

Virtual Buttons Using AR

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Abstract: This paper demonstrates the idea of Augmented Reality and the Internet of Things controlling home appliances through the internet. Earlier there were physical buttons to control the home appliances which has to be turned off physically with the touch of the hands. To overcome that, we have come up with the concept of Virtual Buttons replacing the physical buttons. The virtual buttons uses the concept of Augmented Reality and Internet of Things to control the home appliances. The main purpose of this paper is to control the home appliances using Augmented Reality and IoT by a WiFi-based microcontroller. We have used an LED as a home appliance. When the target image is displayed to the camera, it recognizes two virtual buttons 'ON' and 'OFF' by which the LED can be controlled. Nowadays, Home Automation using IoT became an essential part but it can be attached with Augmented Reality. Augmented Reality is used to super impose interactive content into real-world objects. It helps to place the 3D objects that allows in controlling different IoT devices. This paper also illustrates its idea towards multiple devices and demonstrates that augmented reality and IoT are interrelated to each other that visualizes interactive objects that can control the IoT devices.

Keywords: augmented reality, AR, Internet of Things, IoT, marker, markerless, tracking, interaction

I. INTRODUCTION

In recent times, innovation in emerging technologies has made human life easy in all ways of communication and control. The emergence of Smartphones had made a revolution in the communication field but the interactive environment is not still provided.

Here in this paper, the demonstration of the work with augmented reality and IoT gives an interactive feature. Also we have used IOT devices like Node MCU ESP8266 microcontroller which is programmed with Arduino IDE and it can be connected using USB cable and also we are using an LED which can be controlled by using the Virtual buttons.

Augmented Reality is the placing of digital objects in the real world and computer-generated graphic content that is shown as real-time objects. IoT is an interactive environment where all devices are interconnected to each other and can transfer data without any human intervention [1]. In this digital world augmented reality plays a major role in terms of interaction [2]. The IoT, Augmented Reality, and voice command robots are in existence and these technologies can be also extended to realities like AR, VR, and also mixed reality [3]. Using a Wi-Fi inbuilt processor in terms of IoT, automation can be done. This also can be done with Augmented reality by extending it with IoT [4].

The combination of Augmented Reality and IoT leads the way as innovative technology. Augmented reality has rendered its application in education, entertainment and also provides a scalable amount of devices automation [5].

Several ubiquitous technologies ensure the interaction of humans and the world. The usage of Unity3D facilitates the mobile app for augmented reality and also in providing digital 3D objects that can be augmented in the real-world [6].

Blynk API is a Cloud-Platform that is used as IOS and Android apps to control the microcontroller over the internet. It's a digital dashboard where a graphic interface for the project is built. It can control hardware remotely and it provides better secure communication.

We believe that data management, object guided tracking, and the interface design are key components for the development of an efficient IoT-AR infrastructure [11], and we focus on these three areas.

A. IoT Implementation

The IoT part is controlling the home appliance using ESP8266 that is connected to relay and Blynk API through the Internet.

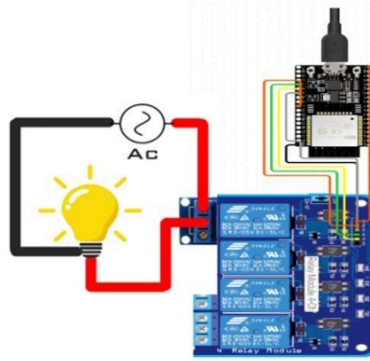


Fig. 1.1: Connection diagram of Home Appliance with ESP32 and Relay

The above circuit represents the IoT connection of controlling an AC appliance. The ESP8266 is connected to the input of the relay using one of the GPIO pins. The relay module is an electronically operated switch used to turn on and off the circuit.

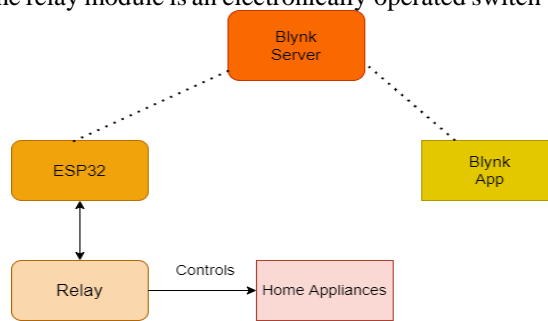


Fig. 1.2: IoT Block Diagram of controlling Home appliances

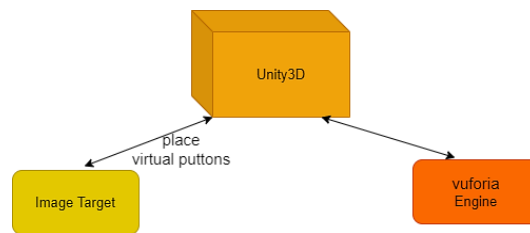


Fig. 1.3: Augmented Reality Block for placing virtual buttons on the image target

Vuforia Engine process is for focusing the image target. First, the image target chosen is to be uploaded to the vuforia developer site and the width of 1 is set and it is downloaded as a 3D database. This is then imported to the Unity hub for placing the image target in the 3D workspace.

