



# Controlling The Access Of Home Appliances Using Augmented Reality And the Internet Of Things

**Ms. R. Indumathy<sup>1</sup>, M. Muthu<sup>2</sup>, C. Ragu Raman<sup>3</sup>, T. Sabastin<sup>4</sup>**

Assistant Professor, Department of Computer Science and Engineering, DMI College Of Engineering, Chennai, India<sup>1</sup>

B.E, Department of Computer Science and Engineering, DMI College Of Engineering, Chennai, India<sup>2-4</sup>

**Abstract:** Augmented Reality (AR) and the Internet Of Things (IoT) are ubiquitous technologies. Augmented Reality is a sub-domain of Mixed reality. Placing the virtual object in a real-time environment is called Augmented Reality. The Internet Of Things describes the network of physical objects that are embedded with sensors, software, and other technologies for connecting and sharing data with other devices and systems over the Internet. In the IoT part, we have used Blynk Cloud to create an On/Off button to control the home appliances in the dashboard. Then Blynk provides the Authentication token. The Authentication token uses to access the buttons we created in the Blynk Cloud and upload the code in the ESP32 WIFI module. After successfully uploading the code, then ESP32 is connected with the relay and home appliance, and by clicking the On button the appliances will On, and by clicking Off the appliances will turn Off. In the AR part, we used Unity to create a virtual button. Import the target images in Unity using the Vuforia engine. Then we placed the On/Off button on the target image and scan the target image using the mobile camera the button image will appear on the mobile screen. After that using the authentication token, pin, and value of the button in the Blynk Cloud we generated the URL. V0 and V1 are pin and value 0 for Off and 1 for On. Copy the URL and paste the URL in the dialog box in the Unity hub. Then build the application for Android using Unity. Install the application and scan the target images and the created virtual button will display on the mobile screen touching the virtual button in the target image we On/Off the home appliances.

## I. INTRODUCTION

### A. General

Home automation is a network of hardware, communication, and electronic interfaces that works to integrate everyday devices through the internet. Each device has sensors and is connected to the WIFI, so you can control them using mobiles, tablets, and laptops. This allows you to turn On and Off your home appliances like lights, and fans, and even we control the heater also. Nowadays using Microcontroller is easier to control home appliances. Like that using some servers like Blynk, Google Firebase, and Adafruit are used to create the buttons to turn On/Off the home appliances. Creating the buttons, they provide some key named an Authentication token. This Authentication token is used to access the button we created in the server.

### B. Internet Of Things

The Internet Of Things or IoT influences our lifestyle from how we react and behave. From light that you can turn on/off with your mobile phone to a smart band which is monitoring your everyday activities. The Internet Of Things is a large network with connected devices. These devices gather and share data about how they are used and operated in the environment. Using sensors all things will be done, sensors are embedded in every physical device. It can be your mobile phone, tablets, smart band, electrical appliances, barcode sensors, and almost everything that you come across in day-to-day life. The working state of the device's data that is continuously emitted by sensors. IoT allows all the devices to share and communicate data with each other. The emitted data from sensors are sent to IoT platform security. IoT platform integrates the collected data from various sources further analytics is performed on the data and valuable information is extracted as per requirements. The result will be shared with the other devices for a better user experience, automation, and improving efficiencies.

### C. Augmented Reality

Augmented Reality or AR means creating a virtual object and placing it in a real-time environment. Augmented Reality is a subdomain of Extended Reality (XR). Augmented Reality is five types Marker-based AR, Marker-less AR, Projection-based AR, Superimposition-based AR, and Location-based AR. But in the project, we used Marker-based Ar. Marker-based AR is also called image recognition AR. In some products, the QR code is printed and by scanning the QR



code with the help of a mobile we can see the 3D object on our mobile screen. The limitation of Marker-based AR is it can only be used with smartphones or tablets.

#### D. ESP32

ESP32 is a microcontroller and it is also called a WIFI module. ESP32 is a dual-core microprocessor with clock frequency up to 240 MHz and it supports WIFI and also Bluetooth. ESP32 is more user-friendly it is programmed in more than one way. It supports multiple programming environments like Arduino IDE, PlatformIO IDE (VS code), Espressif IDE, etc.

