IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

CLASSIFICATION SMART HOME IOT DEVICE THROUGH NETWORK TRAFFIC ANALYSIS USING MACHINE LEARNING

Mrs.V.Kavitha[1] , V.P.Sujith[2] ,S.R.Tharun Kumar[3] , M.Vignesh[4] and C.Vellaisamy[5]

[1]Associative Professor, Computer Science and Engineering, V.S.B Engineering College, Karur,Tamilnadu, India

[2] Student, Computer Science and Engineering, V.S.B Engineering College, Karur,Tamilnadu ,India

[3] Student, Computer Science and Engineering, V.S.B Engineering College, Karur,Tamilnadu ,India

[4] Student, Computer Science and Engineering, V.S.B Engineering College, Karur,Tamilnadu, India

[5] Student, Computer Science and Engineering, V.S.B Engineering College, Karur,Tamilnadu, India

Abstract—IoT devices have become increasingly prevalent in our homes, and with that comes the need for efficient and accurate classification of these devices for various reasons such as security, network management, and resource allocation. Traditional methods of device identification using IP addresses and MAC addresses may not be reliable, as devices can have dynamic IP addresses, and MAC addresses can be easily spoofed. The proposed research aims to use machine learning algorithms to analyze the network traffic generated by various smart home IoT devices to develop a classification system based on patterns in the network traffic. This would involve collecting and analyzing network traffic data from a range of different devices and using supervised learning algorithms to train a model to accurately classify them. The success of this project could have important implications for the future of smart home technology, improving the security, network management, and overall user experience of these devices.

This Internet of Things allows things to be sensed and controlled remotely through existing network infrastructure, allowing for much more direct integration of the physical world into computer-based systems and resulting in increased efficiency, accuracy, and economic advantage. In our study, we incorporated a solar-powered system to achieve home automation. The goal of this project is to use IOT to automate home automation while integrating a solar-powered energy system. Integration of sensing systems linked to the Internet is likely to optimize overall energy use. It is anticipated that IoT devices will be integrated into all types of energy consuming equipment (switches, power outlets, lamps, televisions, and so on) and will be able to interact within utility supply companies in order to properly balance energy generation and energy demand.

Keywords— Internet of things, Arduino Uno,Relay

Introduction

The introduction to a research project on smart home IoT device classification using machine learning techniques based on network traffic analysis would typically provide background information on the topic and explain the need for this research. Smart homes have become increasingly popular in recent years, with the proliferation of various IoT devices that can automate and optimize many aspects of daily life. These devices include smart speakers, smart thermostats, security cameras, and other home automation devices. However, the increasing number of devices in a smart home can create various challenges, including network congestion, security threats, and resource allocation issues. To address these challenges, it is important to accurately identify and classify different IoT devices in the network. Traditional methods of device identification, such as IP and MAC addresses, are not always reliable, as they can be easily spoofed or dynamically assigned. Therefore, it is necessary to develop a more robust and accurate classification system for smart home IoT devices. This research proposes using machine learning algorithms to analyze network traffic generated by various IoT devices and develop a classification system based on patterns in the network traffic. The main goal is to accurately identify and classify different IoT devices in a smart home network based on their unique network traffic patterns. The research aims to contribute to the field of smart home technology by improving the security, network management, and overall user experience of smart home IoT devices. The remainder of the paper will discuss related work in this area, the methodology used for data collection and analysis, and the results of the study.

Smart home IoT gadgets lack adequate security, increasing worries about safety and privacy. Because of the various peoples want a home quality through machine devices, one-size-fits-all network administration is useless. Device categorization can help with IoT management and security. It detects susceptible and malicious devices and automates network management based on device type or function. In light of this, a potential research subject centered on Machine Learning (ML)-based traffic analysis has arisen in order to decode hidden patterns in IoT data and allow automated device categorization. This research examines different methodologies to determine their strengths and weaknesses. It begins by outlining a general method for classifying IoT devices. The approaches and solutions for each stage of the workflow are then examined.

