# INTERNET OF THINGS WITH AWS CLOUD

*A Summer Internship Report submitted in partial fulfillment of the Requirements for the award of degree of*

**BACHELOR OF TECHNOLOGY**
**In**
**PETROLEUM TECHNOLOGY**

**Submitted by**

**Tammana Naga Harsha Prudhwi Raj**
**22A95A2711**


**DEPARTMENT OF MINING & PETROLEUM ENGINEERING**
**ADITYA UNIVERSITY**
**(Formerly Aditya Engineering College (A))**

**2024-2025**

# ADITYA UNIVERSITY

(Formerly Aditya Engineering College(A))

## DEPARTMENT OF MINING & PETROLEUM ENGINEERING

ADITYA
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# CERTIFICATE

This is to certify that the internship report entitled *"***INTERNET OF THINGS WITH AWS CLOUD***"* is being submitted by **TAMMANA NAGA HARSHA PRUDHWI RAJ (22A95A2711)** in partial fulfillment of the requirements for award of the B.Tech., degree in Petroleum Technology for the academic year 2024-2025.

**Internship Coordinator**
Mr. V.V.SRIMANNARAYANA, M.tech
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**Head of the Department**
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Associate Professor
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# DECLARATION

I hereby declare that the internship report entitled **"INTERNET OF THINGS WITH AWS CLOUD"** is a genuine report. This work has been submitted to the **ADITYA UNIVERSITY,** Surampalem, in partial fulfillment of the **B.Tech.,** degree**.** I further declare that this report has not been submitted in full or part of the award of any degree of this or any other educational institutions.

**by**

**TAMMANA NAGA HARSHA PRUDHWI RAJ**
**(22A95A2711)**

# Internship Completion Certificate


**CERTIFICATE OF INTERNSHIP**

Date: 27-07-2024

This is to certify that **Mr. Naga Harsha Prudhwi Raj Tammana,** of the **Petroleum Technology** department with Roll No:**22A95A2711** of **Aditya Engineering College(A)** has successfully completed a summer internship with **Technical Hub Pvt Ltd** from **03-06-2024 to 27-07-2024**.

During this tenure, the trainee worked with the technology **Internet of Things with AWS Cloud** and excelled in major concepts.

- Arduino with Electronics and Physical Computing
- Implementation of Internet of Things
- AWS EC2, VPC and S3 Services
- Identity and Access Management in AWS

The trainee has a great amount of responsibility, sincerity, and a genuine willingness to learn new things.

We found the trainee's performance and conduct were satisfactory.

We wish you all the best and success in your future endeavours.

Intern ID – THSI240906
https://verify.technicalhub.io/

Babji Neelam
Founder & CEO
Technical Hub Pvt Ltd

# ACKNOWLEDGEMENT

First, I would like to thank the **BABJI NEELAM** Founder and CEO of **Technical Hub Pvt Ltd** for giving me the opportunity to do an internship within the organization. I also would like all the people that worked along with me in **Technical Hub Pvt Ltd** with their patience and openness they created an enjoyable working environment.

It is with immense pleasure that we would like to express our indebted gratitude to our internship coordinator **Mr. V.V.SRIMANNARAYANA, M.tech,** who has guided us a lot and encouraged us in every step of the intern project work, his valuable moral support and guidance throughout the Intern project helped us to a greater extent.

Our deepest thanks to **Mr. Satyajeet Parida, Associate Professor & Head of the Department** for inspiring us all the way and for arranging all the facilities and resources needed for our project.

I wish to thank our **Dr. M.V. Rajesh, Associate Dean** and **Dr. Dola Sanjay, Dean School of Engineering** for their encouragement and support during the course of my intern project work.

I would like to extend my sincere thanks to **Dr. G. Suresh, Registrar, Dr. S. Rama Sree, Pro Vice-Chancellor, Dr. M.B. Srinivas, Vice-Chancellor, Dr. M. Sreenivasa Reddy, Deputy Pro Chancellor and Management**, Aditya University for unconditional support for providing me the best infrastructural facilities and state of the art laboratories during my intern project work.

Not to forget, **Faculty, Lab Technicians, Non-Teaching Staff and our Friends** who have directly or helped and supported us in completing my intern project work in time.

# Abstract

Arify is an innovative application designed to automate smart devices by seamlessly integrating Augmented Reality (AR) and the Internet of Things (IoT). Developed by the ARtronix team, Arify enables users to control electronic devices remotely using their smartphones or tablets, providing a highly immersive and intuitive experience. The application features a user-friendly interface, developed using Adobe Photoshop and Adobe Illustrator, and leverages the Unity Engine for both AR and UI components. Vuforia Engine is employed to enhance the AR capabilities, enabling real-time interaction with smart devices.

The IoT aspect of Arify involves circuit building and the integration of an MQTT broker, ensuring reliable communication between the app and connected devices. This integration allows users to automate tasks, manage energy consumption efficiently, and enhance home security. The project culminated in the deployment of an Android application, offering users a practical and accessible solution for smart home automation.

Arify showcases the potential of AR and IoT in creating intelligent and user-centric automation solutions. The application not only saves time and energy but also provides personalized and secure interactions with smart devices. This project highlights the future of home automation, combining cutting-edge technologies to deliver an unparalleled user experience.

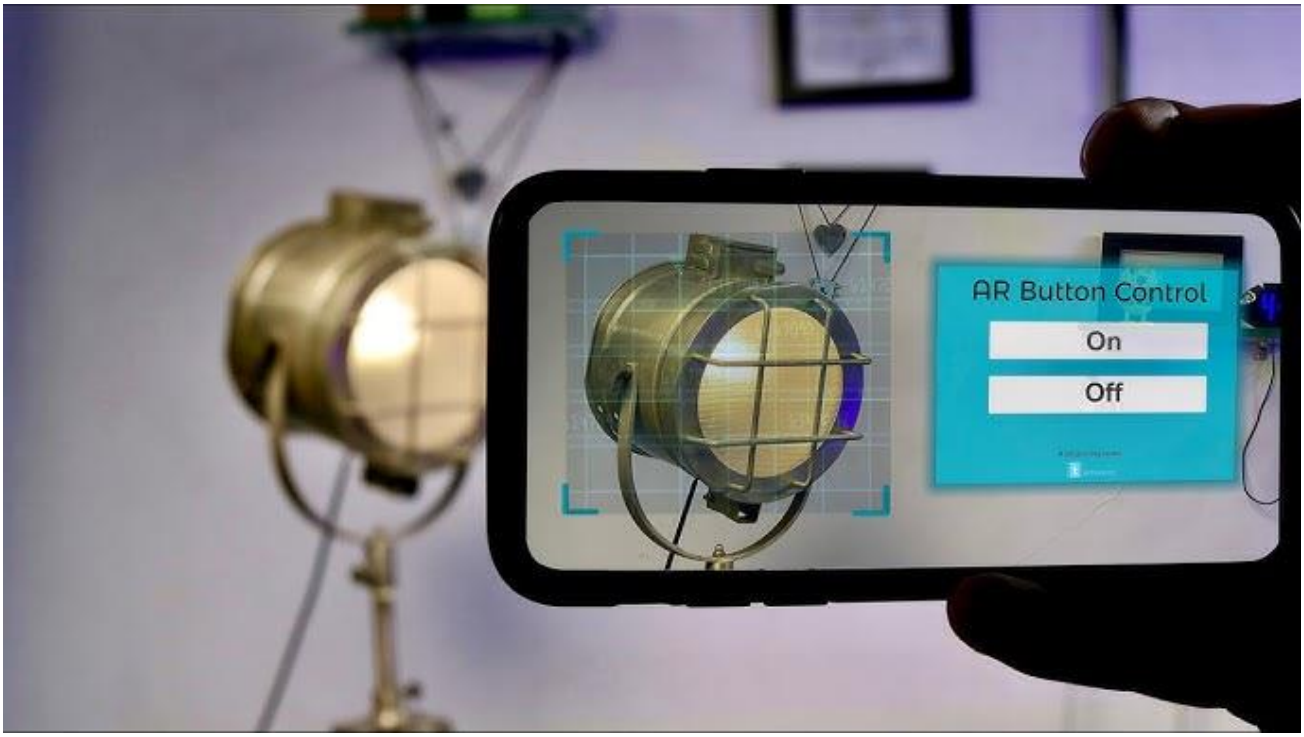


Fig-1: AR in Home Automation

# Learning Objectives/Internship Objectives

- Internships are generally thought of to be reserved for college students looking to gain experience in a particular field. However, a wide array of people can benefit from Training Internships in order to receive real world experience and develop their skills.
- An objective for this position should emphasize the skills you already possess in the area and your interest in learning more
- Internships are utilized in a number of different career fields, including architecture, engineering, healthcare, economics, advertising and many more.
- Some internships are used to allow individuals to perform scientific research while others are specifically designed to allow people to gain first-hand experience working.
- Utilizing internships is a great way to build your resume and develop skills that can be emphasized in your resume for future jobs. When you are applying for a Training Internship, make sure to highlight any special skills or talents that can make you stand apart from the rest of the applicants so that you have an improved chance of landing the position.