#### E. Blynk

Blynk is an IOT platform for mobile phones that is used to control the microcontroller. The commonly used microcontrollers are ESP32, ESP8266, Arduino UNO, and Raspberry Pi on the Internet. The Blynk server helps us to create a widget to control the input/output of the devices that are connected to the Blynk Cloud. We can make an own design of our widgets like changing colors, font size, style, etc.

#### D. Unity

Unity is a game engine and also a tool to create 3D and 2D objects. Unity is a powerful cross-platform IDE for the game developers. Unity has many builds features for game development. Using a timeline tool, we can create an animation-related project.

## II. LITERATURE SURVEY

**Yongbin Sun, Alexandre Armengol, et al. (2019)**, Investigated the Augmented Reality (AR) visualization and interaction tool for users to control Internet of Things (IoT) devices with hand gestures. Today, smart IoT devices are becoming increasingly ubiquitous with diverse forms and functions, yet most user control over them is still limited to mobile devices and web interfaces. AR has developed rapidly and provided immersive solutions to enhance the user experience of applications in many fields. They built a prototype system consisting of a depth camera, raspberry Pi and HoloLens, allowing users to interact and control the sound lighting system with gestures. The system first detects and localizes available target devices using color and depth information obtained from a depth camera mounted on the HoloLens. Once a smart device (speaker) is found, a virtual Control panel is rendered nearby on the HoloLens screen. The user intends to pause and play the songs and move to the next or previous songs before performing the corresponding action. They Propose Magic Hand an AR-based visualization and interaction tool with a Deep Learning approach, to solve the problem by providing touch-less and robust techniques to interface with smart devices.

**Bhagyashri, Yogesh Dalal. et al. (2020)**, Investigated Distributed Denial of service (DDoS) and energy-oriented DDoS attacks (E-DDoS) on smart home devices and explores the underlying reasons from the perspective of an attacker, victim device, and access point. The smart home devices of energy consumption are attacked by the internal and external through the router portal of the IP address. Compared to the existing work, which primarily focuses on DDoS attacks launched by compromised IoT devices against servers, our work focuses on the connectivity and energy consumption of IOT devices when under attack. E-DDoS attack rate sent by the attacker may not necessarily lead to a victim's higher energy consumption, The majority of the existing works strive to propose defense methods against DDoS and E-DDoS attacks, and much less attention has been paid to the quantitative analysis of these attacks. In contrast, by proposing and conducting a pragmatic approach, in this work, we quantitatively analyzed and revealed new challenging dimensions considering attack rate, port state, payload size, and device's response, we quantitatively studied the impact of DDoS and E-DDoS attacks on several, broadly-used smart home IoT devices and analyze the underlying reasons for victim devices' various response types.

**Ziarmal Nazar Mohammad, Fang Zhou. et al. (2021)**, Investigated the Access Control and Authorization and Survey in smart Homes the rapid development of smart home technology, human life is changing to a new virtual dimension with several promises for improving its quality. Smart home technology, which is one of the most important and fastest-growing fields of the IoT, is being massively deployed by many manufacturers and companies. The smart home includes home automation, home monitoring, and home security for local users. Smart home devices can be accessible by multiple users through a user-friendly interface, such as a web browser or mobile application. Access control is an effective technique for addressing privacy, security, and access violation issues in smart homes. Its main goal is to ensure that the house resources can only be accessed by authorized users, data, and services. It protects the system by restricting legitimate users' access according to their privileges and preventing unauthorized users.



**Sung Lae Kim, Jun Mo Jung. et al. (2014)**, Investigated the created the Mobile Augmented Reality Health-related game named Calory Battle, they used Unity 3D Framework and Vuforia Libraries to create this game. In this game, the player finds and defuses virtual calory bombs in a real-world environment. Specifically, we present the development of two game versions. The prototype was created without a third-party game engine and it led to many challenges. To explore solutions to these challenges, we created a new version of the game with the Unity 3D game engine. We solved some of the prototype's challenges by using Unity 3D. Other challenges, such as interaction with the bomb, were solved by re-design of game interaction. Virtual buttons made it possible for players to have more intuitive interaction by using their fingers directly. Another improvement was made to the graphical expression with Unity's built-in shaders. Moreover, Unity's complete toolset made programming more intuitive and faster. However, there are still some challenges to be solved in the future.