Vuforia engine is also used to augment the virtual buttons on the image target [16-17]. Its process is shown in fig. 7 in which the image is taken into it and it updates the logic state and renders the graphics on it and it is shown on the device.

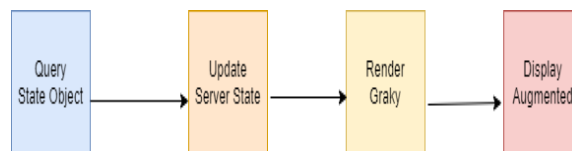


Fig. 1.4: Vuforia Engine Process

The process that is involved in the augmented reality part is shown in Figure 2.3.

First an image target is chosen and it is uploaded to the vuforia developer site and the database is created for that image and the license of that image is also created in vuforia. The database is then downloaded and imported into unity hub. The unity 2021 version is used and the image is now imported into unity. The Vuforia package is also imported. The main camera is present default is removed and the AR camera is chosen as an augmented reality-based project is developed and then it is connected to Unity 3D and vuforia the license is used that is copied and pasted into the license column.

The AR camera will be shown on the left side of the screen by clicking it, an image target that is imported from vuforia engine is added and so the image will be displayed in the 3D workspace.

Now two virtual buttons are placed on the image target by going to the advanced options present on the right side of the workspace and clicking the 'Add Virtual Button' option also it is invisible while creating an android application. So for that, a

plane is brought near to these buttons and the button images shown in fig. 2.5 are placed. The C# script is written particularly for the virtual buttons. This C# script is uploaded to the hub and then these Blynk addresses are pasted into the input field that is mentioned in the C# script. Before developing it can be tested using the webcam of the laptop by clicking the play button at the top.

The Proposed Block diagram is shown in Figure 8. A class is created in the script for these virtual buttons and if the virtual button behaviour is triggered.

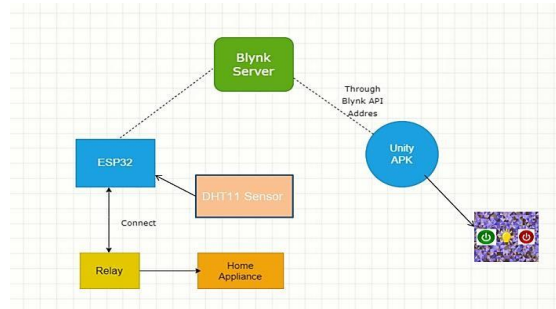


Fig. 1.5: Proposed Block Diagram for Home appliance control



Fig. 1.6: Virtual Buttons View

II. Literature Survey

Conventional 2D touch-based interaction methods for handheld Augmented Reality (AR) cannot provide intuitive 3D interaction due to a lack of natural gesture input with real-time depth information. The goal of this research is to develop a natural interaction technique for manipulating virtual objects in 3D space on handheld AR devices. We present a novel method that is based on identifying the positions and movements of the user's fingertips, and mapping these gestures onto corresponding manipulations of the virtual objects in the AR scene. We conducted a user study to evaluate this method by comparing it with a common touch-based interface under different AR scenarios. The results indicate that although our method takes longer time, it is more natural and enjoyable to use. Conventional 2D touch-based interaction methods for handheld Augmented Reality (AR) cannot provide intuitive 3D interaction due to a lack of natural gesture input with real-time depth information. The goal of this research is to develop a natural interaction technique for manipulating virtual objects in 3D space on handheld AR devices. We present a novel method that is based on identifying the positions and movements of the user's fingertips, and mapping these gestures onto corresponding manipulations of the virtual objects in the AR scene. We conducted a user study to evaluate this method by comparing it with a common touch-based interface under different AR scenarios. The results indicate that although our method takes longer time, it is more natural and enjoyable to use.

Conventional 2D touch-based interaction methods for handheld Augmented Reality (AR) couldn't provide intuitive 3D interaction due to a lack of natural gesture input with real-time depth information. The goal of this research [20] was to develop a natural interaction technique for manipulating virtual objects in 3D space on handheld AR devices. They have present a novel method that was based on identifying the positions and movements of the user's fingertips, and mapping these gestures onto corresponding manipulations of the virtual objects in the AR scene. They conducted a user study to evaluate this method by comparing it with a common touch-based interface under different AR scenarios.