# WEEKLY OVERVIEW OF INTERNSHIP ACTIVITIES

| | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| 1st WEEK | 3/6/24 | Monday | Reporting at office with all Photocopies of Documents.<br>Overview to Company Profile & Total Internship Schedule |
| | 4/6/24 | Tuesday | Brief Introduction on Internet of Things (IOT) |
| | 5/6/24 | Wednesday | Discuss PROS & CROS of IOT |
| | 6/6/24 | Thursday | Learning the Electronic components |
| | 7/6/24 | Friday | Learn how to connect circuits |
| | 8/6/24 | Saturday | Connecting different circuits |

| | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| 2nd WEEK | 10/6/24 | Monday | Knowing about the sensors |
| | 11/6/24 | Tuesday | Learning components of IOT |
| | 12/6/24 | Wednesday | Working with components |
| | 13/6/24 | Thursday | IoT protocol |
| | 14/6/24 | Friday | About the microcontroller Node MCU |
| | 15/6/24 | Saturday | Making the circuits with the Node MCU |

| | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| 3rd WEEK | 17/6/24 | Monday | Holiday |
| | 18/6/24 | Tuesday | Introduction to MQTT protocol |
| | 19/6/24 | Wednesday | Configuring MQTT box |
| | 20/6/24 | Thursday | Creating the topics in MQTT |
| | 21/6/24 | Friday | Sample Projects using MQTT box |
| | 22/6/24 | Saturday | Discuss about the latest IOT projects |

| | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| 4th WEEK | 24/6/24 | Monday | Discussion on left over Topics |
| | 25/6/24 | Tuesday | Connecting MQTT box and IoT |
| | 26/6/24 | Wednesday | Implementing the project |
| | 27/6/24 | Thursday | Making the home automation project with HTTPS protocol |
| | 28/6/24 | Friday | Implementation of Project |
| | 29/6/24 | Saturday | Implementation of Project in real world |

| 5th WEEK | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| | 1/7/24 | Monday | Introduction to Cloud |
| | 2/7/24 | Tuesday | Installation of software |
| | 3/7/24 | Wednesday | Introduction to AWS |
| | 4/7/24 | Thursday | Installing the Putty |
| | 5/7/24 | Friday | Introduction to EC2 |
| | 6/7/24 | Saturday | Holiday |

| 6th WEEK | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| | 8/7/24 | Monday | Discussion on left over Topics |
| | 9/7/24 | Tuesday | More detailed about EC2 |
| | 10/7/24 | Wednesday | Lunching the instance using EC2 |
| | 11/7/24 | Thursday | Introduction to S3 Bucket |
| | 12/7/24 | Friday | Discussion on left over Topics |
| | 13/7/24 | Saturday | Introduction to VPC |

| | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| 7th WEEK | 15/7/24 | Monday | Assigning Project |
| | 16/7/24 | Tuesday | Discussing about that project and titled as ARify |
| | 17/7/24 | Wednesday | Holiday |
| | 18/7/24 | Thursday | Started doing the front end of the app using the Photoshop and Illustrator |
| | 19/7/24 | Friday | Making the User Interface (UI) |
| | 20/7/24 | Saturday | Started writing the code of backend |

| | DATE | DAY | NAME OF THE TOPIC/MODULE COMPLETED |
|---|---|---|---|
| 8th WEEK | 22/7/24 | Monday | Making the powercard and setting the Vuforia Engine |
| | 23/7/24 | Tuesday | Making the circuit design for the project |
| | 24/7/24 | Wednesday | Set up the MQTT topic and connecting the MQTT box and ARify application |
| | 25/7/24 | Thursday | connecting the MQTT box with IoT and Installing the project in real world |
| | 26/7/24 | Friday | Project Presentation |
| | 27/7/24 | Saturday | Submission of Project abstract & Presentation |

# INDEX

# 1. Introduction

**ARify** is an advanced project aimed at transforming the way users interact with and control their home appliances through Augmented Reality (AR). The goal of ARify is to provide a user-friendly, immersive experience that simplifies appliance management and enhances everyday convenience.

Home automation has emerged as a key component in the evolution of smart living environments, enabling enhanced comfort, security, and energy efficiency. By integrating various household devices and systems, home automation allows for centralized control and monitoring, transforming the way we interact with our homes. One of the most promising technologies driving this innovation is MQTT (Message Queuing Telemetry Transport), a lightweight messaging protocol designed for efficient communication between devices.

MQTT, originally developed by IBM, has gained widespread adoption in the Internet of Things (IoT) ecosystem due to its simplicity, scalability, and reliability. Its publish-subscribe architecture enables seamless data exchange between multiple devices, making it an ideal choice for home automation systems where numerous sensors, actuators, and control units must interact in real-time.

This project aims to design and implement a home automation system leveraging MQTT to create a cohesive and responsive environment. By utilizing MQTT, we can ensure that various home appliances and systems—such as lighting, heating, security cameras, and entertainment units—operate harmoniously, providing users with an intuitive and efficient control interface.

In the following sections, we will explore the underlying principles of MQTT, outline the system architecture, and discuss the implementation process. The ultimate goal is to demonstrate how MQTT can be effectively utilized to enhance the functionality and user experience of modern home automation systems, paving the way for smarter and more connected living spaces.

Fig-2: ARify App Logo

# 2. Project Objectives

ARify was designed to address the growing need for more intuitive and efficient home appliance management. The key objectives of the project were:

- **Enhance User Interaction:** The primary goal was to improve how users interact with their home appliances by integrating Augmented Reality (AR). This aimed to make appliance control more intuitive and visually engaging, reducing reliance on physical buttons and traditional interfaces.
- **Simplify Appliance Management:** By using AR, ARify sought to simplify the management of various household devices. The project aimed to provide users with a clear, interactive way to control and monitor their appliances, making routine tasks more straightforward and less time-consuming.
- **Automate Routine Tasks:** Another objective was to automate common tasks related to appliance operation. ARify aimed to streamline these processes through AR interfaces, allowing users to set schedules, adjust settings, and receive notifications with ease.
- **Provide Real-Time Feedback:** ARify was designed to offer immediate visual feedback on user actions. This real-time interaction helps users understand the impact of their commands and make adjustments as needed, enhancing the overall user experience.
- **Integrate Seamlessly with Existing Devices:** The project aimed to integrate AR functionality with existing home appliances without requiring significant changes to the devices themselves. This goal was achieved by developing a flexible AR interface that could interact with various appliances and their functions.

**Implementation Strategy:** To achieve these objectives, ARify employed a combination of advanced technologies and development strategies:

- **AR Technology:** Utilized AR to overlay digital controls and information onto physical appliances, allowing for interactive and immersive experiences.
- **Unity Development:** Leveraged Unity for developing the AR application, utilizing its AR Foundation framework for cross-platform compatibility and robust AR features.
- **Design Tools:** Employed Adobe Photoshop and Illustrator to create and optimize visual assets, ensuring a cohesive and engaging user interface.

The project's success was measured by its ability to meet these objectives, providing users with an enhanced and efficient way to manage their home appliances through innovative AR technology.

# 3. **Technology Stack**

In the ARify project, we utilized several technologies to achieve the desired output by integrating these technologies effectively. The technologies used include:

## 3.1. Augmented Reality (AR):

For the AR component of the ARify project, Vuforia Engine was utilized as the primary AR SDK. Vuforia Engine provided the necessary tools and capabilities to implement robust and interactive AR experiences. Key aspects of Vuforia Engine used in the project include:

- **Image Recognition:** Vuforia's image recognition capabilities allowed ARify to identify and track specific images or markers associated with different home appliances. This feature enabled the application to overlay digital information and controls on the correct appliances in the real world.
- **Model Targets:** Vuforia's model target functionality was used to recognize and interact with 3D models of appliances. This capability facilitated precise and dynamic interactions between the AR environment and physical appliances.
- **Extended Tracking:** Vuforia's extended tracking feature ensured that digital overlays remained accurately positioned even if the user moved the device or the appliance was partially obscured. This feature enhanced the stability and reliability of the AR experience.
- **Environment Tracking:** The engine's environment tracking capabilities were employed to provide a consistent and immersive AR experience by accurately mapping the user's surroundings and ensuring that digital elements integrated seamlessly with the real world.

