, controlled water heater, controlling the house music system,etc

The addition of voice controlled automation using our own standalone voice input device.Further We can work to incorporate more than one languages for voice commands.We can use voice authentication libraries for security purpose.We can use a bluetooth mic which allows users to command from anywhere in the room.

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