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Impact of Interpretation Skills in Geography through Augmented Reality Integrated with Chatbot

Anireddy Srilakshmi
Chitkara University Institute of Engineering and Technology, Chitkara University
Punjab 140401, India
Srilakshmi.anireddy@gmail.com

Archana Mantri
Chitkara University Institute of Engineering and Technology, Chitkara University
Punjab 140401, India
archana.mantri@chitkara.edu.in

Deepti Prit Kaur
Chitkara University Institute of Engineering and Technology, Chitkara University
Punjab 140401, India
deeptiprit.kaur@chitkara.edu.in

Abstract— Technologies like Augmented Reality (AR) and Artificial Intelligence (AI) like Chatbot are widely used in people's lives and work, especially to motivate, collaborate and improve learning skills. Numerous applications have been created to meet needs for daily life and learning as a result of the rising study into the use of augmented reality and artificial intelligence in education. AR is a technology used for better visualization, and a chatbot application developed with AI is used for assistance at any time. Integrating AR and Chatbot would impact increasing the student learning experience in the geography compared to the conventional approach. To support this, a pilot study was conducted for 30 middle school students to study the impact of integrated AR-AI applications on the student's learning experience in understanding geography concepts.

Keywords-: Augmented reality, Artificial Intelligence, Geography

I. INTRODUCTION

Augmented Reality (AR) is an interactive and immersive experience that blends computer-generated content with the real world. Through a combination of sensory modalities such as visual, auditory, haptic, somatosensory, and olfactory, AR creates a seamless integration of virtual objects into the physical environment [1,14]. Unlike virtual reality, which completely replaces the real world with a simulated one, AR overlays digital content onto the real world, allowing for real-time interaction and accurate 3D registration of virtual and real objects. This unique fusion of virtual and real worlds in AR alters the user's perception of their environment, providing an enhanced and interactive experience that is seamlessly integrated into their surroundings [2,14].

A. Augmented Reality and artificial intelligence in education

Augmented Reality (AR) and Artificial Intelligence (AI) are related technologies that developers combine to establish different experiences. AR is an experience that combines both physical and digital environments. It is the technology that allows adding virtual elements to an actual image visualized by an electronic device. For this, codes are usually used to project a virtual image onto an actual appearing image by creating a transformed reality when focused through an electronic device [11,15]. AI is the usage of machines and computer systems to simulate human intelligence. AR in geographical education is a part of emerging pedagogies [12]. Integrating AR with AI enables the devices to adjust to new inputs, learn from experiences, and perform human-like tasks. The innovations in technology have bought significant changes in classroom pedagogy that would help students to learn abstract concepts, such as Geography [13].

B. Augmented Reality in Geography

Understanding and interpreting maps requires the application of spatial reasoning and thinking. The ability to use geographic maps effectively is one that students must master. It has been discovered that students' use of maps to describe and analyze natural events in order to identify answers to geographical challenges, however, is insufficient. Students can learn geography while exploring geographical locations virtually, superimposing virtual maps onto real-world scenes, visualizing

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landforms and terrain, observing climate and weather patterns, analyzing population and demographic data, studying environmental changes, taking part in virtual field studies, and more through use of augmented reality (AR).

II. LITERATURE SURVEY

The survey includes papers on Augmented Reality and Artificial Intelligence in Education from the last 5 years. The literature study from Table 1 shows that many applications developed in AR and AI enhance students' learning skills in various fields. However, the usage of visualization tools in the field of geography is less. The students are facing trouble understanding the abstract concepts of geography, where visualization is really required.

