

Exploring the Opportunities and Challenges of Adopting Augmented Reality in Education in a Developing Country

Adnan Sharif¹, Fahim Anzum², Ashratuz Zavín, Sayma Alam Suha, Anika Ibnat, Muhammad Nazrul Islam³

Department of Computer Science and Engineering
Military Institute of Science and Technology (MIST)
Dhaka-1216, Bangladesh

Email: ¹adnan.sharif.mail@gmail.com, ²anzumbivor@gmail.com, ³nazrulturku@gmail.com

Abstract— Augmented Reality (AR) is one of the emerging advanced technologies which bridges the gap between the real and the virtual worlds, that gives students prodigious possibilities to learn the information in a completely unique way. With the rising use of personal smart devices in this modern era, the vast potentials of AR have begun to be explored as the smart devices are capable of producing AR environments. In this paper, we have conducted a survey with the purpose of exploring threats and possible opportunities of adopting AR in education in a developing country like Bangladesh. Data analysis and outcomes of the survey demonstrate that lack of expertise, adoption of AR in rural area are the main challenges while increased focus and satisfaction in learning, increased accessibility of AR applications in our smart devices with 4G evolution are the opportunities of adopting AR in education sector of a developing country.

Keywords—augmented reality; adoption in education; developing country; smart devices; challenges and opportunities

I. INTRODUCTION

Augmented reality [1] is related to a more general concept called mediated reality, in which a view of reality is modified by a computer. This brings out the components of the digital world into a person's perceived real world. The surroundings of the user become interactive and digitally controlled with the help of advanced AR applications. There are different types of AR devices such as Head Mounted Display (HMD) [2] which is a display device, worn on the head or as part of a helmet. Head Wearable Displays (HWDs) [3] are developments of HMDs and tend to be smaller, more refined design. Finally hand held devices [4] are perhaps the fastest growing area of AR.

Learning through AR may promote student-teacher interaction and enhance students' satisfaction with the learning experience. It may also develop oral communication skills, social interaction skills and may encourage diversity understanding etc. Presently, AR is used in different mobile apps [5] related to games, education etc. Therefore, the objective of this paper is to explore the fundamental disputes and possible opportunities of AR adoption in education by the users of a developing nation like Bangladesh. To attain this objective, we conducted a survey where a total of 185 responses were collected and the survey data were analyzed using the statistical approaches. After analyzing the data, we got the insight about AR adoption in education.

Later sections of this paper are arranged as follows. Section II gives the idea about the related works on AR tech-

nologies and its impact on education. Section III represents the research methodology that we followed. Data analysis and results of the survey are shown in Section IV. Finally, Section V concludes the paper with discussion and future extension of the current work.

II. RELATED WORKS

This section will briefly discuss some learning experiences and benefits of deploying AR technology in certain sectors like education, gaming, medical, entertainment etc.

A study conducted by Agarwal et al. [6] presented the evaluation of current practices and past researches on AR and the encountered problems with proficient ways to overcome them. Santos et al. [7] discussed the progress in real-time tracking, graphics rendering and AR authoring tools that are already usable in educational context. In another study, Dunleavy et al. [8] focused on AR technology for learning that utilizes smart devices to enable participants to interact with digital information embedded within the physical environment. Some studies highlighted that, though AR technology is frequently used, educators often remain unclear regarding educational values of AR applications [9], [10]. However, Yuen et al. [11] considered five directions of AR in education to elaborate the possible benefits. Kaufmann [12] presented an example of collaborative AR application called Construct3D which was designed for mathematics and geometry education. In another study, Bower et al. [13] reviewed uses of Augmented Reality both in mainstream society and in education.

A study conducted by Neha et al. [14] showed that Indians have focused on generating adversity of AR features in mobile android based applications and marker-based library applications. They added augmented 2D or 3D effects, videos in number of apps like custom AR effects, 3-D space etc. In Bangladesh, 'Rise Up Labs' recently released an AR application entitled "1952-History of 1952 in Augmented Reality" [15]. The application makes people enlightened about the history of the language movement and martyrs of 21st February.