A well designed and appropriately sized solar energy system will not require much administration. The goal of the project is to integrate a solar-powered energy system into a home automation system utilizing IOT. Integration of sensing and actuation systems linked to the Internet is expected to optimize overall energy usage. It is anticipated that IoT devices will be integrated into all sorts of power consuming equipment (switches, power outlets, lamps, televisions, and so on) and will be able to interact with utility supply companies in order to properly balance power generation and energy use. A well designed and appropriately scaled solar energy system would not need much administration. Only three factors must be considered. The first is the level of charge on the battery bank. (AmpHour Meter), and the second is the amount of charging power that is flowing in. (Solar Amps Meter), and the third is the amount of electricity utilized. (AC Amps Meter). IoT is especially significant to Smart Grid because it enables systems to acquire and act on power-related information in an automated manner with the objective of improving the efficiency, reliability, economics, and sustainability of energy production and delivery. There are various large-scale IoT deployments planned or underway to allow the finest system of cities and systems. Songdo, South Korea, for example, is nearing completion of the world's first

entirely clean and networked smart city. Ambient intelligence and autonomous control are not original Internet of Things truths.

LITERATURE SURVEY

[1] This paper describes the design and development of a system for household appliance control using cell phone through global system for mobile communication (GSM) technology. The cellular communications is a potential solution for such remote controlling activities. SMS (short message service) technology can be used to control household appliances from distance.

[2] This paper presents the development of GSM-based control home appliances for smart home system. The main aim of the prototype development is to reduce electricity wastage. GSM module was used for receiving short message service (SMS) from user's mobile phone that automatically enable the controller to take any further action such as to switch ON and OFF the home appliances such as light, air-conditioner etc.

[3] . Multiple embedded nodes are measuring various industrial parameters to monitor and control industrial process. Data acquired from each node is processed, displayed and sent to master processor (CPLD XC9572) that compile data received from different nodes and send this information to remote location using GSM technology and simultaneously display the variations in quantity under measurement to local and remote system configured with Lab VIEW platform

[4] designing the system Proteus, a virtual system modelling and circuit simulation application, was used as simulation software. The code for micro controller was written in mikroC PRO and burnt with PICkit 2 softwares. This system ensures smart safeguarding as well as efficient use of energy for its user's office and living place.

[5] The key components of this system are a pocket sized microprocessor- Raspberry Pi and a microcontroller- Arduino Uno and an Android application to visualize the data provided by the Raspberry Pi and also to send, receive and process the requests.

[6] Availability 01' high speed mobile networks like 3G and Long Term Evolution (LTE) coupled with cheaper and accessible smart phones, mobile industry has seen a tremendous growth in terms 01' providing various services and applications at the finger tips 01' the citizens. Internet 01' Things (loT) is one 01' the promising technologies which can be used for connecting, controlling and managing intelligent objects which are connected to Internet through an IP address.

[7] In this era of digitization and automation, the life of human beings is getting simpler as almost everything is automatic, replacing the old manual systems. Nowadays humans have made internet an integral part of their everyday life without which they are helpless. Internet of things (iot) provides a platform that allows devices to connect, sensed and controlled remotely across a network infrastructure.

[8] This paper illustrates a methodology to provide a low cost Home Automation System (HAS) using Wireless Fidelity (Wi-Fi).This crystallizes the concept of internetworking of smart devices. A Wi-Fi based Wireless

Sensor Network(WSN) is designed for the purpose of monitoring and controlling environmental, safety and electrical parameters of a smart interconnected home.

[9] Internet of Things offers user interoperability and connectivity between devices, systems, services, networks and in particularly control systems. IoT involves enhancing network to proficiently collect and analyze the data from various sensors and actuators then sends the data to the mobile phone or a personal computer over a wireless connection.