TABLE I: RESEARCH STUDY FROM PAST 5 YEARS

Reference Number	Author	Methodology	Limitations/conclusion
[1]	Archana Rane, Varun N John, Sahana Murthy	Web application developed using UI/UX (ADOBE XD)	Similar to Traditional learning. Not an AR based application
[2]	Nafisat A.Adedokun-Shittu, Adedeji Hammed Ajani, Kehinde Muritala Nuhu & AbdulJaleel Kehinde Shittu	Augmented reality instructional tool **(**ARIT**)**	Limited to selected concepts in Geography
[3]	Tamara L. Shreiner & B.M.Dykes	Tested with different set of questionnaires on data visualization on teachers as well as students.	Tested only with few people with random dataset.
[4]	E.Kasthuri, Dr.S.Balaji	Data Preprocessing Lemmatization Word Pickle	Can answer limited questions
[5]	Shubham Gargrish; Harun; Leeza Sharma; Bhanu Sharma; Neha Tuli; Manisha Pathania	This article discusses the steps involved in building and designing a smartphone app for a physics experiment that makes use of augmented reality technology. This mobile-based AR software for Physics Experiment's ultimate objective is to disseminate rigorous knowledge in addition to conventional practices and learning tools.	The experiments that will be shown in ElectroAR include a number of topics. An expert review is conducted to evaluate input. In the future, ElectroAR will be evaluated by users in actual classroom environments.
[6]	Vahldick, A., & Bittencourt, D. L.	For pupils in IX class, an app to explore Africa's geography	Absence of text or voice descriptions for the models utilized, etc.
[7]	Malek El Kouzi; Abdihakim Mao; Diego Zambrano	They have created an interactive application that transforms a paper-based, 2D human skeleton model into a virtual, 3D model that learners are able to interact using a tablet.	Only one School was used for their user research. In order to hold the tablet and touch the bones at the same time, the pupils had to take more time.
[8]	A. A. Ayub; M. B. Othman; Nan M. Sahar; M. S. M. N. Azni; M. A. Ilyas; M. B. Jaafar	The primary children who are being known to as remedial students in the Remedial Education Programme (REP) and who have selected the consonant vowel consonant (KVK) module are the subject of this project. The Unity Real-Time Development platform (Unity 3D) and Vuforia were used to construct the AR application education platform apps.	Only remedial pupils who struggle to spell, read, and pronounce the KVK should use this app.

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III. TOOLS AND TECHNOLOGIES

The software tool needed to build this AR application are Unity. Unity is a game engine that uses 3D models designed to create the application with real-time rendering. AR-core is a Software Development Kit (SDK) that supports different operating systems. 3D models can be designed using Adobe Photoshop or external digital media software like Turbos quid. The software used to develop 3D models is Unity and it supports different platforms like Windows, Linux, and Mac. The tool supports many features like 3D world building, AR, VR, Gameplay, Cinematic studio and Engineering feature set.

IV. METHODOLOGY

The primary framework will be put into place using Unity 3D, with assistance from the AR-Core used to create Android AR applications and chatbot will be integrated with the application for better assistance. 3D model of India was created using the unity software, along with 3D models that were downloaded from several open-source source websites. There are three basic stepsas shown in Figure 1 that make up the technique:

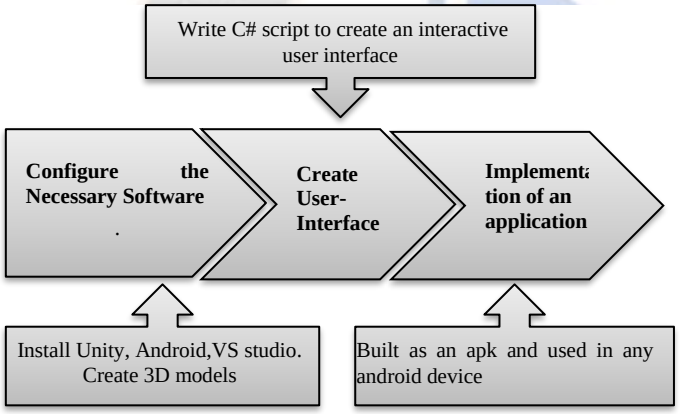

Figure 1: Methodology

A. Configure the Necessary Software

The setup of the Unity game engine is the initial phase in this project. This phase entails establishing a Unity project and deciding which android, iOS, etc. platform to support. Since the majority of Android mobile phones were produced `in 2017 and later operate on that level of software, Android 7.0 "Nougat" (API Level 24) is strongly recommended.

B. Create User-Interface

Next step in the project is to create the user interface (UI) for the application. The UI is developed using Unity itself. The application displays the Indian map where the map is scalable to different sizes based on the screen resolution of the android mobile. We can rotate the 3D model around 360 degrees. The sliders and scalars are designed using UI module found in unity software. The buttons are coded using C# script to perform their functionality.

C. Implementation of an Application

The main step in developing the application is to display the text when we click on any state on the map. This is implemented using the help of buttons and colliders which are available with Unity software. The buttons are coded using C# scripts to display text when clicked on the 3d model with help of ray cast manager module found in ARCore.

V. SYSTEM ARCHITECTURE

The application that is built first loads the Indian 3D model. Once the model is loaded, we can scale and rotate the 3D model to fit the 3D model to the resolution of the mobile used by the user. The Unity software is used to develop 3D models as per the requirement and it also supports the adjustments required for mobile display.