In sum, though AR projects are being used in education sectors of many developed countries, it is not yet expanded in developing countries. Therefore, this paper is aimed at exploring the factors like opportunities and challenges regarding augmented reality adoption in education sectors of a developing country.

III. RESEARCH METHODOLOGY

Our research methodology consists of generating survey questions, collecting survey data from student respondents of different educational backgrounds and then analyzing respondents' answers and opinion towards those questions. The survey was started at the beginning of April, 2018 and three weeks were given for the response collection. It was conducted at several colleges and universities followed by distributing the survey through mails and social media. The confidentiality of the respondents was assured. We selected total 19 survey questions related to biography, opportunities and challenges (shown in the Appendix) of AR adoption. There were two open questions to find out other possible opportunities and challenges and all other questions were closed questions which were asked to rate (except biographical questions) into a scale of 1 (strongly disagree) to 5 (strongly agree). After the survey period, we found total 185 successful responses that we considered for the data analysis and result later on.

IV. DATA ANALYSIS AND RESULTS

Total 185 responses were collected from university students (127 from Bachelors program and 22 from Masters program) and college students (total 36). Total 44 respondents were aged below 20, 124 respondents were in between 20 to 24, and others (total 17) were above 24. Total 110 (59.5%) respondents were male, 71 (38.4%) were female and other 4 preferred not to disclose their gender. Most of them (total 110) used smart devices more than 3 hours a day, 69 respondents used less than 3 hours a day and other did not use any smart devices. Most

of the respondents (about 68%) knew about AR before this survey and others got informed about AR through this survey.

We asked the respondents to rate total six statements related to opportunities of AR adoption. Most of the respondents (94 agree, 65 strongly agree, 10 neutral, 5 disagree and 11 strongly disagree) think the idea of making smart devices a beneficial medium will be fruitful. Figure 1 shows that most of them are thinking positive about 4G evolution towards AR. The respondents also think (on average 90 agree and 53.33 strongly agree) that AR application will improve learning experience through visualization, lower the learning complexity and make typical academic process more playful and effective. Figure 2 shows that 87 of the respondents agreed while the second highest number (total 45) of people remained neutral on using AR to increase concentration and satisfaction.

We also asked them to rate some specific challenges of AR adoption. A total of 88 agree and 41 strongly agree responses symbolize that lack of expert is the most challenging fact for AR adoption in education shown in Figure 3. The respondents also showed their consent to shortage of knowledge, bear the expenses and accessibility of internet as possible challenges of AR adoption. But a mixed response is received for affordability of smart devices. However, total 61 agree, 50 neutral and 49 disagree responses show that this might be a less important challenge. Like previously, we then asked them to rate five statements. They disagreed (on average 79 disagree and 24 strongly disagree responses) on the statements of students not being able to adopt this process and it being difficult for them to use. On the other hand, total 66 agree,

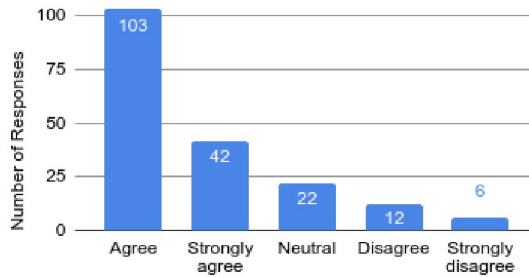


Fig. 1. Respondents' opinion about increasing the accessibility of AR applications in our smart device with 4G evolution

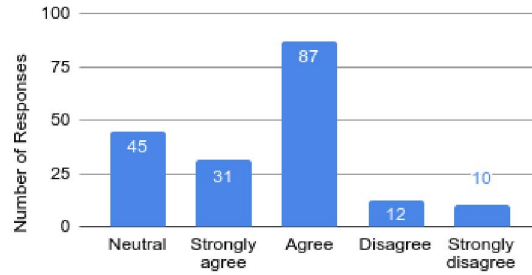


Fig. 2. Respondents' opinion about increasing the concentration and satisfaction in the study with AR applications