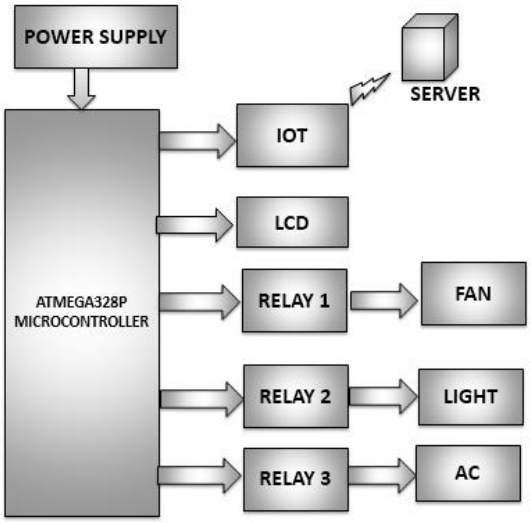
[10] This paper presents the overall design of Home Automation System (HAS) with low cost and wireless remote control. This system is designed to assist and provide support in order to fulfill the needs of elderly and disabled in home.

PROPOSED SYSTEM

In my project, The first step is to clearly define the research objectives and what the survey aims to achieve. This could include identifying the specific types of devices to be classified, the level of accuracy required, and the impact of the research on network security and performance. Next Collecting network traffic data from a range of smart home devices is a critical step in developing a machine learning algorithm for device classification. This can be done using network monitoring tools and data analysis software. Pre-process and analyze the data: Pre-processing of data involves cleaning and filtering the data to remove any noise or irrelevant information. Machine learning algorithms can then be trained using the pre-processed data, and the accuracy of the algorithms can be tested using validation data,and Using machine learning algorithms, a classification model can be developed to accurately classify smart home IoT devices based on their network traffic patterns. The model can be fine-tuned using validation data to improve accuracy. Evaluate the model: The developed model should be evaluated to assess its accuracy, reliability, and performance. This can be done using various performance metrics, such as precision, recall, and score. Implement the classification system: The final step is to implement the classification system on a smart home network and monitor its performance over time. Any potential issues or inaccuracies should be addressed and the system should be continuously optimized to improve its accuracy and performance.

In this system, owner directly monitors and control through their mobile phone using IOT (Internet of Things).The Arduino controller will control the load depending on the input given by the user.The ac home load such as fan and light will be controlled with the help of IOT website.In this projects we use light,Fan and AC. Which can be controlled by IOT command.The command for the system is given by IOT website.

BLOCK DIAGRAM



EXPLANATION

Control the home appliances and the flow of current equitably divide to home appliances in my project. We utilize the microcontroller to operate home appliances such as fans, lights, and air conditioners. All gadgets are controlled by the microcontroller (IOT, LCD, and relay through light, fan, and ac).