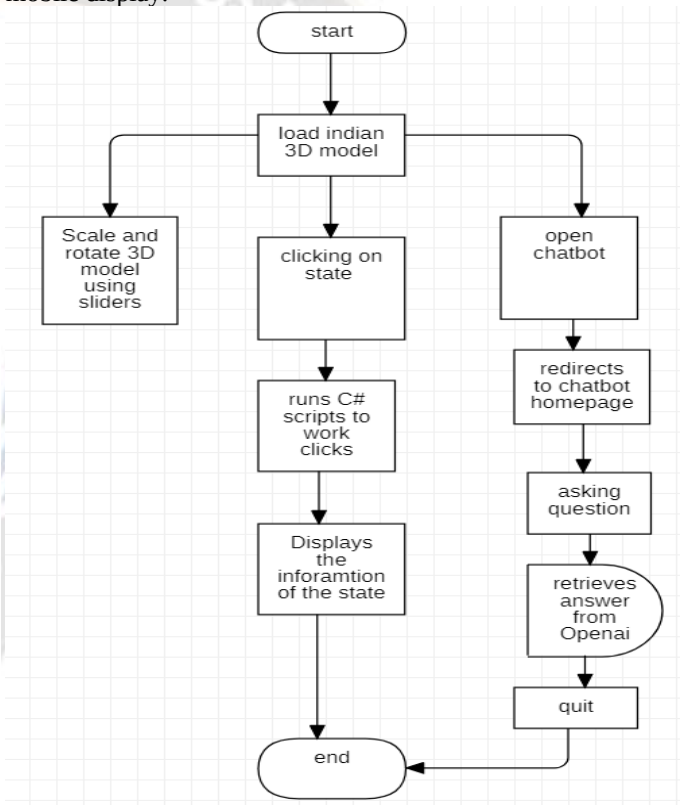

Figure 2: Workflow diagram of the project

A 3D Indian map is developed with all states, each state shows information of land, water and soil. An application can be used through mobile, and it is an interactive application. The student can click on particular state to view the information. If we open the application, it shows an Indian map with all states and its boundaries, if we click on any state within its boundary it triggers the script and display the details of that particular state. The details include the overview information of land, soil and water of that state.

If any student wants to learn more information about any particular state, here the AR-AI application integrated with a chatbot acts as assistance in the absence of the teacher. It gives the answer for the question asked. It helps the students to learn more information and upgrade their knowledge and for slow

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_ learners it acts as a guidance to clarify their doubts at any point of time.

VI. Application Framework

The project is developed using Unity engine. Figure 3 shows the unity software interface and implementation of the Indian 3D model. Each state in the Indian 3D model will act like a clickable object as shown in Figure 3 where if we click on any state the application shows the information of that state. Each state is colored to distinguish it from other states.

Figure 4 shows the mobile application interface. After installing the mobile apk in Android, the application asks permission for camera access. The application loads the Indian 3D model as shown in Figure 3. The sliders at the bottom are used to scale and rotate the 3D model. Each state is a clickable object as shown in Figure 3. When we click on any state the application displays the information of that state

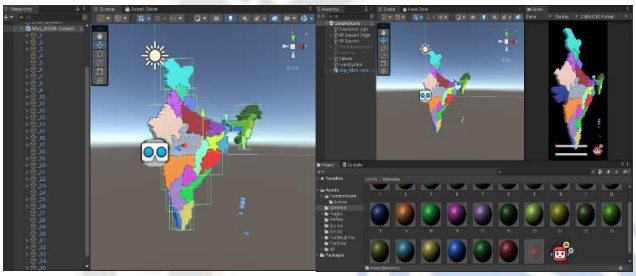

Figure 3: Developing AR application in Unity

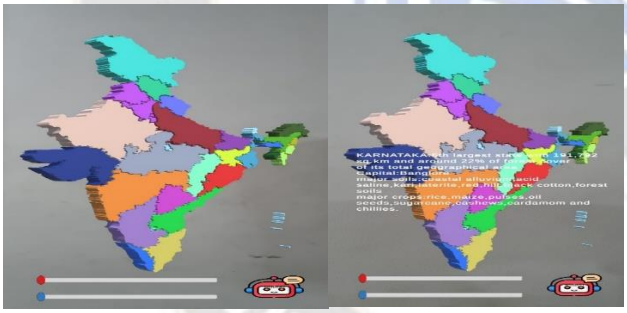

Figure 4: Mobile Application Interface

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VII. Application Implementation and Results

The application is demonstrated for a sample size of 30, initially a test is conducted to check their spatial ability skills.

