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Augmented Reality For Computer Networking

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Abstract : In recent years, Augmented Reality (AR) has captivated much attention as a technology that holds promise in improving learning experiences. This essay explores the newly emerging area of using AR for computer networking. This review systematically examines various applications, attributes and effectiveness of AR in the field of computer network teaching. The main purpose of this inquiry is to help augmented reality based learning and create software that can simplify understanding complex concepts regarding networking computers. We intend by way of reviewing the existing literature and investigating real life implementations to reveal how AR may become a tool to revolutionize computer networking education. By doing so, this article contributes to the literature on computer network education assisted by AR through highlighting current trends, difficulties confronting it and directions for future studies. Ultimately, our research findings highlight the need for employing augmented reality technology in creating interactive and immersive learning environments to enable people to understand intricate network concepts better.

Keywords: Augmented Reality, Networking Protocols, Computer Networking, 3D, Marker less, WebAR

Fig. 1. Networking Components

I. INTRODUCTION

Technology serves the purpose of simplifying tasks which make it easier for humans to complete or work on their activities. One of such interesting technologies that is currently used is Augmented Reality. AR is a technology that combines two or three dimension objects into real three dimensional objects. Imagine looking through a special pair of glasses or your phone's camera and seeing virtual objects or information overlaid on your surroundings. It's like having digital graphics or information pop up in your everyday environment, making it more interactive and engaging. Augmented Reality can be used as an interesting learning medium. This is because AR can present interactive and more efficient learning because the teaching and learning process is not only theoretical but also can see objects taught in 3D objects. Augmented Reality applications are in retail where you can try products virtually, and games like PokemonGo, and social media platform Snapchat use Augmented Reality for face filters.

[1] Optical video streams are vital data sources to support AR in both types of hardware. Object detection and object recognition help the AR system to understand the environments surrounding the user.

One of the lessons that can be used using AR is to learn the protocols of computer networking. AR is integrating digital information into the real world. Users can interact with digital content by using either mobile or AR glasses.

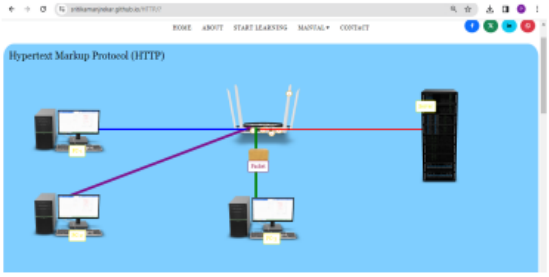

Fig 2. Packet Simulation (HTTP)

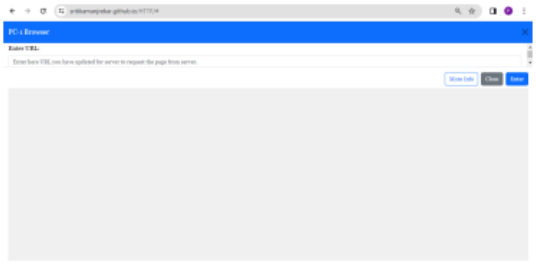

Fig 3. Enter URL Window(HTTP)

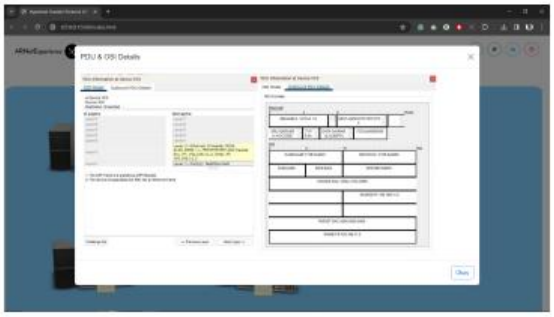

Fig 4 PDI & OSI Details (HTTP)

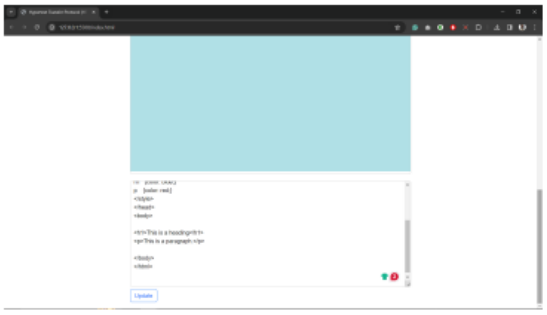

Fig 5 Text editor (HTTP)

There are two types of Augmented Reality

• Marker-based In marker-based augmented reality we use a specific marker as the basis for modeling. The digital content appears upon the marker. Digital content adjusts the position as the marker shifts or turns. The specific marker is called a ”trigger photo”. While initiating for marker-based needs, mobile application scans markers triggering the digital experiences.