Fig-3: Augmented Reality (AR)

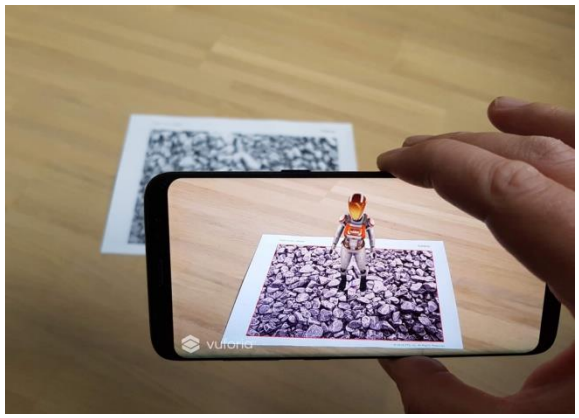

Fig-4: Vuforia Engine

## 3.2. Unity:

Unity served as the development platform for ARify, providing a powerful environment for building and managing the AR application.

- **AR Foundation:** Integrated with Vuforia Engine through Unity's AR Foundation, enabling cross-platform AR development and ensuring compatibility with both iOS and Android devices.
- **3D Modeling and Interaction:** Used Unity to import and integrate 3D models of home appliances into the AR environment. Unity's tools allowed for the creation of interactive AR experiences, including virtual controls and information overlays.
- **User Interface Development:** Developed intuitive and responsive user interfaces within Unity, utilizing its UI toolkit to design and implement virtual buttons, sliders, and informational displays.

Fig-5: Unity

## 3.3. Design Tools:

Adobe Photoshop and Illustrator were essential in creating and refining visual assets for the ARify project.

- **Photoshop:** Used for designing high-resolution textures and visual elements, including interface components and overlay graphics. Photoshop's editing capabilities ensured that all visual assets were optimized for clarity and performance within the AR environment.
- **Illustrator:** Provided vector-based design tools for creating scalable and crisp graphical elements such as icons and control buttons. Illustrator's vector graphics ensured that UI elements remained sharp and clear at various sizes.

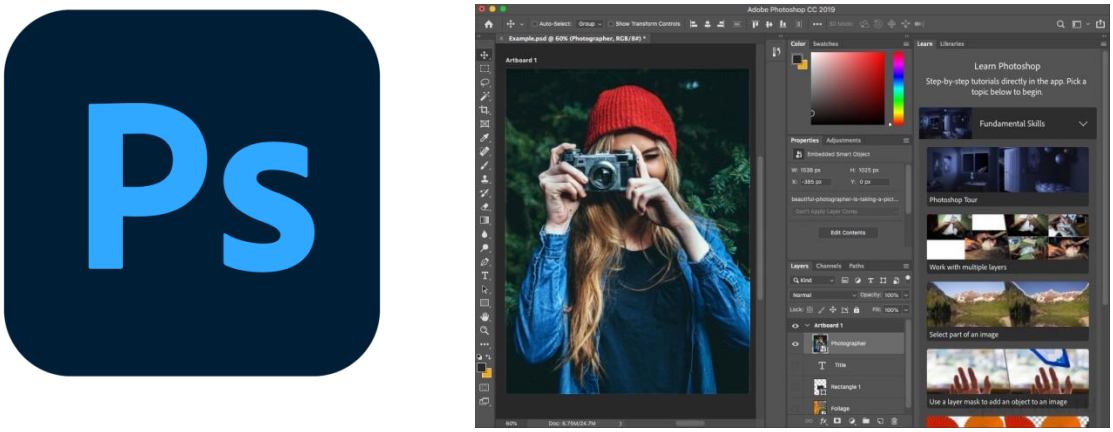


Fig-6: Photoshop

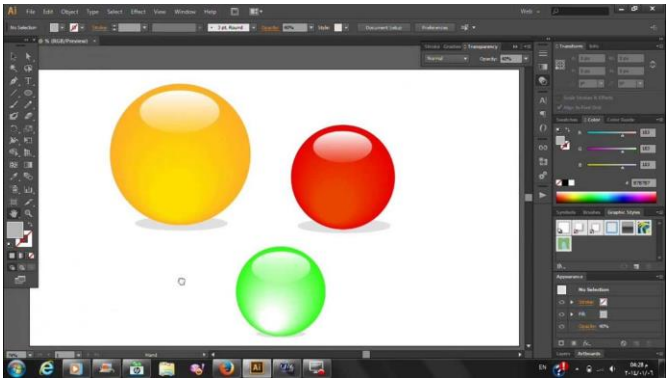

Fig-7: Illustrator

## 3.4. Internet of Things (IoT):

The Internet of Things (IoT) refers to the network of interconnected devices that communicate and exchange data with each other through the internet. These devices, often embedded with sensors, software, and other technologies, range from everyday household items to sophisticated industrial tools.

- **Microcontrollers:** Microcontrollers act as the brains of the IoT devices, controlling the operations of smart devices such as lights, thermostats, cameras, and locks. These microcontrollers receive commands from the ARify app and execute the necessary actions.
- **Sensors:** Various sensors are deployed to gather real-time data from the environment. These sensors can detect motion, temperature, humidity, and other parameters, providing the necessary inputs for automating tasks and enhancing security.
- **Actuators:** Actuators are responsible for performing physical actions based on the received commands. For instance, they can turn lights on or off, adjust the thermostat, or lock and unlock doors. These actions are initiated by the app's user interface or triggered by sensor data.

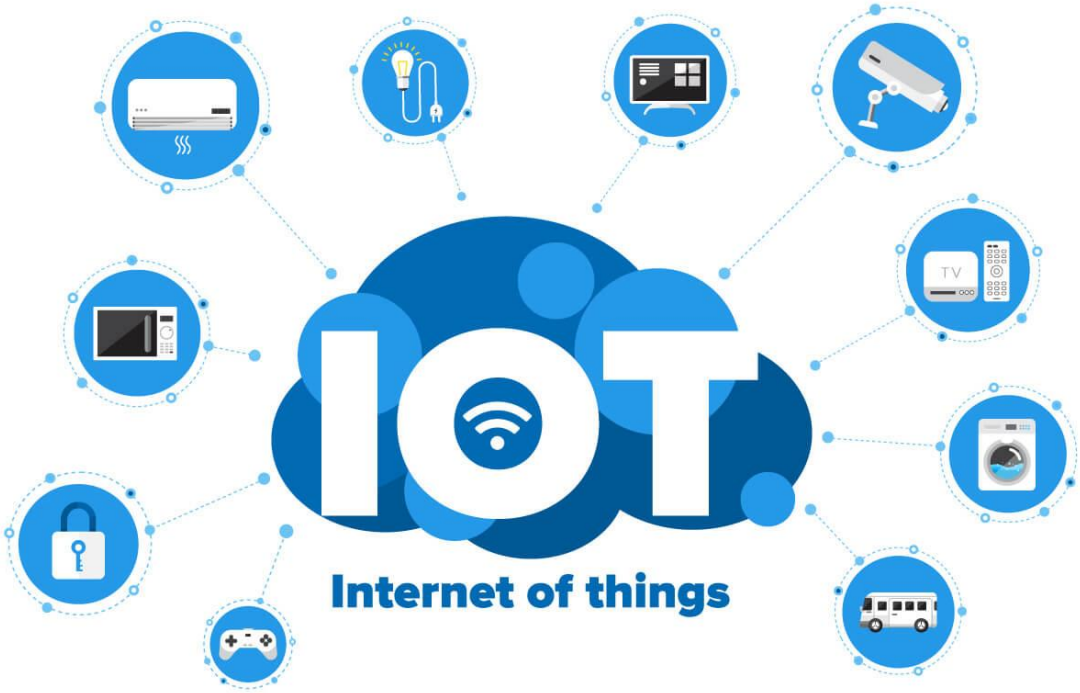


Fig-8: Internet of Things (IoT)

## 3.5. Message Queuing Telemetry Transport (MQTT):

Message Queuing Telemetry Transport (MQTT) is a messaging protocol that connects devices over the internet. It's the most common messaging protocol for the Internet of Things (IoT). MQTT is lightweight and efficient, requiring minimal resources, and supports bi-directional messaging between device and cloud. It's designed for resource-constrained devices and low-bandwidth, high-latency, or unreliable networks.