### III. PROPOSED SYSTEM

Our project's main aim is to combine the Internet Of Things and Augmented Reality into domains. We control the home appliances using two platforms one is Blynk Cloud and another one is Unity. We are separating this project into three parts. Internet Of Things implementation part, Augmented Reality part, and Integration part (combining AR and IoT).

#### A. Internet Of Things Implementation

The IoT part is home automation using the microcontroller, 5V relay, jump wire, any home appliance, and Blynk Cloud through the internet.

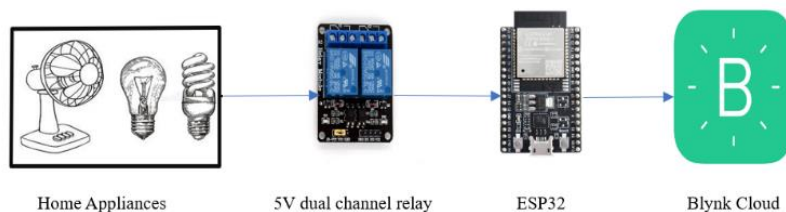


Figure 1: Internet Of Things Implementation

The starting point in the IoT part is creating the account in the Blynk cloud. Using mail id and password login to the Blynk Cloud. Then create a new template on the home page of Blynk Cloud. The name of the project is given Controlling the access of home appliances using AR And IoT. Then select the microcontroller ESP32 and select the type as WIFI. After that give done the template will be created.

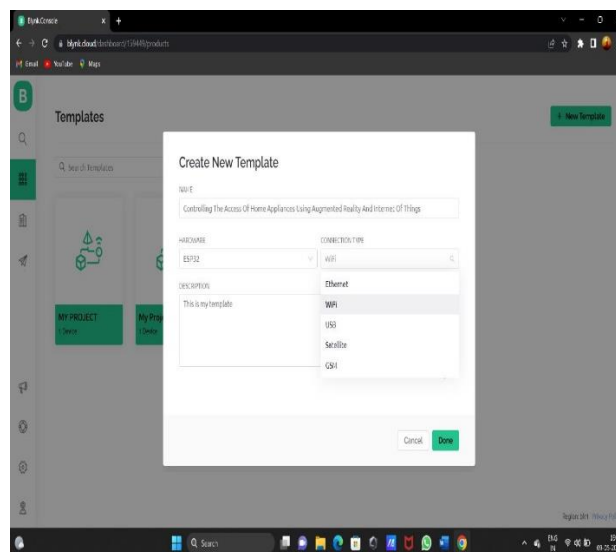


Figure 2: Creating a new template in Blynk Cloud



Then in the dashboard create a virtual pin V0 and V1. The pin V0 for one device and V1 for another device. The value is 0 and 1. The value 0 is for off and the value 1 is for on. Then save it, move it to DataStream, and click edit to create the switch. Click and drag the button in the DataStream and click the created button and make a copy of it. Then in button 1, select the DataStream value V0. Doing the same thing for button 2 and saving it. After all this is done Blynk will provide the authentication token and template id and it will be viewed in the device info.

