

Home Automation System Using IOT And Wi-Fi Technology

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Abstract— Automation of the surrounding environment of a modern human being allows increasing his work efficiency and comfort. An automation system is a precisely planned change in a physical or administrative task utilizing a new process, method, or machine that increases productivity, quality, and profit while providing methodological control and analysis. The value of system automation is in its ability to improve efficiency; reduce wasted resources associated with rejects or errors increase consistency, quality, and customer satisfaction; and maximize profit. There has been a significant development in the area of an individual's routine tasks and those can be automated. In the present times, we can find most of the people clinging to their mobile phones and smart devices throughout the day. Hence with the help of his companion – a mobile phone, some daily household tasks can be accomplished by personifying the use of the mobile phone. Analyzing the current smart phone market, novice mobile users are opting for Android based phones. It has become a second name for a mobile phone in layman terms. Home automation gives an individual the ability to remotely or automatically control things around the home using the mobile application. A home appliance is a device or instrument designed to perform a specific function, especially an electrical device, such as a light, fan, refrigerator, for household use.

Keywords— Arduino UNO, Classification, Home Automation System, PIR Sensor, Relays.

I. INTRODUCTION

As we enter the 21st century, the interaction between humans and computers is breaking the old barriers and entering a new realm. Today's homes require sophisticated control in its different gadgets which are basically electronic appliances. This has revolutionized the area of home automation with respect to an increased level of affordability and simplicity through the integration of home appliances with smart phone and tablet connectivity. Smart phones are already feature-perfect and can be made to communicate to any other devices in an ad hoc network with a connectivity options like Bluetooth and Wi-Fi.

In the highly technology driven world of today's computer and cell phones have become a part of our lifestyles. Computers are no longer tool to manage data and neither cell phone is just communication tool.

Now a days Home automation has become important issue. Many types of solutions were developed and implemented .The wireless communication in mobile network has proved to be the best solution among all and has become a fast growing business .With the recent development in the mobile computing devices and the mobile networks new and better solution can be developed to make home automation more convenient and accessible for 24x7 from anywhere and anytime. Our project tries to derive a solution providing a better control on home appliance with the help of cell phone and computer system at home. Also the system comprehends the implications of IT on Administration and functioning of the Home appliances.

Home automation system makes the operations of various home appliances more convenient and saves energy. With the energy saving concept, home automation or building automation makes life very simple nowadays. It involves automatic controlling of all electrical or electronic devices in homes or even remotely through wireless communication. Centralized control of lighting equipment's, air conditioning and heating, audio/video systems, security systems, kitchen appliances and all other equipment's used in home systems is possible within the system. The system is mainly implemented by sensors, controlling devices and actuators. Controllers may be personal computers/laptops, touch pads, smart phones, etc. Attached to the controlling devices like programmable-logic controllers that receive the information from the sensors, and based on the program, control the actuators.

II. OBJECTIVES

- A. To implement home automation system and monitoring using advanced internet technology.
 - B. Use of smart phone Eg. Android phone to control home appliances from remote location.
 - C. Real time controlling of home appliances from remote location.
 - D. Power saving and improving overall power/cost efficiency.
- To Implement Home Automation And Monitor Using Advanced Technology Recent development in technologies such as WI-FI, GSM and BLUETOOTH has opened wide scope for automation. Moreover with the development of technologies such as IOT(internet of things) has added to efficiency of this system. Thus enabling users to control their home appliances from far of places.
 - Helpful For Elderly People. Today we are living in 21st century where automation is playing important role in human life. 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.
 - Power Saving And Improves Overall Efficiency The home automation system tends to reduce the power loss through smart switching of electrical appliances and thus increasing the overall cost efficiency.

III. LITERATURE SURVEY

The paper [1] consists of comparison of different technologies used in home automation. The different technologies mentioned in these paper are Bluetooth, Wi-Fi, GSM. The paper also consists of different advantages and disadvantages of technologies used in home automation systems. Basically, the paper explains how home automation is carried out with the help of different wireless devices.