MQTT (MQ Telemetry Transport) is a lightweight messaging protocol that uses a publish/subscribe model to maximize bandwidth. First the MQTT client connects to an MQTT broker. Than the client can publish messages, subscribe to messages, or the client can do the both publish and also subscribe. By this the client can send messages with topics through the help of broker. Finally the broker can forward the messages to subscribers who are interested in that topic.

There are mainly 4 basic concepts are in MQTT

1. Publish and Subscribe system
2. Messages
3. Topics
4. Broker

## 1. Publish and Subscribe system:

A publish-subscribe (pub/sub) system is a software architecture that allows publishers to send messages to subscribers. In a pub/sub system, publishers post messages to an intermediary message broker or event bus, and subscribers register subscriptions with that broker. The broker then performs filtering, selecting messages for reception and processing. Subscribers typically only receive a subset of the total messages published.


Fig-9: Publish and Subscribe system

## 2. Messages:

By using the MQTT we can send the messages, information, data and some to it. By this type of things we can publish and subscribe the messages from the MQTT.

## 3. Topics:

MQTT topic is a string used in the MQTT protocol to identify and route messages. It is a key element in communication between MQTT publishers and subscribers. In the MQTT publish/subscribe model, publishers send messages to specific topics, while subscribers can subscribe to those topics to receive the messages.

In comparison to topics in other messaging systems, for example Kafka and Pulsar, MQTT topics are not to be created in advance. The client will create the topic automatically when subscribing or publishing, and does not need to delete the topic.

The following is a simple MQTT publish and subscribe flow. If APP 1 subscribes to the sensor/2/temperature topic, it will receive messages from Sensor 2 publishing to this topic.

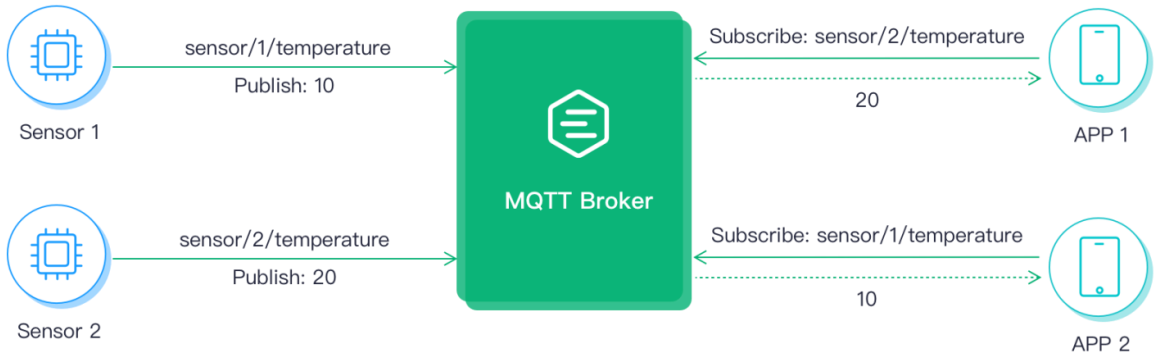


Fig-10: Example for the MQTT publish and subscribe

## 4. Broker:

The MQTT broker is the backend system which coordinates messages between the different clients. Responsibilities of the broker include receiving and filtering messages, identifying clients subscribed to each message, and sending them the messages. It is also responsible for other tasks such as:

- Authorizing and authenticating MQTT clients
- Passing messages to other systems for further analysis
- Handling missed messages and client sessions

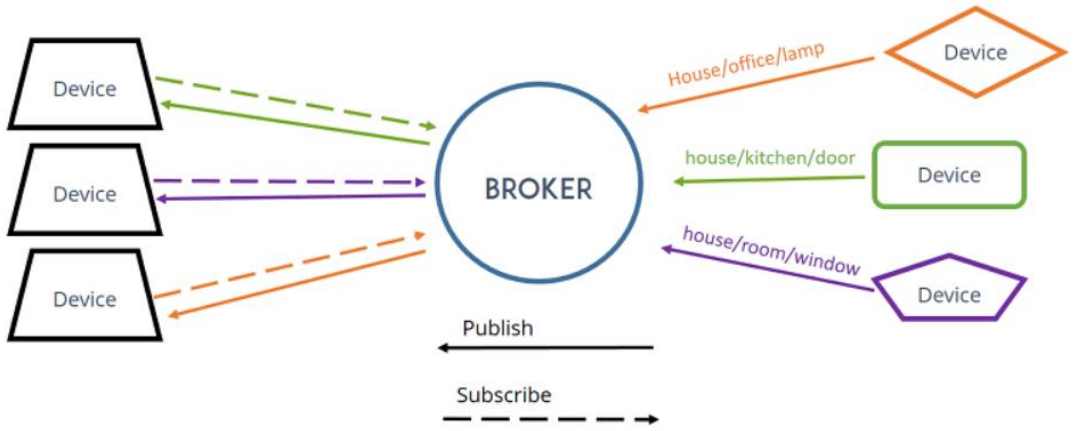


Fig-11: MQT broker

# 4. Development process

## 4.1. Requirements Gathering:

- **Methodology:** Requirements for the ARify project were gathered through a combination of stakeholder meetings and user research. Key needs included intuitive AR interactions, reliable appliance control, and seamless integration with existing home systems.

## 4.2. System Design:

- **Architectural Design:** The system architecture was designed to integrate various components seamlessly:
    - **Augmented Reality (AR):** Utilized Vuforia Engine for AR capabilities, enabling image recognition and model tracking.
    - **Coding and Scripting:** Developed using C# within Unity, ensuring robust functionality and integration with AR features.
    - **Connectivity:** Implemented MQTT for real-time communication between the AR application and home appliances. Custom MQTT scripts were written to handle publishing and subscribing to messages.

## 4.3. Implementation:

- **AR and SDK Integration:** Vuforia Engine was chosen for its powerful AR features, including image recognition and model tracking. C# was used for scripting and handling application logic within Unity.
    - **MQTT Connectivity:** Custom scripts were developed to connect the AR application to an MQTT broker. The scripts handled communication by publishing messages:

- **On Button:** When the user touched the "On" button in AR, the script published a value of 1 to the MQTT broker.
- **Off Button:** When the user touched the "Off" button, the script published a value of 0.

- **Coding Practices:** Focused on clean, maintainable code with modular design to facilitate future updates and debugging.

## 4.4. Required electronic materials:

### 4.4.1. Node MCU (ESP 8266):

ESP 8266 is Low cost, compact and powerful Wi-Fi Module. It gives Power Supply to +3.3V. The Current Consumption is 100mA.It gives input Voltage as 3.6V maximum. The input source current is 12mA max. The low power is 32-bit MCU at 80MH.Flash memory stores 512KB.It can be used as Station or Access Point or both combined. It supports serial communication hence compatible with many development platforms like Arduino. It can be programmed using Arduino. The Arduino connects with ESP8266 to control the home appliances. It is used as a low cost device to provide internet connectivity to your projects.

The module can work both as an Access point (can create hot-spot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it. It can also fetch data from the internet using API's hence your project could access any information that is available in the internet, thus making it smarter. The applications are used such as IOT Projects, Access Point Portals, Wireless Data logging, Smart Home Automation, Learn basics of networking, Portable Electronics and Smart bulbs and Sockets

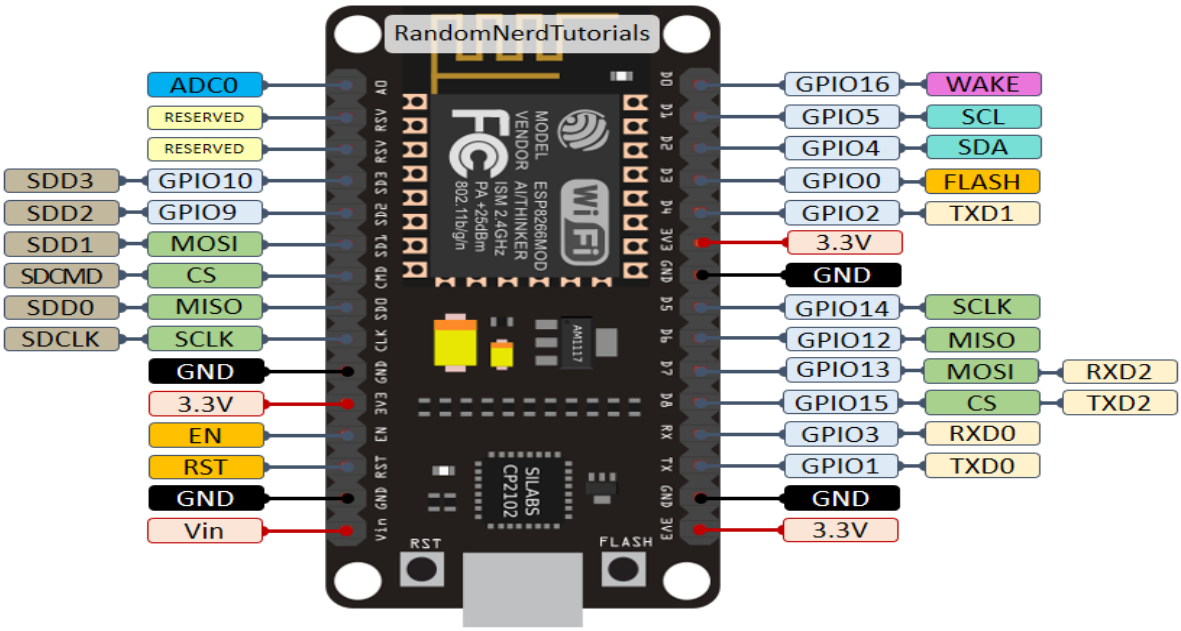


Fig-12: ESP8266 (Node MCU)