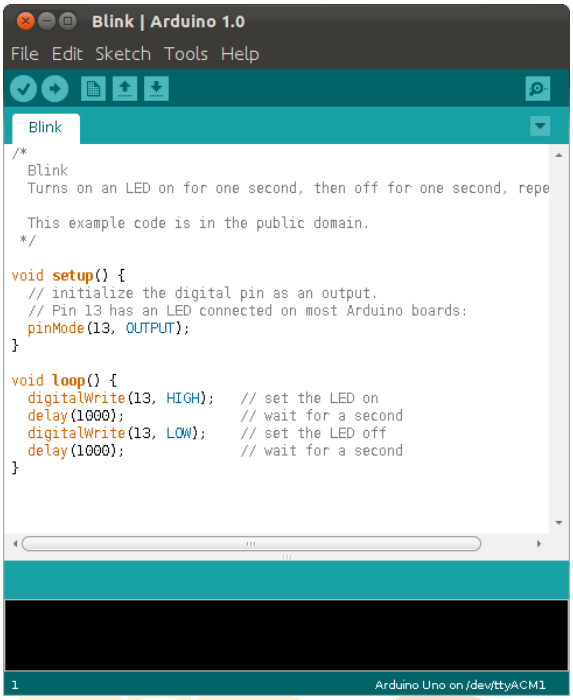
SOFTWARE REQUIREMENTS

We are used to the main programming language of

- Arduino Ide
- Proteus

ARDUINO IDE

A program for Arduino may be written in any programming language and run via a compiler to generate binary machine code for the target processor. AVR Studio and the updated Atmel Studio are development environments for Atmel's microcontrollers. The Arduino project includes the Arduino integrated development environment (IDE), which is a cross-platform application built in Java. It evolved from the IDE for the programming languages Processing and Wiring. It contains a code editor with text cutting and copying, text finding and replacement, automated indenting, brace matching, and syntax highlighting, as well as easy one-click procedures for compiling and uploading programs to an Arduino board. it also has a message area, a text terminal, a toolbar with buttons for common functions, and an operation menu hierarchy. a sketch is a program created with the arduino ide. sketches are stored as text files with the file extension.ino on the development computer, whereas arduino software (ide) pre-1.0 saved sketches with the extension.pde. the arduino ide supports the programming languages c and c++ by employing unique code organization conventions. the wiring project's software library, which supports many common input and output operations, is included with the arduino ide.



User-written code just requires two basic functions, which are built and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, which is also included with the IDE release. The Arduino IDE uses avrdude to transform executable code into a text file in hexadecimal encoding, which is then loaded into the Arduino board via a loader program in the board's firmware. As seen by the Arduino IDE programmer, a basic Arduino C/C++ sketch consists of simply two functions: setup: When a sketch starts after a power-up or reset, this function is called once. It is used to set up variables, input and output pin modes, and other libraries required by the sketch. When setup is performed, the function loop is called repeatedly in the main program. It is in charge of the board until it is turned off or reset. The majority of Arduino boards have a light-emitting diode (LED) and a load resistor linked between pin 13 and ground, which is useful for various testing and program tasks.

PROTEUS

Proteus is a simulation and design software tool used for electronic circuit design, simulation, and PCB layout design. It is commonly used by electronic engineers, hobbyists, and students to design and simulate electronic circuits and devices. Some key features of Proteus include:

Simulation and design capabilities:

Proteus allows users to design and simulate electronic circuits and devices, including microcontrollers, power supplies, and sensors. Mixed-mode simulation: Proteus supports mixed-mode simulation, which enables the simulation of analog, digital, and mixed-signal circuits. Virtual instrumentation:

Proteus includes a range of virtual instruments, such as oscilloscopes, logic analyzers, and waveform generators, that can be used to test and debug circuits. PCB layout design: Proteus includes a PCB layout design tool that enables users to create and edit PCB layouts and generate manufacturing files.

Library of components:

Proteus includes a large library of electronic components that can be used in circuit design, including microcontrollers, sensors, and integrated circuits.

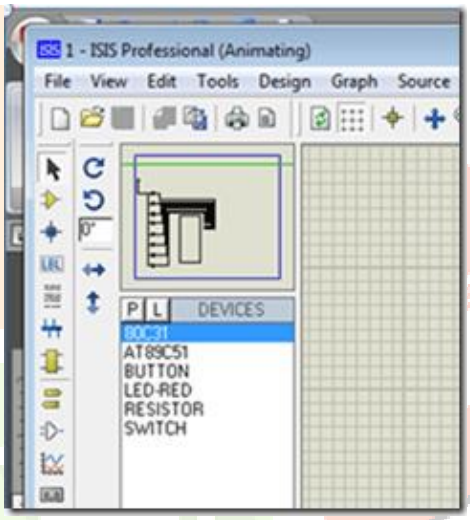
Real-time simulation:

Proteus can perform real-time simulation of circuits, allowing users to observe the behavior of a circuit as it is running.

Interactive debugging:

Proteus includes an interactive debugging feature that enables users to identify and fix errors in their circuit designs.

Finally, Proteus is a powerful tool for electronic circuit design and simulation that is widely used in the electronics industry, education, and research. Its range of features and intuitive interface make it a popular choice for both beginners and experienced users.



