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Research Article

A Novel AR-IoT Framework for Contactless Home Automation for Persons with Disabilities

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ABSTRACT

The fusion of Augmented Reality (AR) and the Internet of Things (IoT) is revolutionizing technology with projects like AIR SWITCHES. This innovation enables control of devices via AR-projected switches, enhancing accessibility for persons with disabilities (PwDs). The system works by placing a camera above a target image; when matched, AR switches appear, allowing users to control a light bulb connected through IoT. The AR interface is developed in Unity, while the IoT functionality involves a NodeMCU Wi-Fi module, a relay module, and a light bulb, with code written in Arduino and PHP links for ON/OFF commands. This research exemplifies how AR and IoT can create seamless, user-friendly interfaces to improve daily life.

Keywords: Air switches, Augmented Reality, IoT, Person with disabilities(PwDs), Target Image.

I. INTRODUCTION

AIR SWITCHES is an application which is used to control the light bulb which is connected in the IOT with an AR switch button. This research focuses to make the lives of people with disabilities better by providing a smart environment, which enables them to be an independent person. We use the combination of AR and IOT technology to make this application feasible. When it comes to the IOT, augmented reality (AR) is a great way to display data which is used to control the IOT device. Through this, information can also be displayed on a specific equipment which includes smartphones, tablets etc. IOT can connect various sources of data and AR helps visualize the data. This research visualizes the switches on top of the target image clicking the AR buttons we can control the light bulb which is connected in IOT. The light bulb is connected with a Node MCU and a RELAY module According to the buttons pressed in the AR application the light bulb act accordingly. It works in a way where initially the target image is scanned and once the image matches the AR buttons appear right above the target image and we can access the light bulb by clicking on the AR buttons.

II. LITERATURE REVIEW

Rashid et al.2017[1] discussed the potential benefits of IoT in smart cities, including increased efficiency and improved quality of life for citizens. The research also explains about the proposed AR application that runs on different interfaces, allowing the user to digitally interact with the physical items on the shelf, through an updated inventory provided by an RFID system.

Dongsik Jo[1] and Gerard Jounghyun Kim[2] 2019[2] provides an empirical study of the application of IoT+AR technology in the retail industry. The IoT+AR approach illustrates the AR visualization scheme for shopping services in terms of physical objects. Individual or groups of physical IoT objects is imbued with data and content in a distributed manner and efficiently utilized by the AR client along with the potential advantages and expected synergies of integrating them. The distribution makes it possible to scale and customize interaction techniques with AR. It leverages the IoT control interface for physical objects, and intuitive and natural AR interaction in a complementary way, also combining the digital and analog worlds.

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Georgios Mylonas et al.2019[3] discussed the rationale behind using augmented reality to complement an in-class lab activity and also provides an interactive class for the students. It utilizes IoT devices and real-time data from sensors, aiming to help students gain a deeper understanding of some concepts related to energy consumption and efficiency inside their own school building. The augmented reality part provides an additional visual companion to these activities. Apart from the lab-specific part, it uses The effects of augmented reality interactive technology on students' learning of national parks. Journal of Hospitality, Leisure, Sport & Tourism Education.

Corentin Haidon et al.2020[4] presented an approach for helping caregivers designing a smart home for assistance using augmented reality. The proposed process highlights two main steps: describing the environment and determining the resident's habits and the assistance required to improve activity performance and Visual guidance and feedback provided to ease the process

Alexander Ilic & Elgar Fleisch 2016[5] discussed about why Augmented Reality technologies are essential for evolving this gateway role in the Internet of Things and how alternate form-factors of the smartphone (e.g. glasses, watches, contacts, gloves, etc.) might impact context-aware service interactions. It also reviews on how AR can be used to accelerate developments and usage of the IoT. And also focuses on the product-service interaction. Where objects are the part of service.

Dongsik Jo and Gerard Jounghyun Kim 2019[6] discussed about the issues in AR and IOT also provides Use case scenario highlighting object-centric data management and intuitive interaction to enable "everywhere" augmented reality (AR) service through the Internet of Things (IoT) and information about AR Enabled IoT Platform for a Smart and Interactive Environment.