### 4.4.2. 4 channel Relay module:

Relay Module is a relay interface board, it can be controlled directly by a wide range of micro-controllers such as Arduino, AVR, PIC, ARM. It uses a low level triggered control signal 3.3 to 5VDC to control the relay. Triggering the relay operates the normally open or normally closed contacts. It is frequently used in an automatic control circuit. Relay is an automatic switch to control a high-current circuit with a low-current signal.

The 5V relay signal input voltage range from 0 to 5V. The trigger Current is70mA.The maximum AC load current is 10A to 250/125V AC. The maximum DC load current is 10A to 30/28V DC. The Operating time is 10msec and release time is 5msec. The maximum switching is 300 operating/minute (mechanically). The application are commonly used in switching circuit, Home Automation projects to switch AC loads, To Control (On/Off) Heavy loads at a predetermined time/condition, Used in safety circuits to disconnect the load from supply in event of failure, Used in Automobiles electronics for controlling indicators glass motors.

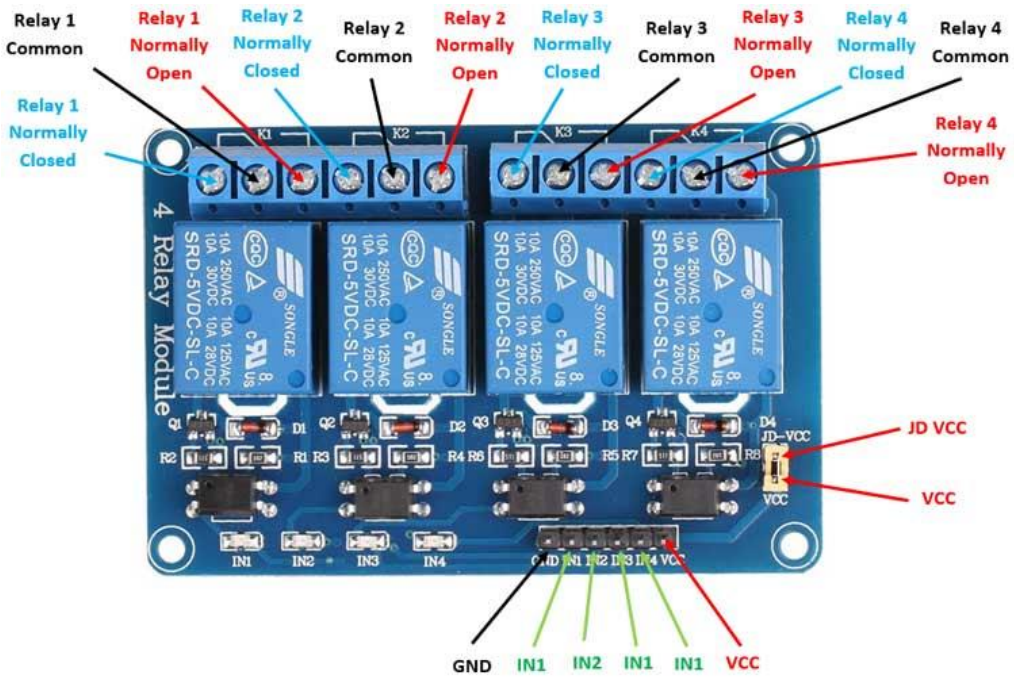


Fig-13: 4 channel Relay module

## 4.5. Testing and Debugging:

- **Testing Strategy:** Comprehensive testing was conducted to ensure the AR application functioned correctly across various scenarios:
    - **Image Sizes and Distances:** Tested the application's performance with different image sizes and distances to ensure reliable image recognition and tracking.
    - **Functionality Testing:** Verified that MQTT messages were correctly published and received, ensuring accurate appliance control through AR interactions.
    - **Debugging:** Employed Unity's debugging tools and logs to identify and resolve issues during development. Iterative testing allowed for refinement of AR interactions and connectivity.

## 4.6. Circuit Diagram:

The circuit diagram is a fundamental aspect of the ARify project, representing the electrical connections and components that enable the integration of smart devices with the ARify app. It serves as a blueprint for building and connecting the hardware elements, ensuring seamless communication and control of the IoT devices.

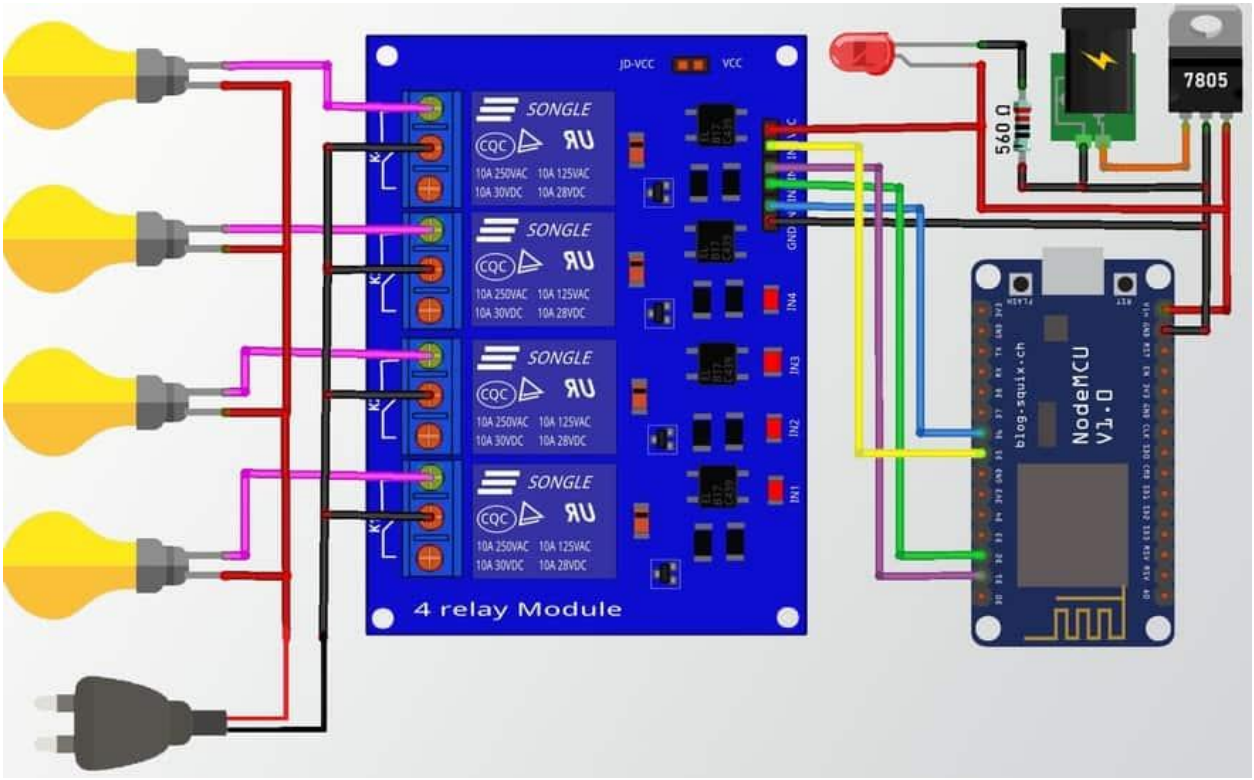


Fig-14: Circuit Diagram

## 4.7. Setting up process of MQTT box:

Initially we have to design the circuit diagram for the hole set up and here we are using the micro controller as the ESP8266 (Node MCU) and the 4 relay module in order to make the 4 electronic devises smart. The circuit diagram will be given in the fig.