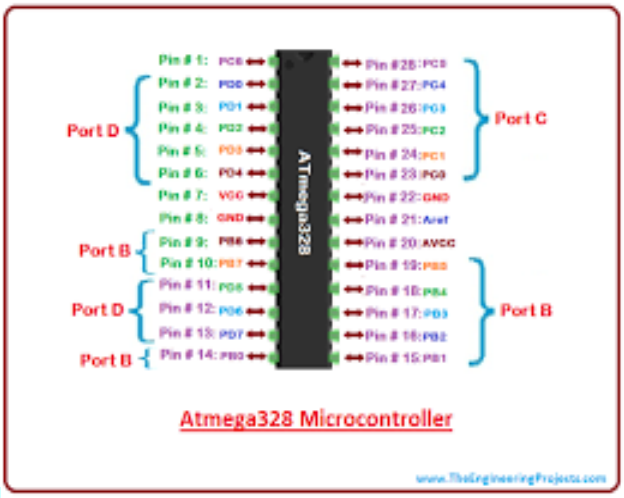
HARDWARE REQUIREMENTS

- ARDUINO UNO
- POWER SUPPLY
- IOT
- RELAY
- FAN
- LIGHT
- NODEMCU

ARDUINO UNO

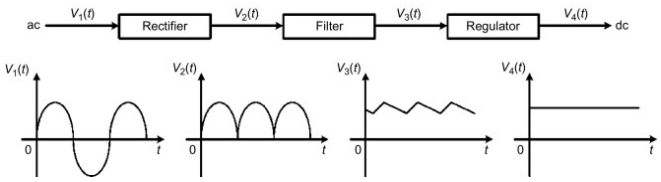
Arduino Uno is a popular microcontroller board based on the Atmel AVR microcontroller. It is widely used for building DIY electronics projects, prototyping, and learning programming. The Arduino Uno board has a 16 MHz crystal oscillator, a USB interface, 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, and a reset button. It can be powered either via the USB connection or an external power supply. The programming language used to write code for Arduino Uno is based on C/C++. The Arduino Integrated Development Environment (IDE) provides a simple, easy-to-use interface for programming the board. The code is uploaded to the board via the USB interface. Arduino Uno is a versatile board that can be

used for a wide range of applications, including robotics, home automation, and data logging. Its ease of use, low cost, and large community make it a popular choice for beginners and experienced makers alike.



POWER SUPPLY

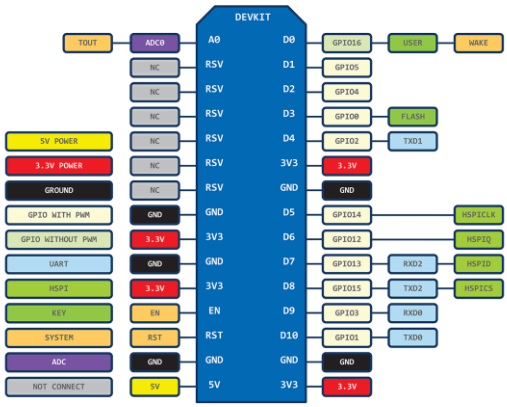
A power supply is an electronic device that converts electrical power from one form to another, typically from mains electricity to the type of power needed by electronic devices such as computers, televisions, and other appliances. Power supplies can be classified into two types: AC power supplies and DC power supplies. AC power supplies take input power from an AC (alternating current) source, such as a wall socket, and convert it to a DC (direct current) output that can be used to power electronic devices. DC power supplies, on the other hand, take an input DC voltage and either increase or decrease it to a different DC voltage level. There are various types of power supplies available, including linear power supplies, switching power supplies, and uninterruptible power supplies (UPS). Linear power supplies provide a simple and cost-effective solution, but they are not as efficient as switching power supplies, which are smaller, lighter, and more energy efficient. Uninterruptible power supplies are designed to provide backup power in case of a power outage or other electrical problem. When choosing a power supply, it is important to consider the voltage and current requirements of the device or devices being powered, as well as the power supply's efficiency, reliability, and safety features.



