Mobile Phone Augmented Reality for Physics Experiments

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ABSTRACT

The laboratory experiments are performed aiming increasing the understanding of subjects among the learners. But sometimes the abstract nature of learning content and accumulated difficulties may hinder the visualization of concept and thus demotivate students. Besides, the conventional technique of experiments needs dedicated laboratory equipped with proper apparatus, maintenance of laboratory materials, etc., which results in high cost in addition to certain time constraints. The inclusion of technologies and hand-held devices in Physics experiments may motivate the students in learning and enhancing their critical thinking abilities [1].Mobile phones are the universally welcomed device by present generation. The intervention of mobile phones in academic sector may provide practical and cost-effective solutions to the students in learning and understanding content in interesting manner to motivate them. The use of internet and mobile provides flexible learning environment beyond the conventional approaches limited by location, space, place, cost and time constraints. The augmented reality (AR) is the technology which allows multimedia content mixed into humans' perception of the real world. Augmented reality is though associated with expensive hardware with different processing capabilities and compatible software. But with recent advancement in mobiles and tablets technologies provide huge potential to implement AR in cheaper way to everyone. Mobile phone operating systems especially Android and IOS are providing location-based AR applications to the users which have effectively exploited by various researchers in

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Geology, Geography, Civil Engineering and many other experimental applications[2-4]. The number of possible educational benefits regarding the use of AR is related to;being safer and cheaper to reproduce and virtual objects that can easily be animated. Mobile AR providesthe opportunity to construct independent learner experiences based on their priorknowledge in the respective subject matter. These types of learning may develop activeparticipation during indoor and outdoor learning activities.

Augmented Reality and its working

In terms of used technology, augmented reality can be said to require the combined real and virtual world in addition to be interactive in real time. Augmented reality is the technology, which mix virtual content into the real-worldenhancing the user's perception and to improve their interaction or to assist them during the execution of specific tasks.

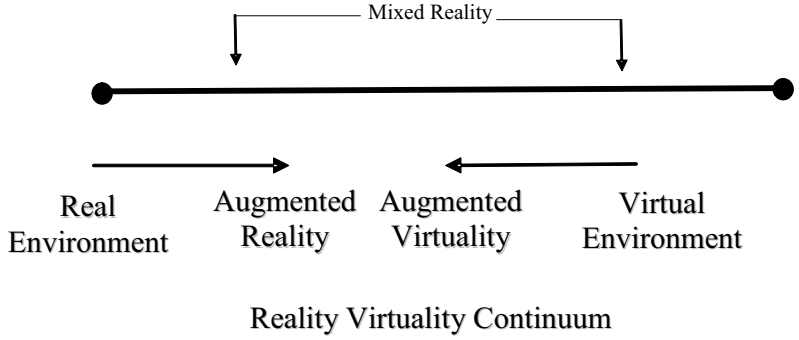

Fig. 1: Simplified representation of an metaverse continuum

The fundamental idea of AR is to combine or to mix the view of the real environment with additional virtual content. This virtual content can appeal to different senses such as sight, hearing, touch and smell. To connect virtual content to the real world, a computational device is needed. This device provides a window (display) through which the physical world can be seen. For the virtual components to become visible in this window, as an augmentation to reality, a software application on this device is needed as well. There are many different hardware devices that can be used for AR. The most commonly used is a hand-held device like a smartphone or a tablet. Smartphone learning grows in formal and informal educational landscape whereby smartphone Augmented Reality merges both learning environments. Smartphone AR concepts are superimposing digital information on real environmentand enhances the interaction between virtual environment and real environment. Besides that,

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Smartphone AR provides opportunity for students to practice 21st century pedagogy skills such as of (i) constructing own learning, (ii) student-centred learning, (iii) ubiquitous, (iv) cultivating critical, creative and higher-order thinking, (v) meaningful use of technology and (vi) gaining wide knowledge. Previous studies have proven that about 30% of teaching influences the students and the other 70% depends on the factors beyond teacher's control such as student's ability, prior preparation, value systems and personal considerations. On the other hand, it suggests that teachers can only filter, highlight, provide guidance, and always encourage students, but at the end, it is up to the learner's representation that determines the learning performance.

Table 1: Conventional experiments Vs Smartphone AR experiments

Parameters	Conventional Experiments	Mobile AR Experiments
Time	Limited	Unlimited
Location	School Lab	Anywhere/Everywhere
Finance	High Cost	LowCost
View of Content	90^0	360^0
Availability of Content	Limited	Unlimited
Type of Experiments	Non-Hazardous	All types

Table 1 attempts to compare conventional experiments and Smartphone AR experiments. Conventional experiment takes place in school laboratory within the allocated time and may suffer high expenditure in cost to provide complete materials as well as apparatus. The cost is probably higher due to the maintenance of laboratory materials under time limitation. Meanwhile, smartphone AR experiments may take place anywhere and anytime.There is also lesser need to upgrade laboratory materials and apparatus and under no time frame. Conventional experiment provides 90 to content viewing while mobile AR experiment may provide 360views. Besides that, the availability of conventional experiment is only available during school hours and it is only allowed to practicenon-hazardous experiments. Whereas, smartphone AR experiment provides the opportunity to repeat the same experiment as much as one wants until one really understands it and practice may resume over either hazardous or non-hazardous experiments.