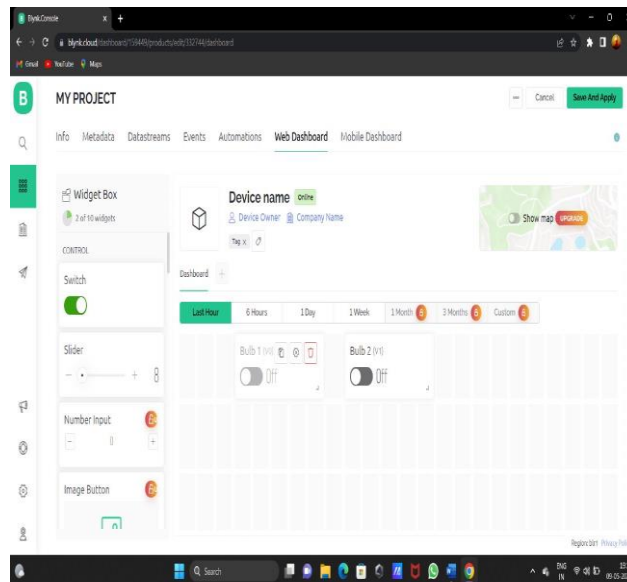


Figure 3: Creating the switch in the web dashboard

Then download the Arduino Ide to upload the code to the microcontroller. In the Arduino, ide installs the latest version of Blynk libraries, and then in the board manager search and install the ESP32. Connect the USB in a system with the ESP32. In tools select the ESP32 Devkit and port.

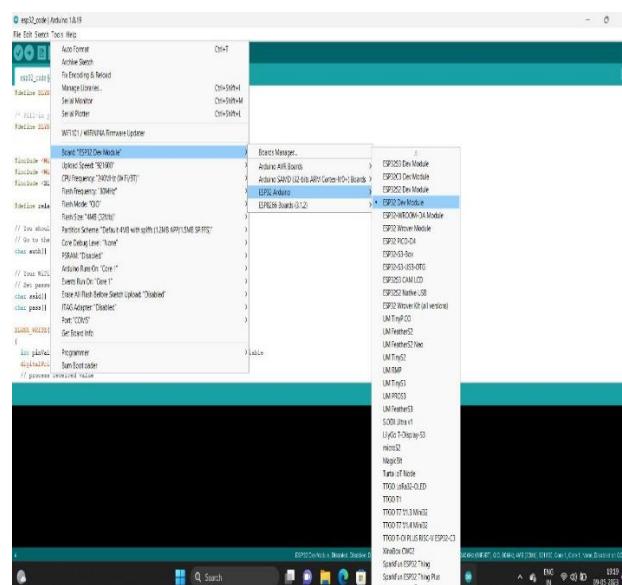


Figure 4: Selecting board and port in Arduino

After connecting the board with the system and using the Blynk authentication token and template id in the code. Use the WIFI name and password in the code to connect to the ESP32 wirelessly. Then run and compile the code to the board. After that in the serial monitor, check whether the board is connected to the WIFI or not.

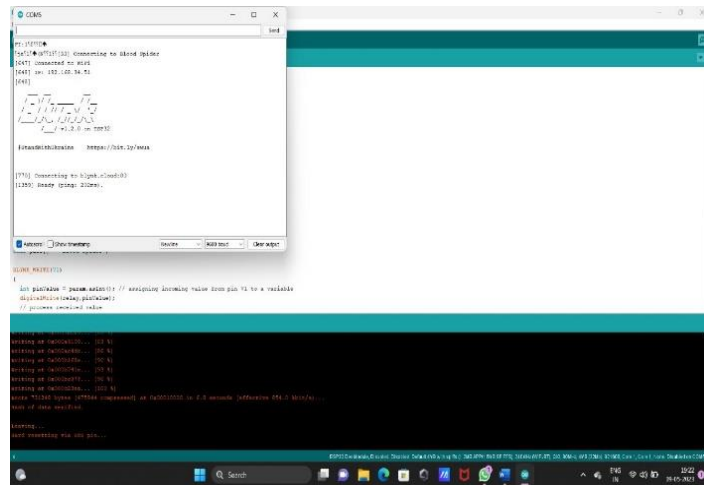


Figure 5: uploading code in ESP32 in Arduino

Connect the board with the relay using jumper wires and connect any home appliance with the relay using the wires and connect the wires with the plug then connect it to the home current. Open the Blynk Cloud check if the device status is online or offline and click the on button on the switch that we created the home appliance will turn on and click again the switch the appliance will turn off.

*B. Augmented Reality Implementation*

The AR part is to create a virtual button on the target image using the Unity game engine.