NODEMCU

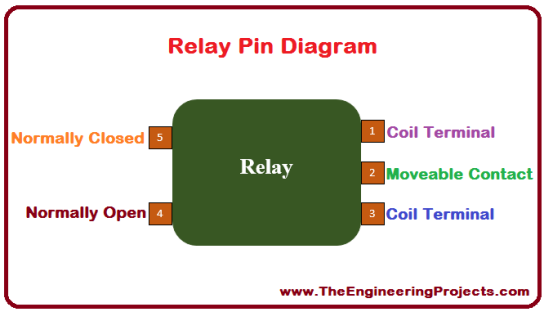
NodeMCU is an open-source firmware and development kit that allows developers to prototype Internet of Things (IoT) products quickly and easily. It is based on the ESP8266 microcontroller, a low-cost Wi-Fi chip that supports both TCP/IP and microcontroller capabilities. NodeMCU provides an easy-to-use Lua scripting language, which simplifies the development process for IoT projects. It also includes built-in libraries for handling Wi-Fi and networking, making it a popular choice for IoT applications that require wireless connectivity. NodeMCU is widely used for building smart home devices, such as smart plugs, smart thermostats, and home automation systems. It can also be used for data logging, sensor monitoring, and remote control applications. NodeMCU boards typically come with a USB port for programming and power, as well as

GPIO pins for interfacing with external sensors and devices. The Lua script is uploaded to the board via a serial connection, making it easy to update and modify the code. Overall, NodeMCU is a powerful and versatile development kit that offers a low-cost, easy-to-use platform for building IoT projects. Its built-in Wi-Fi and Lua scripting capabilities make it a popular choice for both beginners and experienced developers.



RELAY

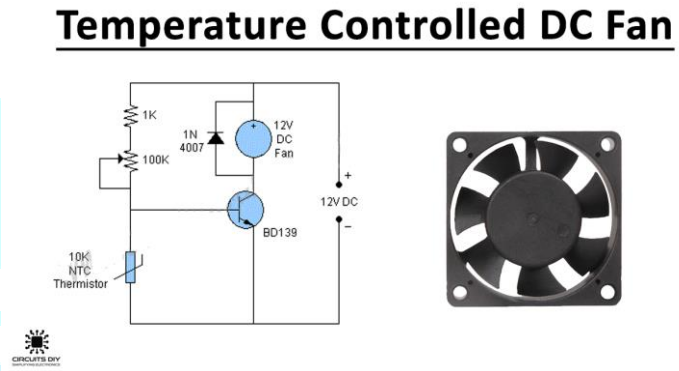
A relay is an electrical switch that is operated by an electromagnet. It is used to control high voltage or high current circuits with a low voltage or low current signal. The main advantage of a relay is that it can be controlled by a low power signal, such as that from a microcontroller, while switching high power circuits. The basic construction of a relay consists of a coil, which when energized by a low voltage signal, generates a magnetic field. This magnetic field pulls a switch mechanism, called a contact, which completes the circuit of the high power load. Relays can be classified based on the number of contacts and their switching capabilities. The two most common types of relays are single-pole, single-throw (SPST) and double-pole, double-throw (DPDT) relays. SPST relays have a single contact and can be used to turn a load on or off. DPDT relays have two contacts and can be used to switch between two different loads, or to reverse the polarity of a load. Relays are commonly used in various applications, such as home automation, robotics, industrial control systems, and automotive systems. They are a simple and reliable way to control high voltage or high current circuits with a low voltage signal.



FAN

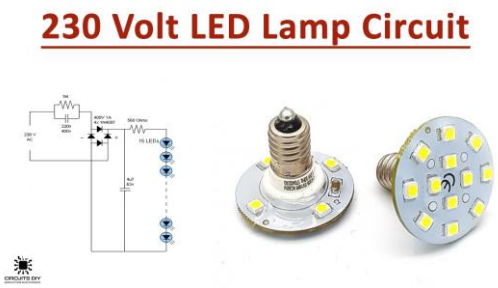
A 12V DC fan is a type of electric fan that operates on a 12-volt DC power source, which is typically provided by a battery or a power supply. These fans are commonly used in electronic devices, such as computers, gaming consoles, and power supplies, as well as in automotive and marine applications. 12V DC fans are available in different sizes and styles, including axial fans, centrifugal fans, and blower fans. Axial fans are the most