[2] Marker (marker) is hardware supporting augmented reality applications that function as a liaison interface between modules and augmented reality applications. In general, the process of making markers for augmented reality applications consists of several stages: a. Designing a marker display with design software b. Upload markers to the vuforia website

[3] In 2017, an interesting cube called Merge appeared on the market, which in conjunction with a mobile device (through its camera) and software can turn the cube into a hologram. By synchronizing the cube with the application and then rotating the physical cube, we see a virtual representation of 3D objects through the screen of the device. It is a completely new way of interacting and experiencing AR. Suddenly we can hold in our hands mathematical 3D objects, historical artifacts, human organs, etc.

[4] Court painting is a traditional Korean type of painting that depicts royal events. It should be understood in the context of royal rituals and historical writing. Therefore, it is only possible for visitors of a museum with historical knowledge to interpret the content accurately. Most methods aim to reconstruct paintings as 3D virtual objects for visitors to view them. In this study we propose an augmented reality system that provides 3D virtual restorations of information necessary for understanding court painting and supports historical context experiences of royal events.

[5] A mobile Augmented Reality platform aimed at training first and second year STEM majors, specifically focusing on the identification and usage of laboratory instruments. The platform addresses challenges faced by students in introductory STEM courses and utilizes computer vision and augmented reality technologies to create an engaging and learner-centric teaching environment.

[6] The Brake operating unit (BOU) of a railway vehicle is one of the important systems for controlling the braking of the train. Because this system uses compressed air, it is difficult to understand and train the system. The existing education method involves learning the pneumatic flow of various control air in a 2D pneumatic circuit diagram based on a maintenance manual. However, in the actual braking system, it was difficult to learn effectively because the air flows in 3D. In order to solve these problems, the improvement of the training technique using the new 3D augmented reality (AR) was performed. In this study, to increase the learning effect of air brake flow, a technique for simultaneously displaying the pneumatic flow in 2D circuit diagram and 3D model was proposed.

• Markerless AR:

In Markerless AR we don’t need to use specific markers to trigger the digital content. This is the modern method for seamless AR via Mobile App or Web AR. A processor, GPU, display, camera, velocity and accelerometer support it. Markerless AR types are location-based AR for placing virtual objects in specific physical locations, projection-based AR for placing digital content onto physical objects, and contour-based AR uses computer vision algorithms to detect and track real-world contours overlaying digital content onto them.

Augmented reality is different from virtual reality. Virtual Reality creates a complete virtual world using a virtual reality headset.VR is used in video games, and education for medical, safety or military training. Placing the display close to your eyes feels like looking at a giant screen. Whereas Augmented Reality combines both digital elements and the real world.

II. OBJECTIVE

The objective is to investigate the potential of Augmented Reality (AR) technology as an innovative and effective tool) for enhancing the learning experience in the field of computer networks. The primary goals of this research are as follows:

• Assess the impact of Augmented Reality (AR) on computer network learning outcomes.

• Use WebAR to enhance training and education in computer networking by creating an interactive learning experience

• Explore how Web AR enhances student engagement, motivation, and interest in the subject.
• Offer interactive lessons, simulations, and notes that help users understand protocol concepts, behavior, and implementation.
• Analyze AR's role in developing problem-solving skills among students.
• Evaluate the user experience and usability of AR tools in network education.

III. METHODOLOGY

In this research project, we aimed to develop a platform for students and teachers focusing on computer network protocols.
• Our Project aim is to provide comprehensive experience with computer network protocols.
• Utilizing the framework model-viewer as Web AR (Augmented Reality) we created a platform for users to explore computer network topics.
• We integrated theoretical knowledge of computer network protocols with practical applications through AR Simulation.
• The target audience is students and teachers for educational and learning purposes. During the development phase, we identified computer networking protocols to be covered.
• Designed the network on Cisco Packet Tracer.
• Gather the .GLB (Graphics Library Binary) format models from third-party platform Sktechfab.
• Selected .glb models to represent network components switches, routers, personal computers, servers, etc.
• GLB models are 3D models saved in a single binary file format called GLTF Binary. They're efficient, portable, and widely compatible, making them ideal for use in various applications, including web-based experiences and AR. Created design of the network protocol using HTML (Hypertext Markup Language), CSS (Cascade Stylesheet), JS (Javascript), Bootstrap framework, and Model-viewer framework.
• Model-viewer provides tools and functionalities to easily integrate 3D models into AR experiences. Model Viewer: This component handles the rendering and display of 3D models in the AR environment. It may include features such as model loading, mesh optimization, animation support, lighting, and interaction handling.
• Utilized the Web AR technology to develop an interactive AR experience accessible through a web browser.
• Integrated Google's model-viewer library to render 3D models within a Web AR environment.
• Implemented packet flow simulation to visually demonstrate how packet flows for a particular computer network protocol.

