GAINING VIGOROUS KNOWLEDGE FOR AUTISM BY AUGMENTED REALITY

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Abstract: Each and every day, our brains interpret the things which we see, smell, hear, taste, touch, and experience. But when someone's brain has trouble interpreting these things, it can make it hard to talk, listen, understand, play, and learn. Most children with autism has neurodevelopmental condition that affects the capability to interact and communicate with others—are less engaged in imaginative play. Our work aims on using the technology for aiding the children with autism in learning new words and day-to-day communication. We are augmenting an interactive system that explores the potentials of Augmented Reality (AR) technology to visually conceptualize the representation of pretense within an open-ended play environment.

Keywords—Augmented reality, Autism, AR apps, Active Learning, Handheld Devices.

I. INTRODUCTION

In the recent years, digital learning has focused mainly on building teaching, learning platforms and on providing support for employing and integrating learning systems. Similarly in Schools clinics that are specialized for the care of the children with autism are towards setting an environment that is the appropriate places to study the long-term use of smart spaces for several conditions. This can be achieved through integrating the physical and digital world-such as augmented reality (AR).The augmented technology could be influential in supporting the autism children in the learning. The most interestingly the therapeutic interventions for the children with autism seriously depend on repetition, which is boring and leads to poor behavior and decreased cooperation with such interventions. Ambient display supporting behavior change and exergues sustaining could encourage the positive behaviors and help children stay focused during therapeutic intervention.

The objective of our work is to design and develop an AR based application for developing the learning skill of the autism children. Augmented reality (AR) is the integration of digital information with the user's environment in real time.AR can also be defined as a live direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory inputs such as video, graphics, sounds or GPS data.

In enlightening environment, AR has been used to counterpart a standard curriculum. Text, graphics, audios and videos were superimposed into a student's real time environment. Textbooks, flashcards and other educational reading material contains an embedded "markers" or triggers that, when scanned by an AR device, produced supplementary information to the student rendered in a multimedia format. Our work's main involvement is to provide a smart environment's real-life deployment and to encourage the individual with autism to intuitively, effectively, ubiquitously interact with smart environments over the long-term.

A. Augmented Reality

Augmented reality (AR) is a technology that provides the opportunity for users to interact with computer-generated content from the real world. The AR technology can be seen in a variety of areas, such as travel, news, commercials and sports, in which tangible and exciting experiences are created .Initially it is used for military, industrial, and medical applications, by 2012 its use expanded into various fields like entertainment and other commercial industries.

B. Background

Augmented Reality (AR) is a technology which extended from the Virtual Reality (VR). VR helps in the creation of real-life facsimile, and it also construct an immersive experience for any user that makes them feel as if they are interacting with their digital environment. On the other hand, augmented reality (AR) layers digital enhancements geared to enrich an existing real life setting by appealing to the senses.

Back in the 1990s, virtual reality was on the top of everyone's mind as multiple companies tried and failed to make it happen. But now augmented reality is ahead of virtual reality, as there are several products already existing on the market. There is a genuine growth of AR towards the hardware devices from Google which developed the Glass, and also plans from Microsoft to launch technology similar with its $150 million purchase for wearable computing assets. The report published in the three Horizon Reports released during 2010–2012, the New Media Consortium predicted that Augmented Reality will be applied on a large scale in the near future (Johnson, Adams, & Cummins, 2012;Johnson, Levine, Smith, & Stone, 2010; Johnson, Smith, Willis, Levine, & Haywood, 2011).

C. Augmented Reality Software Development Kit (Sdk).

An Augmented Reality Software Development Kit (SDK) used for the creation of Augmented Reality applications in the mobile devices. It uses Computer Vision technology that is used to recognize and track the planar images (Image Targets) and simple 3D objects, such as boxes, in real-time. This type of image recognition technique leads the developers to position and orient virtual objects, such as 3D models and other media, in relation to real world images when these are viewed through the camera of a mobile device. The virtual object are then tracks the position and orientation of the image in real-time so that the viewer's perspective on the object corresponds with their perspective on the Image Target, so that it appears as the virtual object is a part of the real world scene.