In paper [2] consists of voice control home automation using Arduino module. The system use in this paper uses c programming language for implementing Arduino module. The voice commands given by the user are detected by voice recognition module of windows. Arduino micro-controller provides control signals to the relays, and the relays are used to switch on the loads which are the parts of the home automation system.

The paper [3] Describes about the features, advantages, disadvantages and working of the Arduino module. How all the different modules are interfaced with each other is explained in detail in this paper. Finally, the outcome of the project is explained i.e. what are the deliverables from this project and who all are benefited by implementing this project.

The objective of [4] this paper consists of voice control home automation. This paper is same as paper 2 only difference here is that they have used microphone module(hardware) instead of any android mobile app or any inbuilt web application. This paper majorly focuses on use of hardware components to build the system instead of using software as the input.

In this paper system [5] android application used to send signal to Arduino board and Wi-Fi module connected to Arduino gives this signal to Arduino for controlling appliances using relay module. In simple terms it is explain how an android application is used to give input commands which are given via clicking the buttons and different action are being carried out.

In this system [6] it is explain how Wi-Fi connection is use to communication purposes in home automation systems . It is explain how Wi-Fi connection is established and how the actual communication takes place in the system.

GSM based [7] device control system using App inventor for Android mobile phones. No need of writing codes to develop app. Provides visual design interface as the way app looks. Installation cost is low as it uses Arduino Uno board along with a GSM shield. Lacks the security feature. This paper [8] provides security mechanisms to safeguard our smart home remotely through our mobile. Uses IP camera which is linked to out smart phone so whenever any intruder is detected on the IR sensor SMS is sent.

IV. PROPOSED SYSTEM

Many people are always on the move from place to place due to business demands. Some people can spend a couple of days away from their home leaving all their household appliances without any kind of monitoring and control. Some devices are left plugged into power sockets whereas others are supposed to be plugged into and out of power sockets at different intervals depending on the time of the day. All this requires an individual to manually attend to each of the devices independently from time to time. All such monitoring and control can be done without necessarily being around or inside the home. Some devices if not controlled properly consume a lot of energy which leads to extra expenditure on electricity.

Therefore we propose to design an internet based home automation system which will enable one to remotely manage his/her appliances from anywhere, anytime. This project includes an Arduino Uno board with a suitable micro-controller for control of various different

devices it has relay module's. An web based application has been develop to control appliances remotely. The systems can be accessed from any web based device including handheld devices such as mobile phones. Lastly it has Security monitoring system built-in using a PIR motion sensor to detect intrusions. The main objectives of the project is to design and to implement a cheap and open source home automation system that is capable of controlling and automating most of the house appliances through an android device.

V. SYSTEM DESIGN AND COMPONENTS USED

Architecture / Block Diagram of the System:

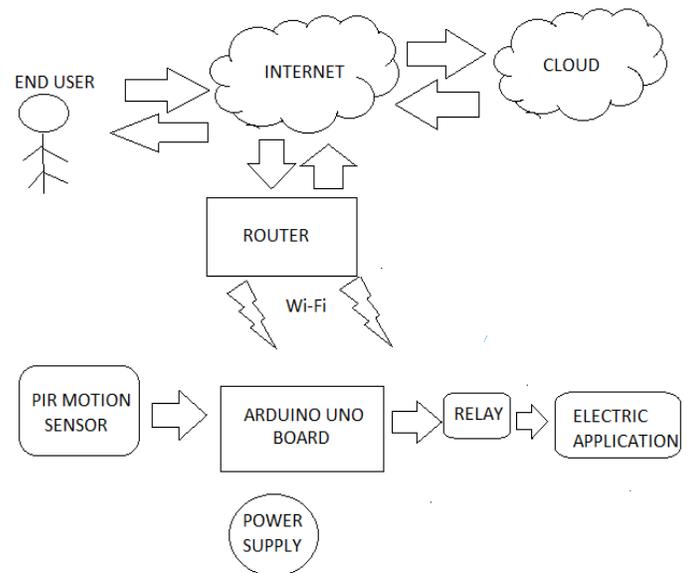


Fig 1: Block Diagram

- The Arduino Uno is programmed to control two devices (light and fan machine) with help of relays to switch them on/off remotely.
- The major part of the project is security system to safeguard the smart home built by using a PIR motion sensor which will send intrusion detection notification/signals to user.