In the next step we have to setup the MQTT broker for the on and off operation. Here we receive the messages and also send the messages by using publish and subscribe communication modal. In order to create we have to first click on the “create MQTT client” and give the details as shown in fig. In this we created our own server to run the host here.

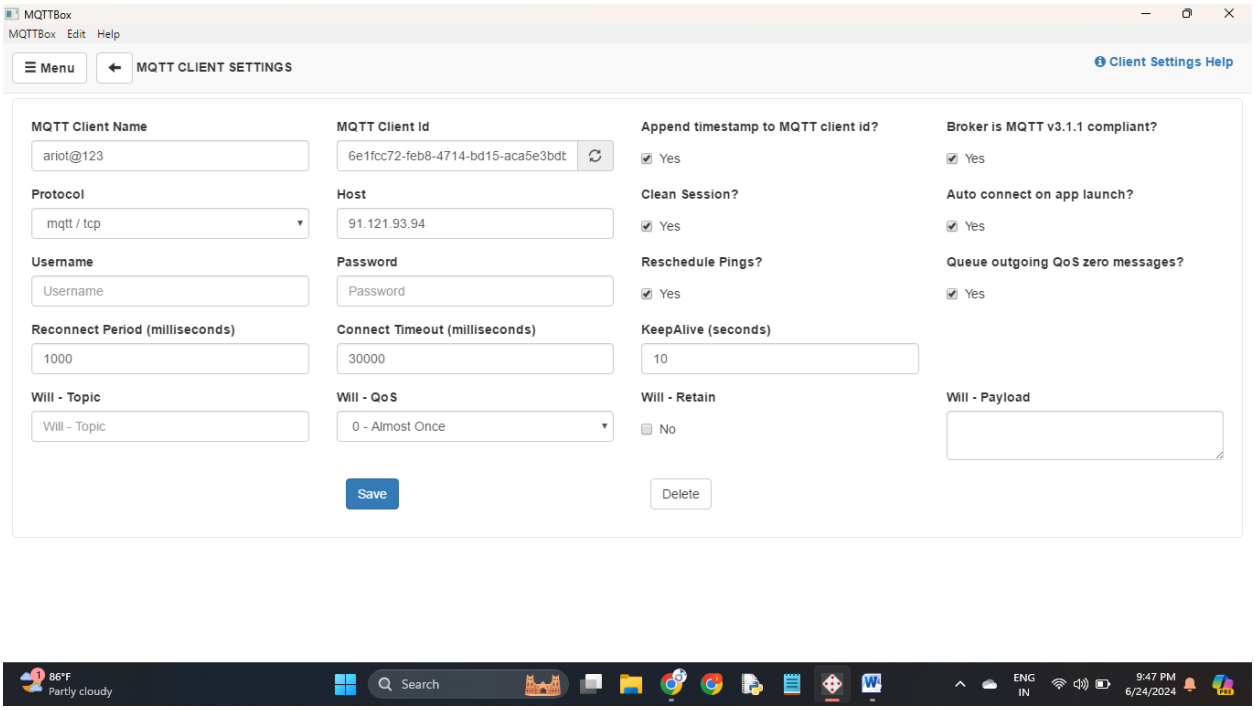


Fig-15: Creating MQTT creation

After creating the MQTT in the publisher give the topic name and also add a subscriber in this we have to subscribe to that same topic of publisher because to receive the message signal if the message is receive or not and it is shown in fig.

Finally dump the code in to the node MCU by adding all the required things like the SSID of the Wifi, password and the topic to subscribe in the code and also give the operation of the relay by the bases of message receiving commands like if we publish the message “01” than the first light will have to be on like that we have to write the code. By this the operation of on and off of the devises will be done.

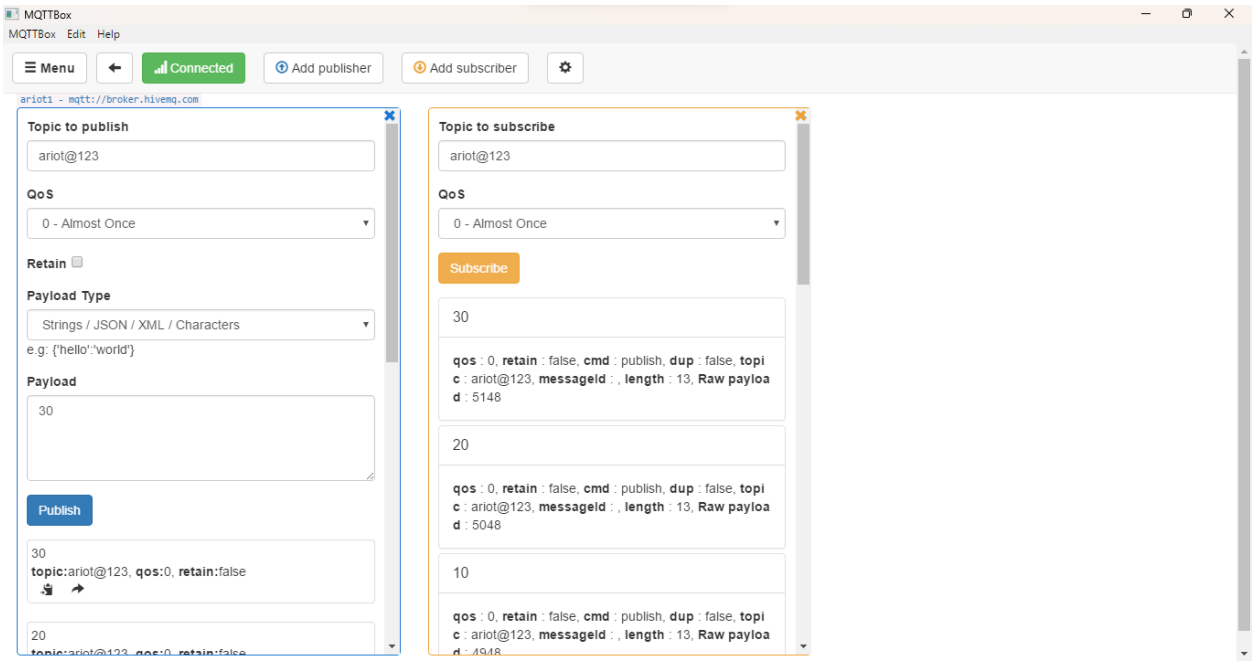


Fig-16: Dashboard of MQTT box

# 5. Features and Functionality

## 5.1. Interactive Overlays:

The ARify project integrates interactive Augmented Reality (AR) elements to enhance user interaction with home appliances. Here's how it works:

- **Image Scanning:** Users start by scanning a predefined image or marker, which acts as an access key for the system. The Vuforia Engine processes this image to recognize it and trigger the display of interactive AR elements.
- **User Interface (UI) Display:** Upon successful image detection, the AR interface appears, overlaying digital controls and information on the real-world view. This UI is designed to be intuitive and responsive, providing users with visual controls to interact with appliances.

**Floor and Room Selection:**

- Interactive Floor Plan: Once the UI is displayed, users can select the specific floor and room where the appliance they wish to control is located. This feature enables users to navigate through a virtual representation of their home, making it easy to pinpoint and manage appliances in different locations.
- **Appliance Operations:** After selecting the desired floor and room, users can interact with the appliances by choosing various operational controls (e.g., turning appliances on or off). The UI provides interactive buttons and sliders to manage these functions seamlessly.

## 5.2. Real-Time Feedback:

- **Immediate Responses:** When users interact with the AR controls, such as touching the "On" or "Off" buttons, the application provides immediate feedback. This is achieved through real-time communication with an MQTT broker:
    - **On Button:** When pressed, the application publishes a 1 to the MQTT broker, signaling the appliance to turn on.
    - **Off Button:** When pressed, the application publishes a 0, indicating the appliance should turn off.
- **Visual Cues:** The AR environment updates in real-time to reflect the status changes of the appliances. This visual feedback ensures users can see the effects of their actions immediately.

**Global Accessibility:**

- **Remote Control:** The ARify system allows users to control their home appliances from anywhere in the world. By using the marker as an access key, users can interact with their appliances through the AR application regardless of their physical location.
- **Marker as Access Key:** The image or marker scanned at the beginning acts as an access key, ensuring that only authorized users can control the appliances. This secure approach provides peace of mind and accessibility, enabling remote management of home systems.