This toolkit provides Application Programming Interfaces (API) in C++, Java, Objective-C++(a language utilizing a combination of both C++ and Objective-C syntax), and the .Net languages. In this way, the SDK supports both native development for Android and iOS .It also enables the development of AR applications in Unity that are easily portable to both platforms. AR applications developed using the toolkit are compatible with a broad range of mobile devices including the iPhone, iPad, and Android phones and tablets running on the Android OS version 2.2 or greater and an ARMv6 or 7 processor with FPU (Floating Point Unit) processing capabilities. The other features that it provides, the SDK supports native development for Android. For providing additional recognition and tracking functionality, this SDK has been integrated as the third party library in the ARAF browser.

II. RELATED WORK

Associated with VR, AR demonstrated a more natural and innovative interactive concept, which provides students interest in learning. El Sayed, Zayed, and Sharawy (2011) devised an Augmented Reality Student Card (ARSC), which can represent any lesson in a 3D format that aids students in visualizing different learning objects, interact with theories and manage information in a totally new way. The Mobile Object Identification System (Mobis), a mobile augmented reality application that lets teachers superimposes digital content on top of physical objects. As the results of a five-week deployment study demonstrate that Mobis is useful and easy to use, increases the sustained and selective attention for children with autism, and elicits positive emotions during therapies which are explored by Lizbeth Escobedo, Mónica Tentori, and Eduardo Quintana. Laura Associazione Astrolabio Firenze (Italy)Clara CorradiPolitecnico di Milano, Milano (Italy)Franca GarzottoPolitecnico di Milano, Milano (Italy) Matteo ValorianiPolitecnico di Milano, Milano (Italy) performed a research which shows that the autistic childrens involvement in the therauptic session and in the learning. The autistic and trisomic children were able to express some positive emotions when confronted to the ARVe(Augmented Reality applied to Vegetal field) which was explained by a survey conducted by E.Richard, V.Billaudeau, P.Richard, G.Gaudin.

In the Mayer's multimedia learning theories research, he presented an seven principles to involve animation in multimedia learning, the first principle is that students learn deeply from narration and animation than narration alone (Mayer & Moreno, 2002). The paper submitted by Sergey. Sannikov1, Fedor Zhdanov, Pavel Chebotarev ,Pavel Rabinovich explains that there are five ways of implementation of AR in education (Discovery-based Learning, Objects Modelling, AR Books, Skills Training and AR Gaming).

The aspect of affordances relates to the use of handheld computers in AR. With mobile devices, wireless connection, and location-registered technology, the prevalent or mobile-AR system could enable ubiquitous, collaborative and it situated learning enhanced by computer simulations, models, games and virtual objects in real environments (Broll et al., 2008; Dunleavy et al., 2009). There are many games related to mobile-AR such as Mad City Mystery (Squire & Jan, 2007) and Environmental Detectives (Klopfer, 2008; Squire & Klopfer, 2007) which are developed in order to support learning outside of classrooms. In Environmental Detectives, student uses handheld computers to conduct investigations, gathered data that are unique to the location, analyzed and interpreted the data, and proposed solutions sensitive to the context. A recent mobile-AR study builder on the AR affordances of enhancing learners' sense of presence, a propinquity and immersion to support students' learning of a Socioscientific issue on nuclear energy use and radiation pollution are in the context of the nuclear accidents at the Fukushima Daiichi Nuclear Power Plant after the 3.11 earthquake in Japan (Chang, Wu, & Hsu, 2012).

III. ARCHITECTURAL DESIGN

The systems use a client-server architecture, in which the mobile application communicates with vuforia Target Recognition system. Initially the Scanned image target are sent to Vuforia Target Recognition System as the requests and the corresponding metadata is returned as the response. The figure.1.a given below explains the relationship between all the system which is being used for designing the application.