common type of 12V DC fan and feature a propeller-like blade that draws air through the fan in a linear direction. Centrifugal fans use a spinning impeller to force air out of the fan in a radial direction, while blower fans use a small high-speed impeller to create a focused jet of air. When selecting a 12V DC fan, it is important to consider the airflow, noise level, and power consumption of the fan. The airflow, measured in cubic feet per minute (CFM), determines how much air the fan can move, while the noise level, measured in decibels (dB), determines how loud the fan will be. Power consumption, measured in watts (W), determines how much electricity the fan will use and is important to consider when running the fan off a battery. Overall, 12V DC fans are a versatile and reliable way to cool electronic devices, and are available in a variety of sizes and styles to suit different applications.



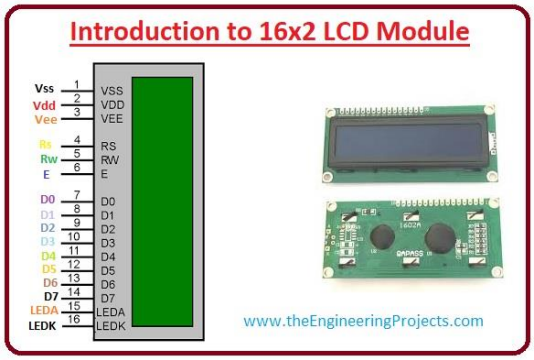
LIGHT

"Light" is a term used to describe electromagnetic radiation within the portion of the electromagnetic spectrum that is visible to the human eye. It is also sometimes used more generally to describe any type of electromagnetic radiation, including ultraviolet, infrared, and radio waves. Visible light has a wavelength range of approximately 400 to 700 nanometers and is made up of different colors, including red, orange, yellow, green, blue, indigo, and violet. These colors can be combined to create different hues and shades, and are responsible for the colors that we see in our everyday lives. Light is produced by many sources, including the sun, light bulbs, and electronic displays such as computer monitors and TVs. Light can also be manipulated and controlled through the use of lenses, mirrors, and other optical components. Light has many practical applications in our daily lives, including lighting our homes and workplaces, illuminating outdoor spaces, and providing the energy needed for photosynthesis in plants. It is also used in many technologies, including lasers, fiber-optic communications, and solar panels. Overall, light is a fundamental aspect of our world and plays an essential role in both our natural environment and in many areas of human technology and innovation.



LCD

An LCD 16x2 (Liquid Crystal Display 16x2) is a popular type of alphanumeric display used in many electronics projects. It consists of two rows of 16 characters each, making a total of 32 characters that can be displayed on the screen. LCD 16x2 displays are typically used to show important information, such as the temperature, time, and other sensor readings. They are also commonly used in menus and user interfaces, where they allow the user to navigate through different options. LCD 16x2 displays are driven by a microcontroller, such as an Arduino or a Raspberry Pi, using a set of digital pins. The display is controlled using a specialized chip called an HD44780 controller, which is responsible for handling the display's internal memory and generating the characters on the screen. To use an LCD 16x2 display, the user must provide it with a 5V DC power supply and connect the appropriate pins to the microcontroller. The microcontroller then sends commands and data to the HD44780 controller to display the desired characters on the screen. LCD 16x2 displays are widely available and are relatively easy to use. They are a popular choice for hobbyists and makers, as well as for commercial applications.



MERITS

There are several potential advantages of conducting a survey of smart home IoT device classification using machine learning techniques based on network traffic analysis:

- Improved network security: By accurately identifying and classifying different IoT devices in a smart home network, potential security threats can be more effectively detected and prevented.
- Better network management: A more accurate classification system can help to optimize network performance by identifying devices that are consuming more bandwidth or resources.
- Enhanced user experience: A well-classified IoT device network can make it easier for users to manage their devices, reducing the potential for confusion and frustration. Cost-effectiveness: A more accurate classification system can help to reduce the costs associated with network management and maintenance, by allowing for more targeted and efficient resource allocation.
- Potential for future innovation: A successful implementation of this research could lead to further innovations in the field of smart home technology, as accurate device classification opens up new possibilities for automation and optimization.