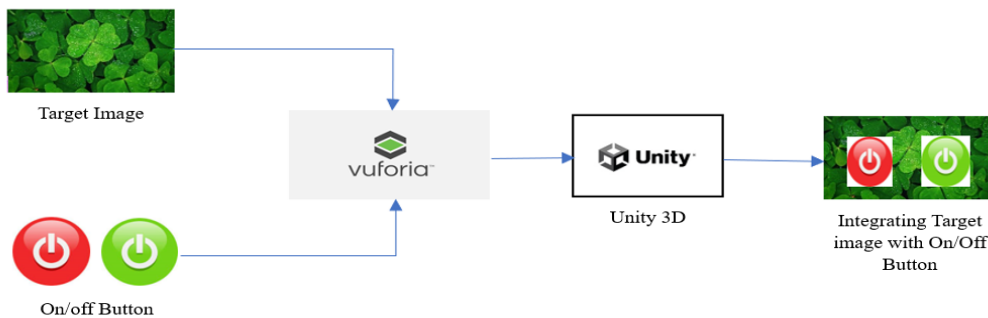


Figure 6: Augmented Reality Implementation

The Unity and the Vuforia are important to add an on/off button on the target image. Download the Unity Hub in Google Chrome. The unity hub is for managing the project that we creating in Unity. In the Unity hub install the latest version of Unity. Then open Unity and click new project. Next, select 3D and give the name for the project and click Create a project.

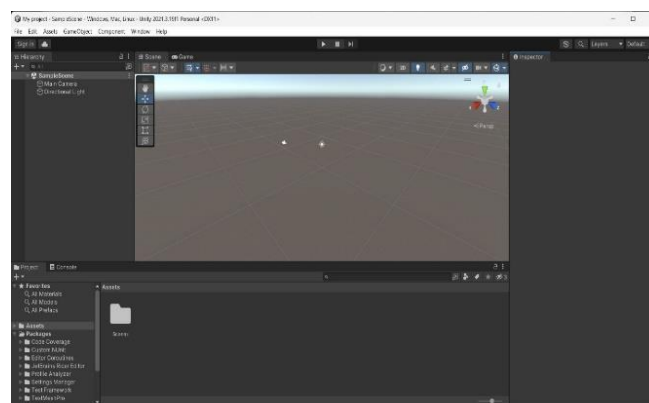


Figure 7: creating a new project in Unity



Then we need to import the package of Vuforia. Search Vuforia in google chrome and login to Vuforia. In Vuforia go to the download option and download the Vuforia engine to the Unity project. After downloading the package import it into Unity. Add a target image and an on/off image in Vuforia to insert it in Unity. In Unity create an AR camera and right click it and select the Vuforia engine in that. In that select the image target to add a target image. Click the image target and it moves to the inspector in that click Add virtual button to add an on/off button. Click the virtual button and go to the Vuforia engine in that to add the on/off button. To connect Unity with Blynk we need to add the script in it.

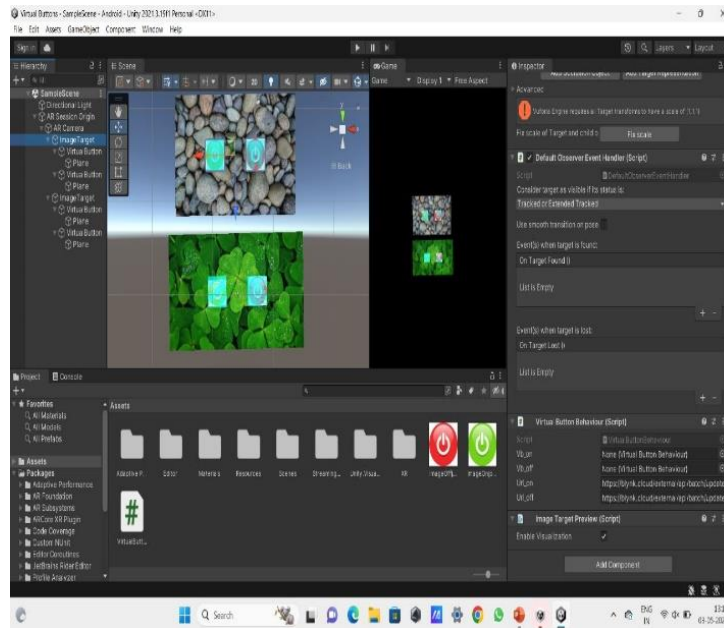


Figure 8: Adding target image and on/off button in Unity using Vuforia

Add a script in the assets and drag it to the image target. Go to file in that select build setting and select Android and go to player setting in that create a key to build the application. Then install the application on your mobile phone. Open the application and scan the target image then the virtual button will appear on the mobile screen.