In marker based Augmented Reality (AR) applications any identified mark is predicted within the received data from the camera and the application adds the predefined computer made data (which can be text, 3D object, video, image, animation, etc.) into the live video according to the position and orientation of the target and displays on the head-mounted screens or mobile apps. The aim of this thesis was to develop a Client-Server application for Schneider Electrics' protection relay's AR application, which makes it possible to continue the augmented data through a web application and save the data into a remote database. The AR application can then always accept updated data from the web application for the device which has a unique serial number and is being videoed live by an AR camera. The web application also provides the opportunity for the client application to update the configuration of a relay. The significant improvements of the current application over the earlier implementation is that data is not saved into runtime variables but permanently in the database and the size of the application is much smaller.

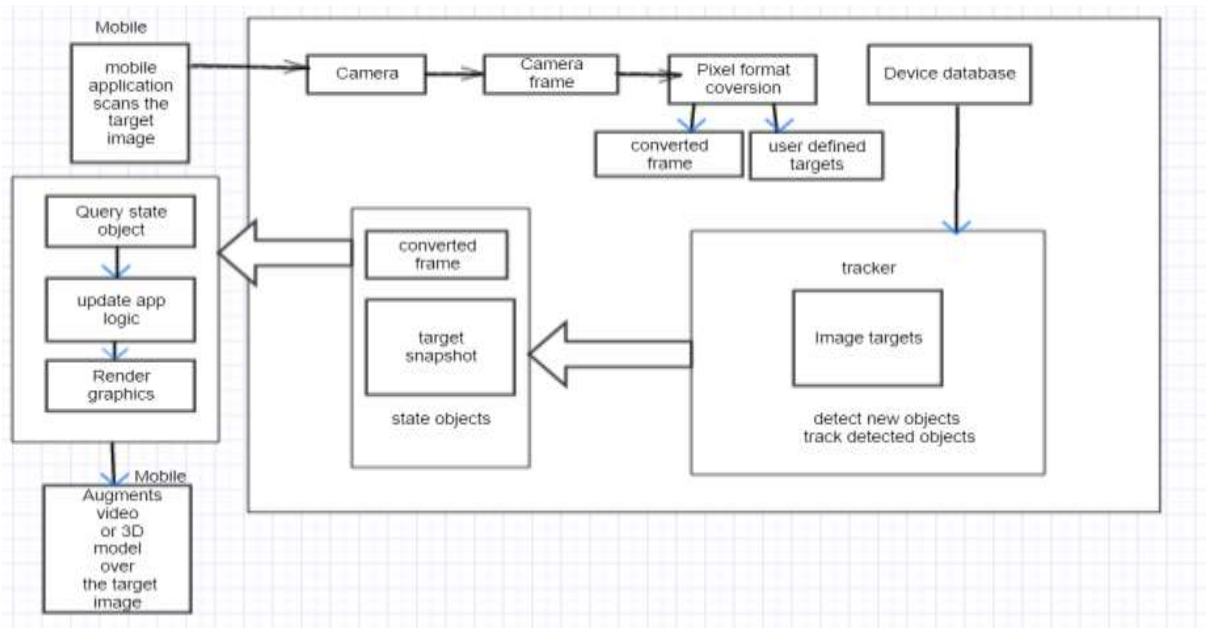


Fig.1.a System Design to carryout learning for Autism

IV. PROBLEM DEFINITION

An augmented reality (AR) based mobile learning application for autism children is developed. This work aims to show that it is possible to introduce a better way of learning on demand, being targeted to disabled users in Ambient Intelligence. This is best for language and communication as it has highly intuitive and kid friendly interface designed specifically for the use of Autism children. It involves scanning of 2D templates/ image (target image/marker) and the output is in two formats, one augmenting video with text related to the scanned image and other is augmenting 3D model of the scanned image on the screen of android mobile. This provides an improved and enhanced the learning experience for students. The main goal is the use of mediated reality, adding information to the perception of reality in such kind of users, increasing their motivation as well as encouraging them to learn for the students suffering autism.