DEMERITS

- Data privacy concerns: Collecting and analyzing network traffic data could raise privacy concerns, especially if personal data or identifiable information is inadvertently collected or analyzed.
- Difficulty in acquiring data: Collecting network traffic data from a range of smart home devices can be challenging, especially if the devices are spread out across different locations or networks.
- Lack of standardization: IoT devices often use different protocols and data formats, which can make it difficult to develop a standardized classification system.
- Complexity of machine learning algorithms: Developing an accurate machine learning algorithm to classify smart home IoT devices can be complex and require a significant amount of resources and expertise.
- Inaccuracies in classification: Despite the use of advanced machine learning techniques, the classification system may not be 100% accurate, leading to misidentified devices and potential security threats.

CONCLUSION

This paper suggested a system for identifying device type in an IoT network based on the devices' periodic communication features. It made advantage of device traffic features including network flow and protocols. The home automation is implemented using IOT. A smart home integrates various electrical appliances in the home and automates them with no or minimum user intervention. The smart home keeps track of different environment variables present and guides the appliances to work according to the needs of the user. In this the electrical appliances are controlled based on the command form the IOT. From the energy is consumed. We achieved the development of Smart Home by using the Internet of Things technologies. From the experiment, it was found that we can manage to make low cost, flexible and energy efficient smart home for the better and greener future.

REFERENCES

1) Y. Song, Q. Huang, J. Yang, M. Fan, A. Hu, and Y. Jiang, ‘‘IoT device fingerprinting for relieving pressure in the access control,’’ in Proc. ACM Turing Celebration Conf.-China, May 2019, pp. 1–8

2) A. Bassene and B. Gueye, ‘‘A group-based IoT devices classification through network traffic analysis based on machine learning approach,’’ in Proc. Int. Conf. E-Infrastruct. E-Services Developing Countries. Cham, Switzerland: Springer, 2021, pp. 185–202.

3) Hafeez, I.; Antikainen, M.; Ding, A.Y.; Tarkoma, S. IoT-KEEPER: Detecting malicious IoT network activity using online traffic analysis at the edge. IEEE Trans. Netw. Serv. Manag. 2020, 17, 45–59.

4) K. L. Lueth, M. Hasan, S. Sinha, S. Annaswamy, P. Wegner, F. Bruegge, and M. Kulezak, ‘‘State of IoT-spring 2022,’’ IoT Anal. GmbH, Hamburg, Germany, Tech. Rep., Spring 2022.

5) Smadi, A.A.; Ajao, B.T.; Johnson, B.K.; Lei, H.; Chakhchoukh, Y.; Abu Al-Haija, Q. A Comprehensive survey on cyber-physical smart grid testbed architectures: Requirements and challenges. Electronics 2021, 10, 1043

6) Quy, V.K.; Hau, N.V.; Anh, D.V.; Quy, N.M.; Ban, N.T.; Lanza, S.; Randazzo, G.; Muzirafuti, A. IoT-enabled smart agriculture: Architecture, applications, and challenges. Appl. Sci. 2022, 12, 3396.

7) O. Salman, I. H. Elhajj, A. Chehab, and A. Kayssi, ‘‘A machine learning based framework for IoT device identification and abnormal traffic detection,’’ Trans. Emerg. Telecommun. Technol., vol. 33, no. 3, p. e3743, Mar. 2022.

8) Gunasekaran, H.; Ramalakshmi, K.; Arokiaraj, A.R.M.; Kanmani, S.; Venkatesan, C.; Dhas, C.S.G. Analysis of DNA Sequence Classification Using CNN and Hybrid Models. Comput. Math. Methods Med. 2021, 2021, 1835056.

9) Li, F.; Liu, M.; Zhao, Y.; Kong, L.; Dong, L.; Liu, X.; Hui, M. Feature extraction and classification of heart sound using 1D convolutional neural networks. EURASIP J. Adv. Signal Process. 2019, 2019, 1–11.