UML Activity Diagram:

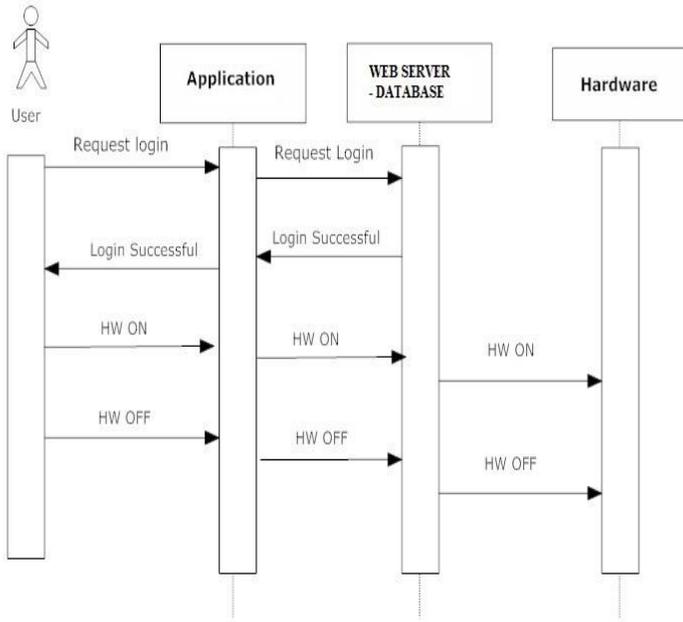


Fig 2: Sequence Diagram

UML Activity Diagram For User

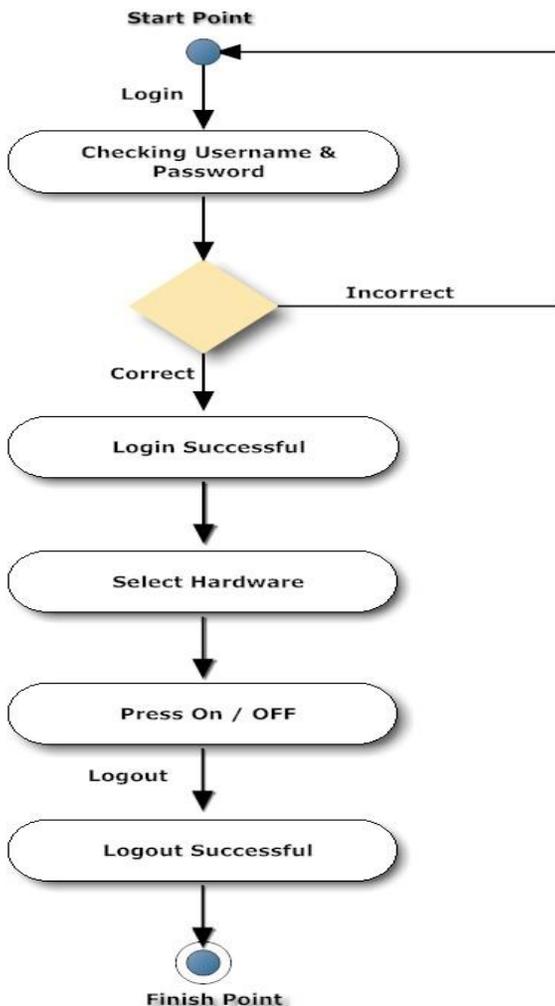


Fig 3: Activity Diagram

COMPONENTS USE:

Hardware components:

- ARDUINO UNO

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself (DIY) kits. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++.