The implementation idea will be carried out for active learning to Autism kids by involving the following levels

(i). design of 3d models and video with text.

(ii). Design of target image and develop image scanner for target image.

(iii). implementation of image recognition mechanism, and it is concluded with Deploying/augmenting 3D model and video.

By keeping some of the below mentioned usage of this application in mind the work has been initiated.

Teachers/parents can make paperless, personalized augmented reality (AR) lessons for children.

▸This application can serve as effective teaching-learning assistive aids for children with autism.

▸This will help children by adding parent's voice/narration, associating augmented video and rendering them on mobiles.

▸The bright video along with and 3D model, provides a fun learning platform and a voice for children struggling to communicate on their own.

▸This application does not require the user to take a snapshot of the target image, once the image target scanning is successful, the interpreted data is returned.

▸This application has highly intuitive and kid friendly interface designed specifically for the use of Autism children.

V. EXPERIPENTAL EVALUATION

(i). Design of 3d models and video

The module one is the initial step where the 3D models are developed which are going to be the output of the system. 3D models for the target image is created using the Blender software. This software helps to create realistic 3d objects using the 3D engine. The model can be customized to our opinion. A 2D image is turned to 3d model using blender software.

Fig.5.a 3D Model Design

The video is created and edited using the windows Moviemaker and text to the video is added using the Movavi software.

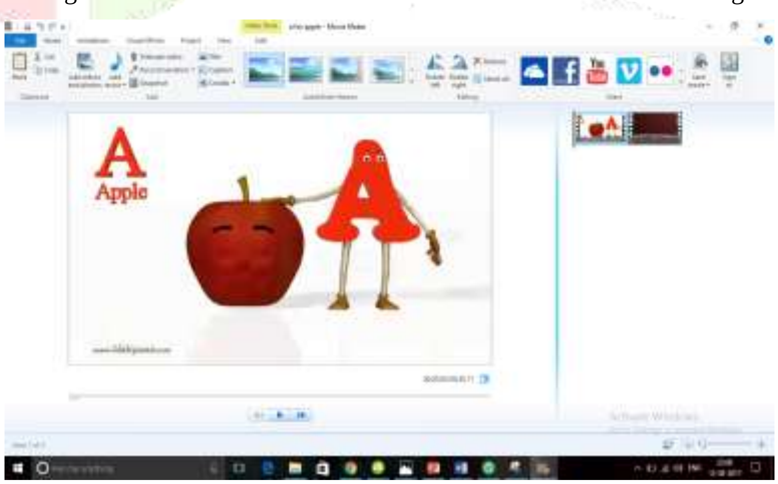


Fig.5.a 3D Model Design

(ii). Design of the target image and develop image scanner for target image

Marker/Image target is a flat image (2d template) which is recognized and tracked by mobile device's camera. Target image can be user-defined which can be selected by the user. The target image should be a good contrast and no repetitive patterns should be used.The target image must be 8 bit/24 bit PNG or JPG files. If not, it is be converted to 8 bit/24bit images. For building user defined targets, start the process of scanning user defined target followed by triggering the process for building the target, finally adding the newly acquired target into a local database for tracking.

(iii). Image Tracking

AR presents information in a correct real world context. In order to do this, the system needs to know where the user is present and what the user is actually looking at. Normally, the user explores the environment through the display that portrays the image of the camera along with the augmented information. Therefore, the system needs to determine the location and orientation of the camera. With a calibrated camera, the system is then able to render augmented objects in the correct place.

For the image tracking there are various methods marker based, visual tracking, feature tracking. Feature detection and tracking algorithms are widely used for various purposes in computer vision applications. They are applied image matching, motion detection, tracking, image mosaicking, and panorama stitching, 3D modelling and object recognition. In this work, tracking was considered as a means for detecting the relative pose of the camera. In the feature detection the localized feature is divide into three categories: feature points (e.g. corners), feature descriptors (e.g. SIFT) and edges. A feature point, also known as an interest point or key point which is a small area in an image, which has a clear definition and a well-defined position.