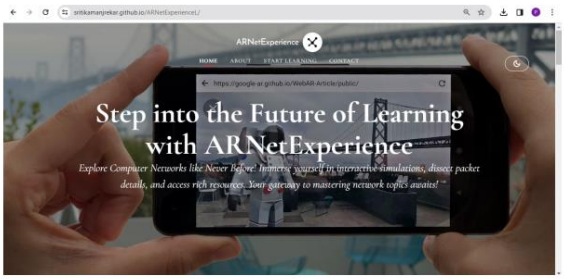

Fig. 6. AR Learning Application for Computer Network

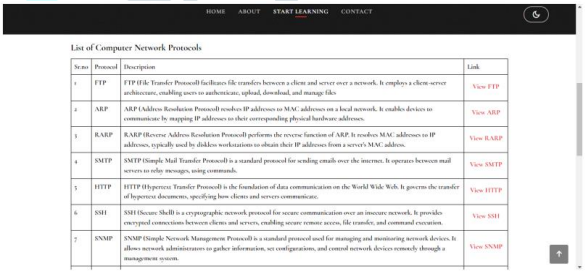

Fig. 7. Computer Network Protocols Page

IV. RESULT AND DISCUSSION

In this method, Augmented Reality requires a Web-AR. Web-AR enables users to experience augmented reality (AR) content directly through web browsers without requiring separate apps or downloads, expanding the accessibility and usability of AR technology. The protocols that we have worked on are HTTP, SMTP, ARP, RARP, FTP, SSH, SNMP, BGP, DHCP, etc.

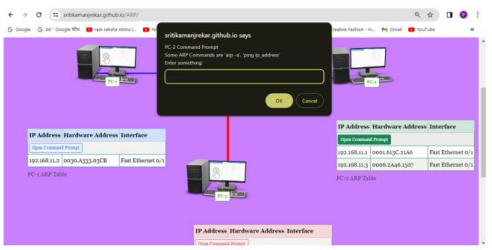

Fig. 8. ARP Command Prompt

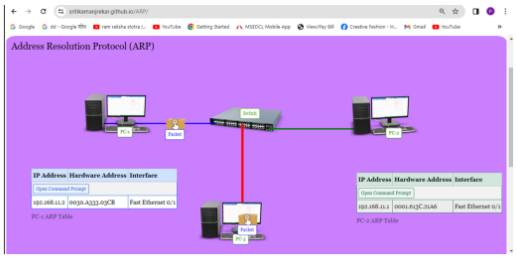

Fig. 9. ARP Packet Simulation

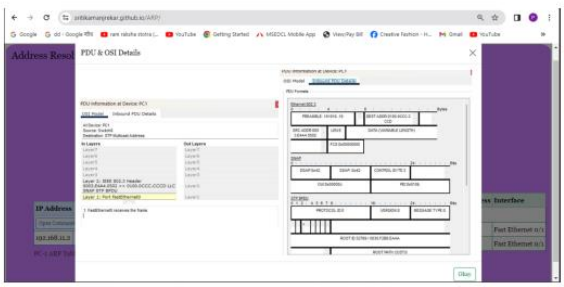

Fig. 10. ARP OSI & PDU Details

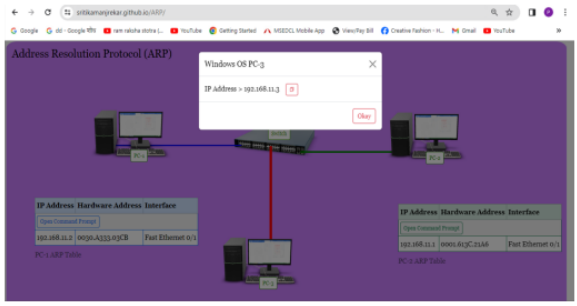

Fig. 11. ARP PC IP Address

The components used in this AR application are Personal Computers, Routers, Cables, Servers, Laptops, and Switches Fig. 1.