In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project. The UNO proves to be Arduino's flagship board for beginner and also for advanced users. The system needs a micro-controller to process data and connects different modules for control. This purpose was solved by Arduino Uno which has ATMEGA328p processor. It has 6 analog input pins and 14 digital input/output pins [13]. It can operate with either 5V from USB plug or 12V from external power supply. In Arduino Uno pin 1 and 0 are used as default transmission and receiving pin.



Fig 4: Arduino Uno

- **RELAY Module**

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 separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

The Arduino Relay module allows a wide range of microcontroller such as Arduino, AVR, PIC, ARM with digital outputs to control larger loads and devices like AC or DC Motors, electromagnets, solenoids, and incandescent light bulbs. This module is designed to be integrated with 2 relays that it is capable of control 2 relays. The relay shield use one QIANJI JQC-3F high-quality relay with rated load 7A/240VAC, 10A/125VAC, 10A/28VDC. The relay output state is individually indicated by a light-emitting diode.

- **2 Channel Relay Features:**

- Number of Relays: 2
- Control signal: TTL level
- Rated load: 7A/240VAC 10A/125VAC 10A/28VDC
- Contact action time: 10ms/5ms.



Fig 5: 2 Channel Relay

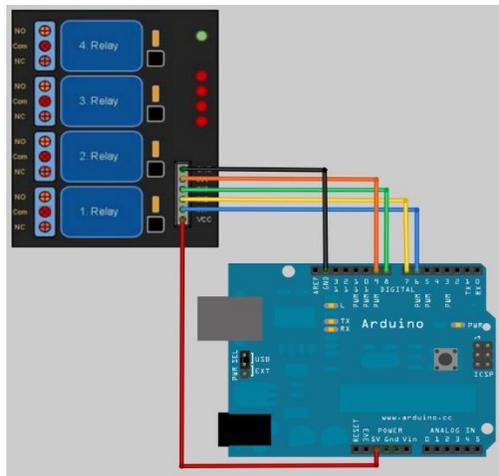


Fig 6: Relay's Connection with Arduino

- **Wi-Fi Module (ESP8266):**

The ESP8266 Wi-Fi Module is a self-stainable SOC with integrated TCP/IP protocol stack that can give any micro-controller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever-growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application-specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

- **Features (ESP8266):**

- 802.11 b/g/n
- Wi-Fi Direct (P2P), soft-AP
- Integrated TCP/IP protocol stack
- +19.5dBm output power in 802.11b mode
- Power down leakage current of < 2ms
- Standby power consumption of < 1.0mW (DTIM3)



Fig 7: Wi-Fi Module

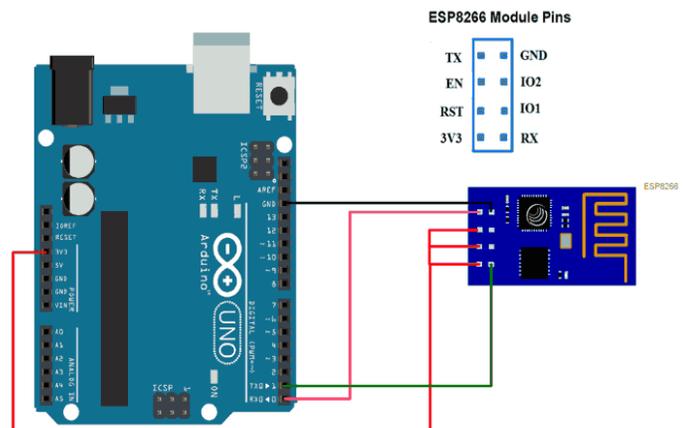


Fig 8: Wi-Fi's Connection with Arduino

- **PIR sensor:**

A PIR-based motion detector is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-activated lighting systems. They are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector". An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well. PIRs come in many configurations for a wide variety of applications. The most common models have numerous Fresnel lenses or mirror segments, an effective range of about ten meters (thirty feet), and a field of view less than 180 degrees. Models with wider fields of view, including 360 degrees, are available—typically designed to mount on a ceiling. Some larger PIRs are made with single segment mirrors and can sense changes in infrared energy over one hundred feet away from the PIR. There are also PIRs designed with reversible orientation mirrors which allow either broad coverage (110° wide) or very narrow "curtain" coverage, or with individually selectable segments to "shape" the coverage.