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Mobile Phone Augmented Reality for Physics Experiments

Augmented reality has huge potential and benefitsto improve user interface technology, frombasic schooling to university education. Through embedded markers, various graphics, video and audio etc can be superimposedinto reading material. Beside it,books supporting augmented reality can never be outdated as augmented information can be updatedfrom time to time. Augmented reality enables layers of digital information to be displayed on top ofthe physical world that can be viewed through smart-glasses, tablets, and smartphones. Augmented reality is a great interface for this because it can quickly bouncearound many types of media such as detailed diagrams, engaging graphics andinteractive maps.There are numerus software and platforms available on Android, IOS and Windows to support educational activities including simulating and performing science experiments[5-8].These Augmented reality mobile applicationsallow the students of viewing the scientific experiments at any time and in any place, which supports the education and make the studying more fun and easier for better understanding [9-10].

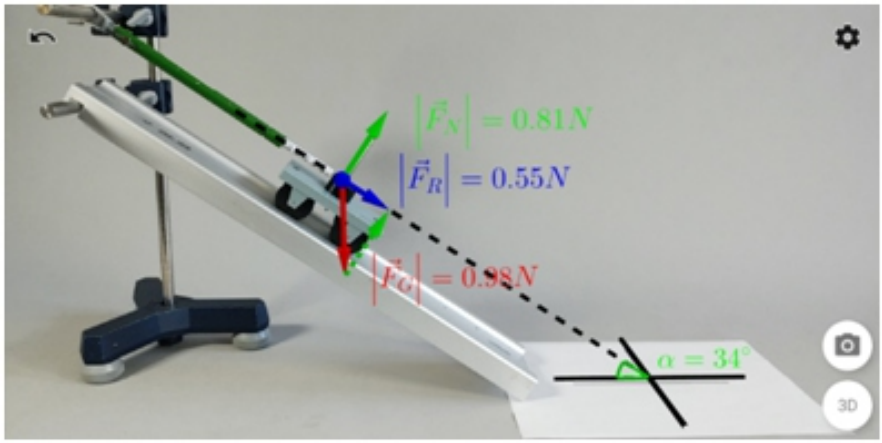

Figure 1: Experimental setup viewed through a smartphone during an AR experiment concerning forces on inclined planes

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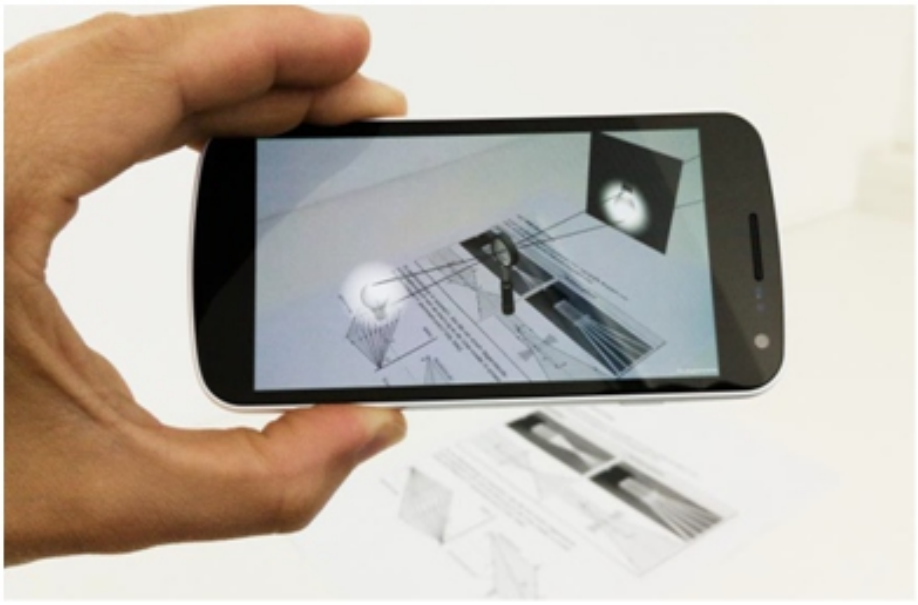

Figure 2: AR lens experiment running on a smartphone

Conclusions:

Researchers have applied mobile phone AR for learning subjects like Chemistry, Mathematics, Biology, Physics, Astronomy, and to adopt it into augmented books and student guides. By augmenting the real world with virtual information utilizing mobile phones, Augmented Reality (AR) provides new possibilities for education.AR allows flexibility in use and can be utilized through a variety of mediums including desktops, mobile devices and smart phones. The technology is portable and adaptable to a variety of scenarios. AR can be used to enhance the content and instructions within the traditional classroom, supplement instruction in the special education classroom, extend content into the world outside the classroom, and be combined with other technologies to enrich their individual applications.

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