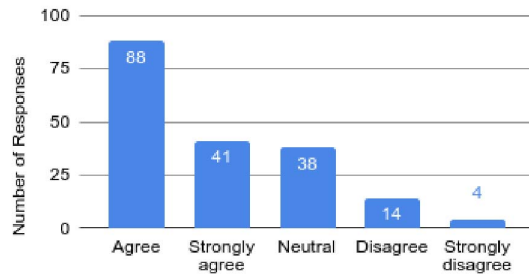


Fig. 3. Participants' opinion about finding lack of expert as one of the biggest challenges in AR adoption

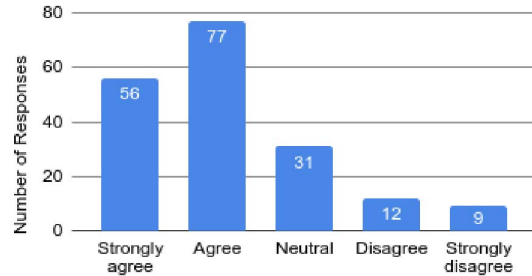


Fig. 4. Participants' opinion about finding AR adoption difficult for people of rural area

43 neutral and 43 disagree responses indicate that most of them think that adopting AR in education will be difficult with existing teaching method. Moreover, adoption of AR will be difficult for the rural people shown in Figure 4. Most remained neutral (69 responses) to the opinion of using smart-phone as a medium device of AR that will make students reluctant to their study and hamper their learning.

We have also taken open answers from the respondents where some anticipated that AR could be a great medium of learning for medical students and handicapped. However, some of them think that it would take time and bearing the expenses would be challenging in the adoption of such new advance technology.

V. DISCUSSION AND CONCLUSION

In this paper, we emphasized on finding the opportunities and challenges of adopting AR in education in developing countries where in most places traditional tools and methods are used for educating students. Research results showed that although recent advancements in smart devices, faster internet usability, 4G evolution and effective learning experience are the key opportunities in AR adoption, lack of sound technical knowledge, financial crisis, traditional education system may hinder the process.

The primary limitation of the study is that the results are presented based on limited data and domain (student participants). However, for more precise observation, this research can be further extended by surveying in broader domain including students, teachers and parents so that considerable responses can be recorded and more accurate results can be determined.

Though AR is not exactly a new technology, but in education it has just started its run. With this technology it is possible to overlay reality with a context sensitive virtual world that gives numerous possibilities for educators to enhance the learning experience. By proper adoption of AR, students will be more motivated, classes will be more interactive and learning will be more playful.

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APPENDIX

QUESTIONNAIRE FOR THE SURVEY

Your education level
Your age range
Your gender
How often do you use your smart device?
How did you come to know about Augmented Reality (AR)?
How would you rate the following statements in context of opportunities of AR adoption <ul style="list-style-type: none"> • The idea of making our smart devices (mobile phones, tablets) a beneficial medium of learning would be great • 4G evolution would increase the accessibility of AR applications in our smart device • Visualizing the reality through AR applications would improve our learning performance/experience • Using AR application would lower the complexity of learning tasks by making the content more interactive • AR applications would increase our concentration and satisfaction in the study • Learning through augmented reality can make the typical academic learning process more playful and effective
How would you rate the following challenges of AR adoption in education: <ul style="list-style-type: none"> • Lack of expert • Shortage of knowledge • Bearing the expenses • Lack of resources • Affordability of smart devices • Accessibility of internet
How would you rate the following statements in context of challenges of AR adoption <ul style="list-style-type: none"> • Students from any education level (school, university) would not be able to adopt this process effectively in their learning • AR would be difficult for students to use • It would be difficult to adopt AR in education with our existing teaching method/curriculum • It would be difficult for people of rural area to adopt AR • Using smartphone as a medium device of AR would make students reluctant to their study and hamper their learning