- **Features PIR sensor:**

Sensitive area: 2 elements
 Supply voltage: 3-15v
 Output voltage: 20mV peak-peak
 Operating temperature: 30-70 degree Celsius
 Viewing angle: 90 degree
 Detection range: up to 30 feet



Fig 9: PIR Sensor

Software components:

- **Open-Source Arduino Software IDE**

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and provides simple one-click mechanism to compile and load programs to an Arduino board. A program written with the IDE for Arduino is called a "sketch".

- **Sketch**

The Arduino IDE supports the languages C and C++ using special rules to organize code. After compiling and linking with the GNU toolchain, also included with the IDE distribution, the Arduino IDE employs the programmer to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

- **ASP.NET**

ASP.NET is more than the next version of Active Server Pages (ASP) it is a unified Web development platform that provides the services necessary for developers to build enterprise-class Web applications. While ASP.NET is largely syntax-compatible with ASP, it also provides a new programming model and infrastructure that enables a powerful new class of applications. You can migrate your existing ASP applications by incrementally adding ASP.NET functionality to them. ASP.NET is a compiled .NET Framework -based environment. You can author applications in any .NET Framework compatible language, including Visual Basic and Visual C#. Additionally, the entire .NET Framework platform is available to any ASP.NET application. Developers can easily access the benefits of the .NET Framework, which include a fully managed, protected, and feature-rich application execution environment, simplified development and deployment, and seamless integration with a wide variety of languages.

- **.NET FRAMEWORK**

The .NET Framework is Microsoft's Managed Code programming model for building applications on Windows clients, servers, and mobile or embedded devices. Microsoft's .NET Framework is a software technology that is available with several Microsoft Windows operating systems. In the following sections describes , the basics of Microsoft .Net Frame work Technology and its related programming models.

C# is a language for professional programming. C# (pronounced C sharp) is a programming language designed for building a wide range of enterprise applications that run on the .NET Framework. The goal of C# is to provide a simple, safe, modern, object-oriented, high-performance, robust and durable language for .NET development. Also it enables developers to build solutions for the broadest range of clients, including Web applications, Microsoft Windows Forms-based applications, and thin- and smart-client devices.

VI. RESULT ANALYSIS

Admin Login:

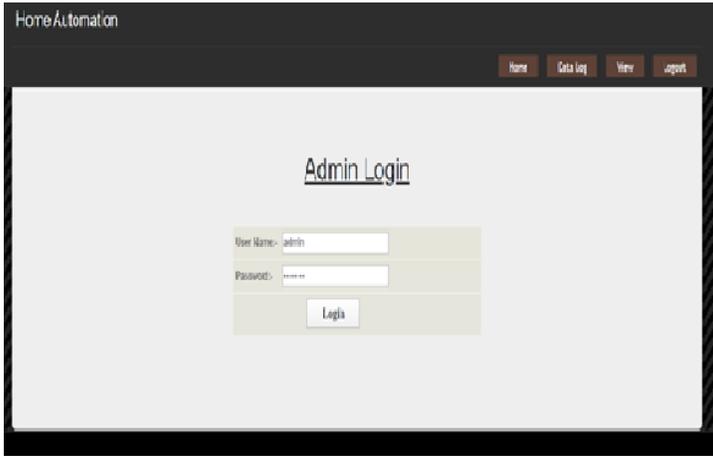


Fig 10: Admin Page

An secured admin login is created with user id and password on time of installation.