Figure 9: Scanning target image using mobile phone

### C. Integrating Blynk with Unity

The integrating part is to combine AR and IoT or Blynk and Unity.

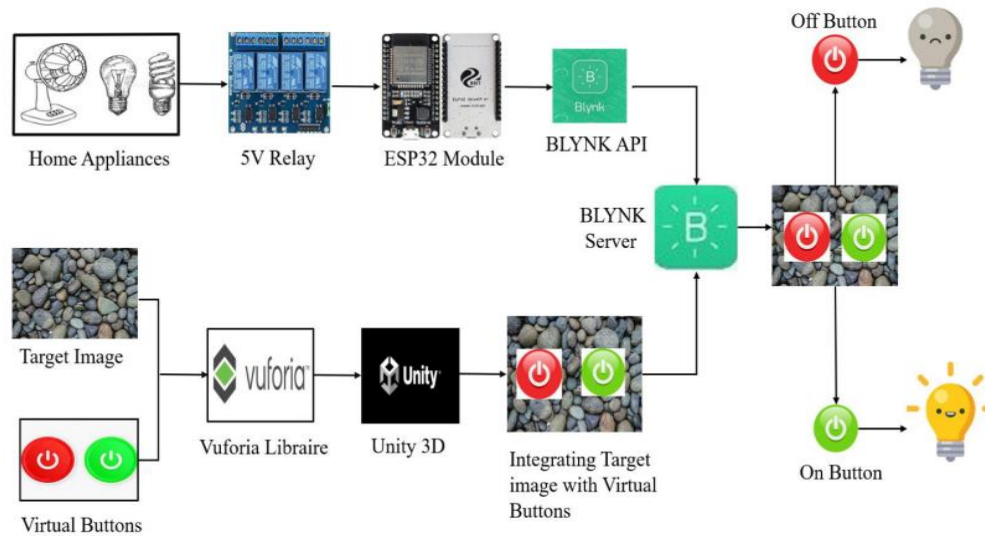


Figure 10: Integrating AR and IoT

In Unity after adding the script to assets. Drag the script and drop it in the image target. After adding the script in the inspector, the four-dialog box will appear. Drag the virtual button and drop it in the virtual button on the box. In the same way, we need to add the off button also. The last two boxes are URL boxes, we can get the URL in the Blynk documentation section.

The format for the URL is <https://blynk.cloud/external/api/update?token={token}&{pin}={value}>. Use the authentication token in the token and enter the pin V0 or V1, V0 for one appliance and V1 for another appliance. Enter 0 or 1 in value, 0 is for off, and 1 is for on.

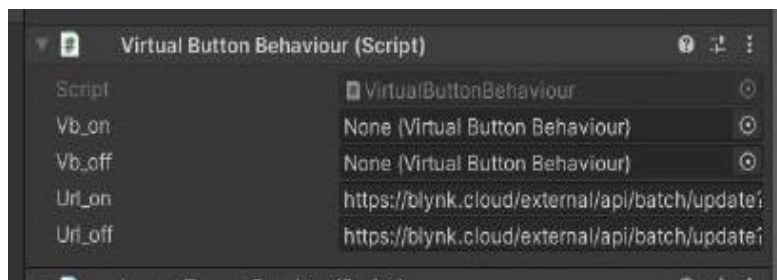


Figure 11: Adding Blynk URL in Unity

Then go to file and build the application. Then download and install it on a mobile phone. Open the application and scan the target image, the virtual button will appear on a mobile screen. Then move the finger or hand near the on button in the target image the appliance will turn on and move the finger or hand to the off button the appliance will turn off.