The paper [21] presents a novel bare-hand interaction method for wear-able AR (augmented reality). The suggested method was using hierarchical virtual buttons which are placed on the image target. Therefore, they had provided precise hand interaction on the image target surface by using wearable AR. It operated on a wearable AR system and used an image target tracker to make occlusion-based interaction button. They introduced the hierarchical virtual button method which was adequate for more precise and faster interaction with augmented objects.

Augmented reality future tense of powerful human computer interaction paradigm. This technology apart from increasing the conceptual understanding of people, also created a new way of user interaction. Many methods and applications were developed based on markers. Here they presented markerless camera tracking and user interface that could be used in smart TVs and smart phones. The markers used were none other than human hand. But even though human hand was used as marker, they

were not fixed one. The markers, nothing but human hand were tracked on frame by frame basis. In spite of tracking on frame by frame basis, the virtual content were stabilized and they can perform rotation, resize, zoom-in and zoom-out operations. This can also be used in seminar presentations, games, for viewing images and many.[22].

III. AR Enabled IoT for a Smart and Interactive Environment:

Along with the emergence of wireless networking and the Internet of Things (IoT), traditional augmented reality (AR) systems to visualize virtual 3D models of the real world are evolving into smart and interactive AR related to the factors of things for physical objects. They proposed the integration of AR and IoT in a complementary way, making AR scalable to cover objects everywhere with an acceptable level of performance and interacting with IoT in a more intuitive manner. They identified three key components for realizing such a synergistic integration: [1] distributed and object-centric data management (including for AR services); [2] IoT object-guided tracking; [3] seamless interaction and content interoperability. They surveyed the current state of these respective areas and herein discussed research on issues about realizing a future smart and interactive living environment.

Augmented Reality

Augmented Reality is the integration of digital information with the user's environment in real time use of information in the form of text, graphics, audio and other virtual enhancements with real-world objects.

Internet of Things

IOT demonstrates the physical objects with sensors, processing ability, software and other technologies which connects and exchanges data with other devices and systems over the Internet.

IV. Virtual Buttons using Augmented Reality

In this paper, we are making Virtual Buttons using Augmented Reality and IOT which will control the home appliances replacing the use of physical buttons through the Internet. Using Unity Hub and Vuforia Engine we can create the two virtual buttons. There will be two virtual buttons in the color 'green' and 'red' indicating 'ON' and 'OFF' of the LED respectively. When the target image is displayed to the AR Camera two virtual buttons will be visible on top of the target image. To make this work, we are using Arduino IDE and Blynk App to connect the ESP8266 microcontroller which helps the LED to turn on/off.

V. Expected Result

The apk file developed using unity hub is saved as a Multi-Target apk file. This apk file is then installed on mobile phones and when it is opened across the image target it shows virtual switches across the image target. These are used for ON (fig. 5.1) and OFF (fig.5.2) which is shown for target 1.



Fig. 5.1: Target 1 Switch ON

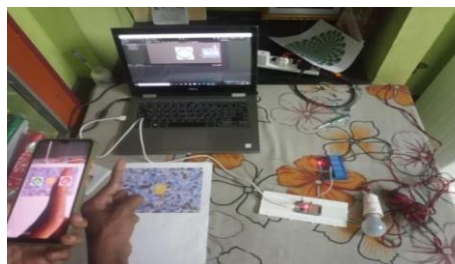


Fig. 5.2: Target 1 Switch OFF



Fig. 5.3: Target 3 Switch ON

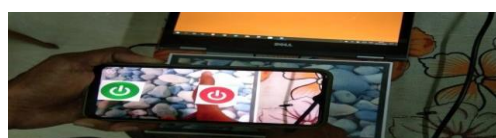


Fig. 5.4: Target 3 Switch OFF

These are the results obtained while showing the app across each target. In these images, the working of the developed AR app is shown and across various situations, it is tested.

VI. Conclusion

This paper proposed a virtual buttons using augmented reality model and has been tested it with different devices and also different analyses has been taken depending upon the Wi-Fi strength providing a friendly interactive environment. The Blynk API is tested in various conditions and also the app is tested across different ranges. The NodeMCU is also instead of ESP32 and tested across various ranges that take more time than ESP32 and thus, sensitivity is low. Finally, it is checked with different Wi-Fi networks in different places with low Wi-Fi strength and it needed less consumption of data providing an optimized performance. The model developed controls different home appliances across different ranges.

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