1. Sever: Servers facilitate centralized access to resources and services, such as file storage, application hosting, and security management within a network.

Personal Computer (PC) and Laptop: Personal Computers and Laptops act as client devices within a network, accessing and utilizing resources and services provided by servers and other network devices.

3. Router: Routers direct network traffic between different devices and networks, enabling communication and ensuring efficient data transmission.

4. Switch: Switches facilitate direct and efficient communication between devices within a local network by forwarding data packets only to the intended recipient.

5. Cable and Wire: Cables and wires physically connect devices within a network, facilitating the transmission of data signals between them.

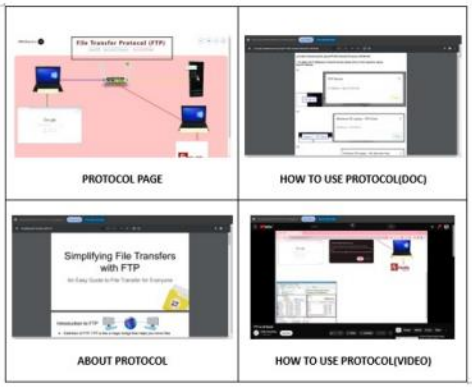

Fig 13. Web AR Learning Application for Computer Network Protocols

1. About Protocol: This section provides a concise overview of the protocol's fundamentals, offering insight into its purpose, structure, and key features.

2. How to Use: The "How to Use" documentation outlines step-by-step instructions on implementing the protocol in document format, facilitating users in understanding and applying its functionalities effectively.

3. How to use Protocol Video: The video demonstrates simulated networking protocols, providing a visual guide on how to utilize the protocol effectively in practical scenarios. Fig. 13.

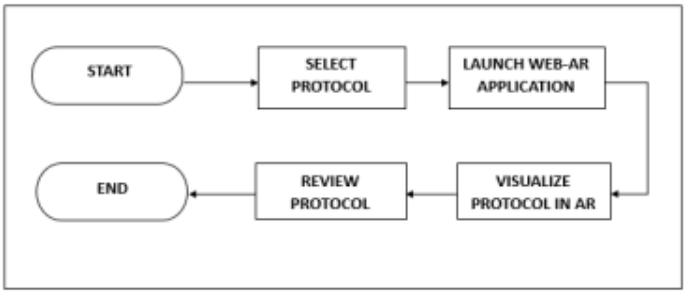

Fig. 12. Flow Chart of ARNetExperience

Augmented Reality system design can be seen in Fig. 12.

1. Initiate your learning journey by clicking on "Start Learning."
2. Choose the specific protocol you wish to simulate.
3. Launch the Web AR application for seamless integration.
4. Experience the visualization of your selected protocol in Web AR.
5. Conclude by reviewing and consolidating your understanding of the protocol.

V. CONCLUSION

This application is developed to assist target audiences such as teachers, students or people interested in Computer networks to understand basic computer networking protocols with features, providing learning content such as viewing computer network devices directly through a combination of virtual worlds using Web Augmented Reality. Through a smartphone device or on a personal computer having the latest internet browser it can be accessed easily and interactively. It contains basic material about Computer Network protocols such as File Transfer Protocol (FTP), Hypertext Transfer Protocol (HTTP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), Simple Mail Transfer Protocol (SMTP), Broader Gateway Protocol (BGP), Secure Shell Protocol (SSH), etc and web augmented reality which displays network devices along with concise information such as Routers, switches, servers, personal computers, laptops, etc. Then the appearance of the 3D object mode, the description of its specification, and supporting video showing a simulation of the concept

VI. Future Scope

Looking ahead, augmented reality in education presents numerous opportunities. Future research will focus on refining gamification-based networking protocols and learning experiences to further engage students. This includes integrating dynamic elements such as quizzes, challenges, and rewards into a gamified classroom setting. Reward systems may include virtual badges, points, or rankings to incentivize participation and achievement and healthy competition among students. Moreover, there is potential to explore personalized networking learning experiences within augmented reality environments, tailoring content and interactions to individual student needs and preferences. Additionally, advancements in augmented reality technology may lead to the development of collaborative learning experiences, allowing students to interact and collaborate in virtual spaces, regardless of their physical location. Strategies may include creating immersive scenarios where students can apply learned networking protocol concepts in simulated real-world situations, making learning more interactive and practical.

VII. Acknowledgement

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