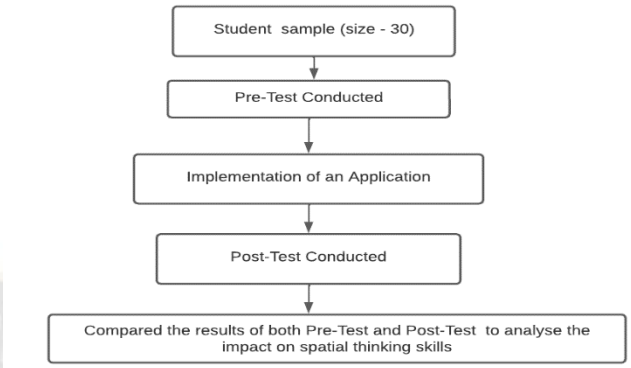

Figure 5: Flow Chart for Analyzing the Results

After explaining the concepts by using AR-AI application one more test is conducted and their results are compared to check their impact on their learning skills as shown in Figure 5.

The pre-test is conducted for a sample number of students 30 in size to check their spatial ability skills. The AR-AI application is demonstrated for middle school students by explaining the geographical concepts and making them understand the abstract concepts. The post-test was conducted on the same sample of students to check the impact of spatial ability skills.

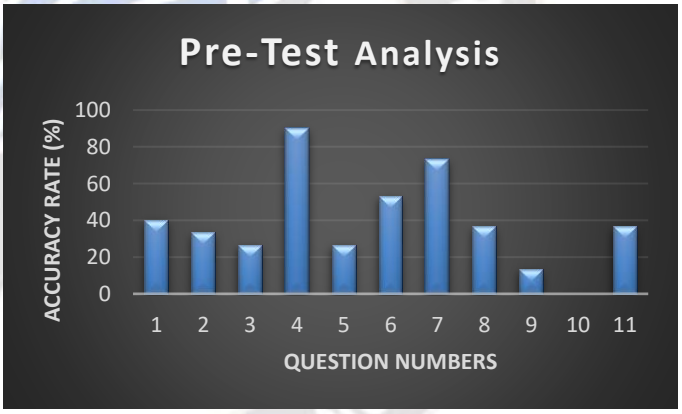

Figure 6: Pre-Test Analysis

The pre-test gives the student analysis of their prior knowledge. The questionnaire contains a total of 11 questions and Figure 6 shows the analysis of each question answered by the students in terms of percentage.

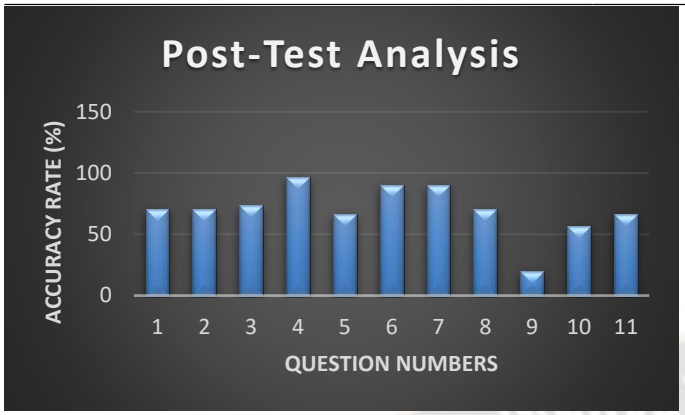

Figure 7: Post-Test Analysis

The post-test analysis from Figure 7 shows an improvement in students answering each question, it gives the positive impact that AR-AI application improves the learning skills and spatial ability skills in understanding the abstract concepts of geography.

VIII. CONCLUSION AND FUTURE SCOPE

An AR-AI application is designed, developed, and implemented for middle-school students to enhance their spatial thinking ability and interpretation skills in understanding the concepts of geography. The AR-AI application provides an interactive and immersive learning experience to middle-school students and their results show a positive impact in understanding the abstract concepts of geography. The main aim of this application is to provide an interactive and engaging platform to learn and understand complex concepts with greater ease and enjoyment. The participants' responses and feedback confirm that the present application is useful as an instructional tool for teaching geography and is an effective learning tool for students to understand information on land, water, and soil in a geographical area. The future work would involve the design and implementation of AR-AI based application for visualization of more complicated geography concepts, such as the structure of atmosphere, agriculture, minerals, etc. which the students really find difficult to visualize and understand.

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