III. PROPOSED METHODOLOGY

Air Switches is an innovative application that uses Augmented Reality (AR) and the Internet of Things (IoT) to control a light bulb via AR switch buttons. Aimed at improving the independence of persons with disabilities, this research creates a smart environment by combining AR for data visualization and IoT for device control. The hardware components q1include a NodeMCU ESP8266 Wi-Fi module, a 5V Relay Module, and a light bulb. Software components involve the ARDUINO IDE, Unity platform, PHP for switch links, and C# for scripting button actions. The NodeMCU receives data to control the relay and light bulb, while Unity and Vuforia manage the AR switches. The application is built into an APK format for mobile devices, allowing users to control the light by scanning a target image, which then displays AR switches to operate the bulb.

IV. ARCHITECTURE

The research projects 3D SWITCHES using the technology of AUGMENTED REALITY. The applications scan the target image if the image matches the 3D switches are projected at the top of the image target, the switches are designed using the UNITY software and also the target image is uploaded from the VUFORIA database. Separate links are created for the ON and OFF switches in PHP, the buttons are scripted with C# in order to to get the URL once the buttons are clicked and access the light bulbs which is connected in IOT. The light bulb is connected with an NodeMCU Wi-Fi module and a RELAY module. the IN pin of the relay is connected to the D0 of the NodeMCU ESP8266. The G pin is the ground pin of the relay module. It is connected to the ground of the NodeMCU ESP8266 for power supply. The V+ pin is the power supply pin of the relay module. This pin is used to power the relay coil and other components on the module. The v+ pin is connected to the Vin pin of the NodeMCU ESP8266.The NodeMCU ESP8266 Wi-Fi module used to connect the IoT devices through the internet, the Relay module is used to control the ON and OFF of the bulb .According to the buttons pressed in the AR application the light bulb act accordingly.

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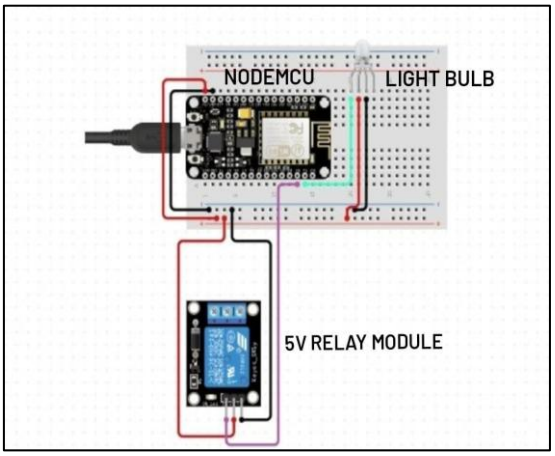


Fig. 1. Circuit Diagram

V. RESULTS AND DISCUSSION

Through the AR application the user places the camera over the image target. The image target is uploaded to Vuforia Database and then is imported to the Unity platform in which the AR application was built. Once the target image matches AR switch buttons are projected on top of the target image. The target image can be customised according to the user's choice.



Fig. 2. AR switches projected on target image

Once the apk file is installed in their mobile device through the application the camera is placed on top of the image target when the image matches, the AR switch buttons which is designed in the Unity platform and scripted in C# to request the URL which was built using php send message to the IOT device the NodeMCU ESP8266 receives the message via Wi-Fi and send it to the Relay module as the relay module controls the ON and OFF the light bulb.



Fig.3. Working of Light bulb using AR Switches

According to user's click bulb acts respectively. As the devices could be accessed right from our by just placing the camera on the target image and clicking the switches to access the devices it would greatly benefit people with

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disabilities in case if they are not able to move to the physical switches and operate it they can just simply open the AR application place the camera over the target image which can be set according to the user convenience and the switches gets projected which are easily accessible and also highly interactive as AR application provides 3D switches this application makes their life easier and comfortable without having to depend on other. Apart from them anyone can use the application in order to access devices right from their places through the AR switches and also any device apart from them anyone can use the application in order to access devices right from their places through the AR switches and also any device apart from the light bulb can be connected to the IoT devices.

VI. CONCLUSION

The AR-IOT application is designed to empower persons with disabilities (PwDs) by providing virtual switches for controlling IoT devices, fostering independence and equality. Built using Unity Hub and Vuforia for AR, and ESP32 Wi-Fi module with relay for IoT, the system projects 3D switch views above a target image. Users can operate a light bulb or other devices connected through NodeMCU ESP8266 and a relay module, using interactive AR switches. This technology eliminates the need for physical switches, aiding PwDs by allowing control from their location. The combination of AR and IoT not only benefits PwDs but also offers broad applications for other users and industries, enhancing interactivity and operational efficiency.

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