#### IV. RESULT AND DISCUSSION

As we are using the Blynk server to turn On or Off the lights via the built-in buttons present in the Blynk server. Next, we are going to develop the virtual Buttons via Unity this is achieved by downloading the target images from Google and loading the images to the database called Vuforia Engine. The Vuforia engine acts like a database to load the downloaded images in the unity which means its acts like a medium to load the image in the unity. After that, we are creating the image target and place the virtual button over there to access the button virtually by focusing the image target through the AR Session camera. Finally, we are building the Mobile APK associated with the unity. Through the APK we can able to recognize the image target and the virtual button is placed virtually on the image target, so we can able to access the On or Off buttons virtually.



## V. CONCLUSION

The concept of Augmented Reality and the Internet of Things controlling home appliances through the WIFI or Bluetooth. Nowadays, Home Automation using IoT became an integral part but it can be extended to Augmented Reality. In our project, we integrate both IoT and Augmented Reality. The selection of an IoT domain for enabling the WIFI and Bluetooth connection. The selection of Augmented Reality to create virtual buttons for controlling purposes. Through our project, we created the interface between IoT and Augmented Reality which makes the biggest revolution in this era.

## REFERENCES

- [1]. Chen, Dr. Joy IongZong, and Kong-Long Lai. "Internet of Things (IoT) Authentication and Access Control by Hybrid Deep Learning Method-A Study." *Journal of Soft Computing Paradigm (JSCP)* 2, no. 04 (2020): 236-245.
- [2]. C. G. Coogan and B. He, "Brain-Computer Interface Control in a Virtual Reality Environment and Applications for the Internet of Things," in *IEEE Access*, vol. 6, pp. 10840-10849, 2018.
- [3]. Harsh Kumar Singh<sup>1</sup>, Saurabh Verma<sup>2</sup>, Shashank Pal<sup>3</sup>, Kavita Pandey<sup>4</sup>, "A step towards Home Automation using IOT", doi:978-1-7281-3591-5/19/\$31.00 ©2019 IEEE.
- [4]. Jorge Wagner, Student Member, IEEE, Wolfgang Stuerzlinger, "Comparing and Combining Virtual Hand and Virtual Ray Pointer Interactions for Data Manipulation in Immersive Analytics", *IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS*, VOL. 27, NO. 5, MAY 2021.
- [5]. Monica AiswaryaAnkireddy, Rajath AV, Ruthwik Ganesh M "Augmented Reality Rendered for IoT applications", Doi: 978-1-7281-2327-1/19/\$31.00 ©2019 IEEE.
- [6]. Seonghun Park, Ho-Seung Cha, And Chang-Hwan IM, "Development of an Online Home Appliance Control System Using Augmented Reality and an SSVEPBased BrainComputer Interface", 10.1109/ACCESS.2019.2952613.
- [7]. Sung Lae Kim, Hae Jung Suk, JeongHwa Kang, Jun Mo Jung, "Using Unity 3D to Facilitate Mobile Augmented Reality Game Development", 2014 IEEE World Forum on Internet of Things (WF-IoT).
- [8]. Tiago Andrade, Daniel Bastos, "Extended Reality in IoT scenarios: Concepts, Applications, and Future Trends" in 2019 5th Experiment@ International Conference (exp.at'19) June 12th – 14th, 2019, University of Madeira, Funchal, Madeira, Portugal.
- [9]. Waheb A. Jabbar<sup>1,2</sup>, (Senior Member, IEEE), Tee Kok Kian<sup>1</sup>, Roshahliza M. Ramli<sup>1</sup>, (Member, IEEE), Siti Nabila Zubir<sup>1</sup>, Nurthaqifah S. M. Zamrizaman<sup>1</sup>, Mohammed Balfaqih<sup>3,4</sup>, (Member, IEEE), Vladimir Shepelev<sup>3</sup> and SoltanAlharbi<sup>4</sup>, 10.1109/ACCESS.2017.
- [10]. Xiuquan Qiao<sup>1,\*</sup>, Pei Ren<sup>1</sup>, Guoshun Nan<sup>1</sup>, Ling Liu<sup>2</sup>, Shahram Dustdar<sup>3</sup>, Junliang Chen<sup>1</sup>, "Mobile Web Augmented Reality in 5G and Beyond Challenges, Opportunities, and Future Directions", 1 State Key Laboratory of Networking and Switching Technology, Beijing University of Posts and Telecommunications, Beijing 100876, China, China Communications September 2019.