## 5.3. User Interface (UI) Design and Functionality:

- **UI Layout:** The user interface within the AR environment is designed to be user-friendly and visually appealing. It features clear, easily recognizable controls for managing appliances.
    - **Buttons and Sliders:** Controls are represented as virtual buttons and sliders overlaid on the AR view. These elements are designed to be intuitive, allowing users to interact with them as if they were physical objects.
    - **Contextual Information:** The UI provides contextual information about each appliance, such as status indicators and operation modes, to help users make informed decisions.
- **Accessibility:** The UI is designed to be accessible and responsive, ensuring that controls are easy to reach and operate within the AR environment. The layout adapts to different screen sizes and orientations to provide a consistent experience across devices.

By integrating these features, the ARify project delivers a seamless and interactive experience for managing home appliances, leveraging AR technology to simplify and enhance user interactions while providing global accessibility and security.


Fig-17: First screen


Fig-18: When scanning power card


Fig-19: Power card

# 6. User Experience (UX) Design

## 6.1Design Principles:

In the ARify project, the UX design was centered around creating an intuitive and user-friendly experience. Key design principles included:

- **Human-Centered Design:** The design process focused on the needs and behaviors of users. This approach ensured that the AR interface was easy to understand and interact with, even for those with limited technical experience. The interface was designed to be visually appealing and straightforward, allowing users to quickly grasp and use the controls.
- **Clarity and Simplicity:** The user interface was designed to present information and controls clearly and simply. This involved minimizing clutter and using clear, concise labels and icons for buttons and sliders. Essential functions were prioritized and made easily accessible to enhance user efficiency.
- **Consistency:** Consistent visual elements and interactions were used throughout the AR application. This consistency helped users build familiarity and confidence with the interface, leading to a more seamless and intuitive experience.
- **Feedback and Responsiveness:** Real-time feedback was integrated into the AR environment to provide users with immediate responses to their actions. Visual cues and status indicators were used to communicate the current state of appliances and the results of user interactions. This responsiveness was crucial for maintaining user engagement and ensuring effective control of home appliances.
- **Accessibility:** The AR interface was designed to be accessible to a diverse user base, including those with varying levels of technical expertise. This included designing controls that were easy to interact with and ensuring that the interface adapted well to different screen sizes and orientations.

## 6.2. Usability Testing:

Usability testing played a critical role in refining the ARify application. The process included the following steps:

- **Testing Phases:** The application underwent several phases of usability testing, involving real users interacting with the AR system in various scenarios. This testing aimed to identify any usability issues and gather feedback on the user experience.
- **User Feedback:** During testing, users provided valuable insights into the effectiveness of the interface and controls. Common feedback points included the ease of use, clarity of instructions, and responsiveness of the AR interactions. Users also highlighted areas where the interface could be improved for better usability.

- **Interface Refinements:** Based on feedback, adjustments were made to simplify the UI further and enhance visual clarity. This included refining button sizes, improving icon visibility, and reorganizing controls for better accessibility.
- **Performance Enhancements:** Some performance issues identified during testing were addressed to improve the responsiveness and stability of the AR interactions. This included optimizing code and adjusting settings to ensure smooth and reliable operation.
- **Feature Enhancements:** Additional features and improvements were made to address specific user needs and preferences. For example, adjustments were made to the floor and room selection process to make it more intuitive and user-friendly.

- **Continuous Improvement:** Usability testing results were used iteratively to refine the application. Feedback from users was continuously incorporated to ensure that the final product delivered a high-quality and user-centered experience.

By applying human-centered design principles and leveraging insights from usability testing, the ARify project aimed to create a seamless and enjoyable experience for users, ensuring that the application met their needs and expectations effectively.

# 7. Challenges and Solutions

## 7.1. Technical Challenges:

**MQTT Script Publishing:**

- **Challenge:** One of the key technical challenges was ensuring that the MQTT script correctly published the state changes (on/off) to the MQTT broker. Inaccuracies in publishing could lead to inconsistencies between the AR interface and the actual appliance states.
- **Solution:** To address this, we meticulously verified that the characters published by the script (`0` and `1`) matched the expected values recognized by the IoT devices. We conducted extensive testing to ensure that the script correctly handled these values and communicated them accurately to the broker. This involved debugging and cross-checking the published data to confirm consistency.

**Receiving and Updating States:**

- **Challenge:** Another challenge was receiving the state updates from the MQTT broker and reflecting these changes in the AR interface in real-time. Ensuring that the AR environment accurately displayed the on/off states of appliances required seamless integration between the broker and the application.
- **Solution:** We implemented a robust message-handling mechanism within the AR application to receive updates from the MQTT broker. This involved developing efficient subscription and data parsing routines to ensure that state changes were processed and reflected immediately in the AR interface. Continuous testing was conducted to verify the accuracy and timeliness of state updates.

**Marker Accuracy:**

- **Challenge:** Providing a reliable marker for image recognition presented its own set of challenges. The marker needed to be accurately detected by the AR system to trigger the correct UI and interactions.

- **Solution:** To overcome this, we carefully designed and tested the marker to ensure its robustness in various lighting conditions and image sizes. We utilized Vuforia Engine's calibration tools to optimize marker detection. Additionally, we conducted field tests to verify that the marker could be consistently recognized in different scenarios, ensuring reliable performance.

**Unity and Vuforia Compatibility:**

- **Challenge:** Building the application in Unity posed significant challenges, particularly with version compatibility between Unity and Vuforia. Occasionally, builds would fail or the camera functionality would not activate properly, hindering development progress.
- **Solution:** To address this issue, we systematically checked and adjusted the versions of Unity and Vuforia to ensure compatibility. We experimented with different versions to identify stable configurations that allowed for successful builds and functional camera integration. This iterative process of version management and testing helped resolve the issues and ensure a functional application build.

## 7.2. Design Challenges:

**User Interface (UI) Design:**

- **Challenge:** Designing a user-friendly UI within the AR environment that was both intuitive and functional required careful consideration. The interface needed to balance functionality with ease of use while presenting a clean and engaging visual experience.
- **Solution:** We employed human-centered design principles to create a UI that was simple and clear. This involved iterative design and user feedback sessions to refine the layout and controls. Elements such as buttons and sliders were designed to be easily recognizable and accessible. Usability testing helped us identify and address design issues, leading to a more polished and effective interface.

**Global Accessibility:**

- **Challenge:** Enabling remote control of appliances from anywhere in the world posed challenges in terms of security and connectivity.
- **Solution:** We implemented secure access mechanisms and ensured that the marker acted as a unique access key to prevent unauthorized use. Additionally, we optimized the MQTT communication for reliable performance over various network conditions, ensuring that users could control their appliances effectively from different locations.

**Real-Time Feedback:**

- **Challenge:** Providing real-time feedback to users about the status of appliances within the AR environment was crucial for a seamless experience. Ensuring that status updates were reflected accurately and promptly required careful coordination between the AR application and the MQTT broker.
- **Solution:** We developed efficient data handling and synchronization processes to ensure that status updates were communicated and displayed in real-time. This included implementing responsive UI elements and leveraging the capabilities of the Vuforia Engine to maintain accurate and timely feedback.

By addressing these challenges with targeted solutions, the ARify project was able to deliver a robust and user-friendly application that effectively integrates AR technology with IoT appliances, providing a seamless and interactive experience for users.

# 8. Impact and Results

## 8.1. User Benefits:

1. **Enhanced Control and Convenience:** The ARify project revolutionized user interaction with home appliances by integrating augmented reality. Users can now control their appliances through an intuitive AR interface, offering a significant improvement in convenience and ease of use compared to traditional methods. The integration of ESP8266 and relays further extends control capabilities, allowing users to manage devices remotely from anywhere in the world.
2. **Improved Accessibility:** The ARify system's user-friendly design caters to individuals with varying levels of technical proficiency. The AR interface simplifies appliance management, making it accessible to a broad user base without requiring deep technical knowledge.
3. **Real-Time Feedback:** The application provides immediate updates on appliance statuses, enhancing user awareness and confidence. Real-time feedback ensures that users are always informed about the current state of their devices, contributing to a more reliable and interactive experience.
4. **Efficient Interaction:** The marker-based access system and seamless integration with ESP8266 and relays facilitate quick and secure interactions with appliances. The marker serves as an access key, ensuring efficient and secure control, while the ESP8266 module and relays handle the communication and switching operations reliably.