Home page:

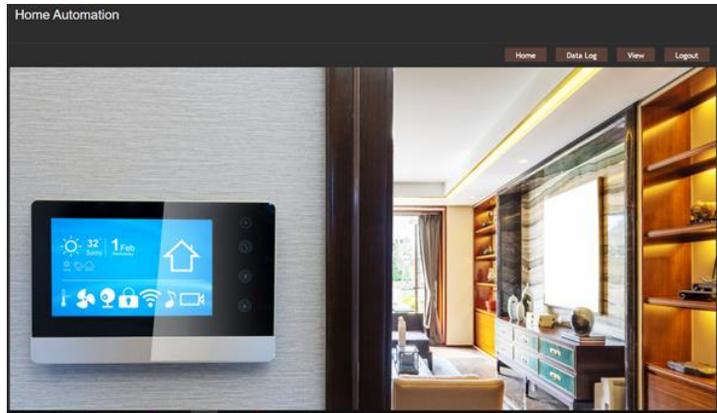


Fig 11: Home Page

After an successful login there is an dash board on home page with various different operations where we can view various electronic devices and check the data logs created by an PIR sensor.

Device Control:

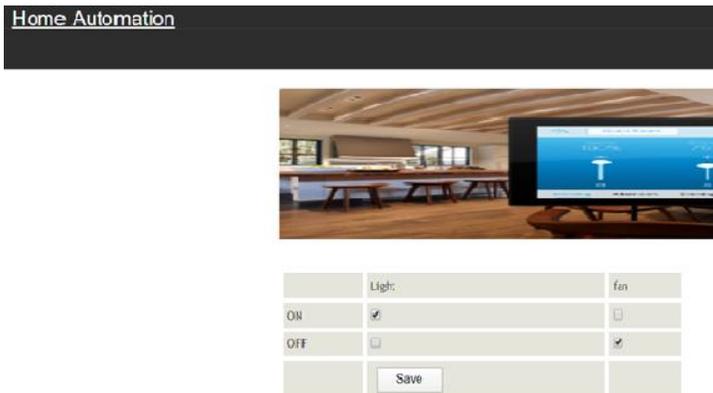


Fig 12: Device Control Page

On this web page we can remotely turn on/off various different electronic house appliances Eg. light and fan.

Data logs by PIR sensor:

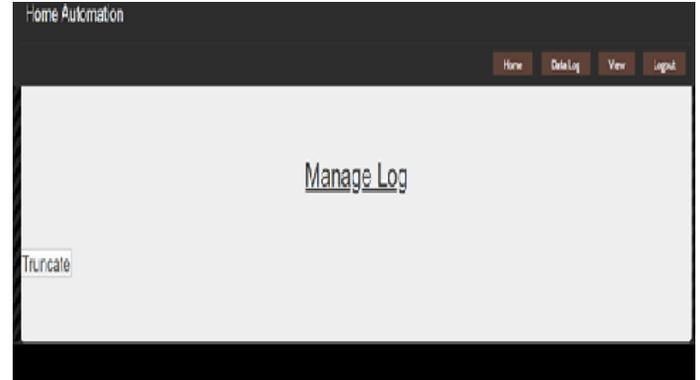


Fig 13:Data Log's Page

Data logs will be reported on this web page an if there is any specious activity recorded by PIR sensor then notification will be send to users device.

V. CONCLUSION AND DISCUSSION

Conclusion:

Keeping in mind the technology is rapidly changing, it is important to recognize how technology is changing how we function within our household. It is estimated that in the next 10 years, 90% of new homes will come equipped with some form of networking, programming and automation. The future home is a “smart secure and automated home”.

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 system is more user friendly and increase the automation. It’s cheaper, flexible and programmable. It supports wide variety of peripherals and accessories. This will help the user to analyze the condition of various parameters in the home anytime anywhere.

Future Work:

The Hardware can be modified in order to add more appliances to it. The system can be extended to Industrial Automation i.e. the system can be made capable of controlling large machines. The system can be extended to add burglar alarm to add security features to it. The system can be modified to allow two way communications i.e. a duplex system. Thus we have a more dynamic system which will be used to quickly adapt to changing scenarios

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