## 8.2. Project Outcomes:

- **Successful Implementation:** The ARify project achieved its goal of developing an effective AR-based control system for home appliances. The combination of Vuforia Engine, Unity, MQTT, ESP8266, and relays enabled seamless communication between the AR application and IoT devices, resulting in a robust and functional solution.
- **Positive User Feedback:** The application received high praise from users for its ease of use, convenience, and effectiveness in remote appliance control. The intuitive AR interface, coupled with reliable performance from the ESP8266 and relay components, contributed to a highly satisfying user experience.
- **Measurable Results:**
    - **Increased Efficiency:** The application streamlined appliance control processes, reducing complexity and minimizing interaction time. The ESP8266 and relays enhanced operational efficiency by providing reliable and responsive control over the devices.
    - **Enhanced Engagement:** Users demonstrated higher engagement with the AR interface compared to traditional control methods. The AR-based approach captured user interest and involvement, leading to a more engaging and interactive experience.
    - **Reduced Errors:** The clear and responsive UI, combined with accurate real-time feedback and the reliable operation of ESP8266 and relays, minimized errors in appliance control, resulting in more precise and dependable device management.

- **Continuous Improvement:** The insights gained from user feedback and testing will drive future enhancements and feature additions. The integration of ESP8266 and relay components provided valuable lessons for optimizing communication and control, setting the stage for ongoing improvements and evolution of the application.

Overall, the ARify project successfully delivered a transformative AR solution for home appliance control, leveraging ESP8266 and relays to provide significant user benefits and achieve positive outcomes in terms of functionality, user satisfaction, and operational efficiency.

# 9. Future Work and Enhancements

## 9.1. Planned Improvements:

- **Dynamic Device Management:** Future iterations of the ARify project will focus on enhancing device management capabilities. The goal is to enable dynamic addition and removal of devices without limitations, allowing users to seamlessly integrate new appliances into their AR environment. This will involve developing a more flexible system architecture that can adapt to changes in the number and types of devices, ensuring scalability and ease of use.

- **AI Integration:** Incorporating artificial intelligence (AI) into the ARify system will open up new possibilities for automation and intelligent control. AI can be used to analyze user behavior, predict appliance usage patterns, and provide personalized recommendations. For example, AI algorithms could learn from user interactions to automate routine tasks or suggest optimal settings based on historical data. This integration will enhance the user experience by making the system more responsive and adaptive to individual preferences.

- **Enhanced User Interface (UI):** Future updates will aim to refine the UI further based on user feedback and emerging design trends. This includes improving the AR interface's visual appeal and functionality, optimizing interaction elements, and ensuring that the UI remains intuitive and accessible. The goal is to provide a more immersive and user-friendly experience that adapts to varying user needs and contexts.

- **Expanded Device Compatibility:** The project will work towards expanding compatibility with a broader range of appliances and IoT devices. This involves integrating support for different communication protocols and standards to ensure that ARify can seamlessly interact with a diverse array of devices. This expansion will make the system more versatile and valuable for users with varied home automation setups.

## 9.2. Potential Expansions:

- **Cloud Integration:** Integrating ARify with cloud services will enhance data storage, analysis, and accessibility. Cloud-based solutions can provide centralized management of device configurations, user profiles, and historical data. This integration will enable users to access their AR environment and device controls from multiple devices and locations, offering greater flexibility and convenience.

- **Cross-Platform Compatibility:** Expanding ARify's compatibility to include various operating systems and devices will increase its reach and usability. This includes developing versions of the application for other platforms such as Android, and ensuring that the system can work across different types of devices, including tablets and smart TVs.

- **Advanced IoT Integration:** Future developments will focus on integrating ARify with advanced IoT technologies, such as smart home hubs and multi-protocol gateways. This will enable seamless communication with a wide range of smart devices and systems, providing users with a unified control interface for their entire smart home ecosystem.

- **Real-Time Analytics and Monitoring:** Implementing real-time analytics and monitoring features will allow users to track appliance performance, energy consumption, and other relevant metrics. This data can be used to optimize appliance usage, identify potential issues, and provide insights for improving energy efficiency and overall system performance.

- **Voice Control and Natural Language Processing (NLP):** Adding voice control capabilities and NLP to ARify will provide users with an additional layer of convenience. Users will be able to control appliances and interact with the AR environment using voice commands, making the system even more intuitive and accessible.

- **Integration with Augmented Reality (AR) Platforms:** Exploring integration with other AR platforms and technologies will enhance the ARify system's capabilities. This includes collaborating with AR hardware manufacturers and exploring new AR frameworks to improve the overall experience and expand the range of supported devices.

By addressing these planned improvements and potential expansions, the ARify project aims to continually enhance its functionality, scalability, and user experience. The goal is to stay at the forefront of AR and IoT innovation, delivering a cutting-edge solution that meets the evolving needs of users and the smart home industry.

# 10. Conclusion

The ARify project represents a significant advancement in the realm of home appliance control through augmented reality. By integrating Vuforia Engine, Unity, and ESP8266, along with relay components, ARify successfully delivered an innovative solution that allows users to manage their home appliances via a sophisticated AR interface. Key achievements include:

- **Effective AR Integration:** Utilized Vuforia Engine and Unity to develop an intuitive AR application that enhances user interaction with home appliances.
- **Reliable Communication:** Implemented ESP8266 for Wi-Fi communication and relays for switching operations, ensuring reliable control and monitoring of devices.
- **User-Friendly Interface:** Designed a marker-based system for easy access and control, providing a seamless and interactive user experience.
- **Real-Time Feedback:** Enabled real-time updates on appliance statuses, enhancing user awareness and control.

The project not only improved user convenience and accessibility but also demonstrated a successful blend of AR technology with IoT devices. The system's ability to allow remote control of appliances from anywhere in the world and provide immediate feedback has set a new standard for home automation solutions.

# 1. EXECUTIVE SUMMARY

This report is about my 8 weeks internship program with **Technical Hub Pvt Ltd**. In this comprehensive report, I have discussed about every major aspect of the company which I observed and perceived during my internship program.

During my internship program, I have learned and mainly worked on Android Application Development and the AWS. All the details have been discussed in detail. All the policies and procedures of the company have been discussed in detail.

As the main purpose of the internship is to learn by working in practical environment and to apply the knowledge acquired during the studies in real world scenario in order to tackle the problems using the knowledge and skill learned during the academic process.

# 2. ABOUT THE COMPANY

They offer a wide range of globally recognized certifications from reputed organizations like Cisco, Red Hat, AWS, Microsoft and Automation Anywhere. These certifications are issued directly by the vendor and are accepted worldwide.

They regularly conduct mock interviews with the help of experienced professionals. These interviews help prepare our trainees for their future placements and help them analyze and upgrade their skills accordingly.

Our in-house development team focuses on providing the best to our customers. Whether you're looking for a custom build product or in house automation, our products are guaranteed to help make your work easier.

**Mission**: “To empower students with practical knowledge and industry-relevant skills through high-quality training programs and internships, bridging the gap between academic learning and professional expertise.”

**Vision**: “To be a leading provider of student training and internship opportunities, fostering a skilled workforce that can seamlessly transition into industry roles and contribute to technological advancements.”

## 3. OPPORTUNITIES:

During these 8 weeks of the internship, I was given the opportunity to perform the following role:

**Intern:**

- Coordinating with the team members and team leads on a regular basis to keep a track of the activities like the meetings held and about the work to be done.
- I learned about developing the applications using different tools.
- For that I have referred the GitHub repositories related to gain the complete knowledge on that.
- Then I have gathered the requirements.
- They also provide us the opportunity to voluntarily interact in other projects as well.
- They have given different tasks to develop different parts of the application.
- Also, they have finally conducted some tests to certify with the completion of internship.

# 4. TRAINING

In these 8 weeks of the training, they have provided us the training in IoT and AWS using different tools.

They have provided us with the training of several technologies like:

- Internet of Things
- Arduino IDE
- AWS

**Internet of Things:** IoT refers to the network of physical objects or "things" embedded with sensors, software, and other technologies, enabling them to connect and exchange data with other devices and systems over the internet. It enhances automation, monitoring, and data insights across various sectors.

**Arduino IDE:** Arduino Integrated Development Environment (IDE) is software that allows users to write, compile, and upload code to Arduino boards. It simplifies programming for electronics projects, often used in IoT and embedded systems.

**AWS:** AWS is a cloud computing platform by Amazon, providing a range of services such as computing power, storage, databases, and machine learning. It supports scalable infrastructure for various applications and is widely used for both development and enterprise solutions.

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# 5. CHALLENGES FACED

- At the beginning of internship, I faced difficulty for understanding the applications and different tools.
- I faced difficulty in installing the software.
- I faced difficulty in managing college and internship timings.
- I faced difficulty in understanding the advanced topics in android.
- I faced difficulty in managing the memory in pc.
- Even with these difficulties, I am able to complete the internship and it helps me in securing a new job.