The term feature descriptor or image descriptor refers to the characteristics of an image region or a feature. Edges are often profiles or outlines of the objects (e.g.in the silhouette of a building), but they also appear in other regions (e.g. change of the color) in augmented reality applications edge detection and matching is often used in model-based tracking. A good feature has a clear and unambiguous definition, preferably a Mathematical one. It has a well-defined position in the image space and the local image structure around the feature is diverse and contains a lot of information. Furthermore, a good feature is invariant under perspective transformation, scale, Rotation and translation. In addition, it should also be invariant to changes in local and global illumination.

There are two approaches commonly used to find feature points and their correspondences:

- Tracking only

  Selecting features that can be locally tracked.

- Detection + matching

  Detecting all features first and then matching them based on their local appearance.

- The third approach is to combine these two:

Tracking + Detection + local matching / detection

Detected features are matched only to locations near their previously detected location. In other words, detected features are tracked.

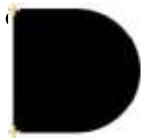
a). Feature detection methods

Feature detection methods are difficult for classification because of the large variety of approaches are used in feature detection. We may classify them based on what kind features they detect: corner detectors (e.g.Shi&Thomasi), edge detectors (e.g. Canny), blob detectors (e.g. MSER) and patch detectors. However, a non-exclusive division, e.g. SUSAN is based on both corner and edge detection, LoG detects both corners and blobs, and FASTER classifies image patches to find corner points. Furthermore, methods using feature classifiers can be trained to find any kind of features including different image patches, corners, blobs and edges. In mobile phones computational efficiency of the methods is essential, and therefore methods such as Workion Shift Analysis (PSA) were used.

b). Natural Features

A feature is a spiked, sharp, chiseled detail in the image, such as the ones present in textured objects. The image analyzer represents features as small yellow crosses.

The square contains four features for each of its corners.



This object contains two features for each of its sharp corner. According to the feature, soft corners and organic edges are not marked as features.

The circle contains no features as it contains no sharp or chiseled detail.

(iii). Implementation Of Image Recognition Mechanism

Besides displaying technologies, an AR system has to recognize and track objects of interest in the real world to which virtual contents are anchored. These objects of interest can be of many different physical forms, such as artificial objects (e.g. 2D markers). The tracking technology used is vision-based tracking. Vision-based tracking applies computer vision technologies to track objects of interest using cameras. In vision-based tracking technology, marker-based tracking technique is used. The Marker-based tracking detects artificial markers, such as passive paper-based 2D markers. The pose of target objects is estimated based on known 2D templates. The marker-based technique uses feature points to detect or recognize the image. The natural feature tracking takes place where the feature points or the local points are fixed in the target image which is used for recognition purpose while the user scans the image. This vision algorithm is used to detect and describe the local neighborhood of feature points. These feature points have sharp, crisp details (such as corners) for e.g.: using gradient orientations, which are suitable for feature points indicated by crosses in the figure. But circle or straight line is not suitable for feature points. For example, the image is a street with stones which has a well textured feature to detect the feature points. But it is not well identified on images with homogeneous color regions or soft edges (such as the blue sky).

The scanning module is that part of the application that scans and interprets target image. Scanning of the target image is done via the camera of the mobile device. The scanning takes place in real-time and does not require the user to take a snapshot of the target image, once the image target scanning is successful, the interpreted data is returned and this could be used for further processing. This module requires the camera permission to be able to access the device camera. The target recognition service is used to map real world objects that are AR markers to digital objects metadata by sending scanned AR markers in real-time to the Target Recognition System. This system immediately compares the images sent with the image targets already existing in the device database, if there is a match, then the Target Recognition System responds with the corresponding metadata of the matched target if there is no match an appropriate error message is sent as a response.

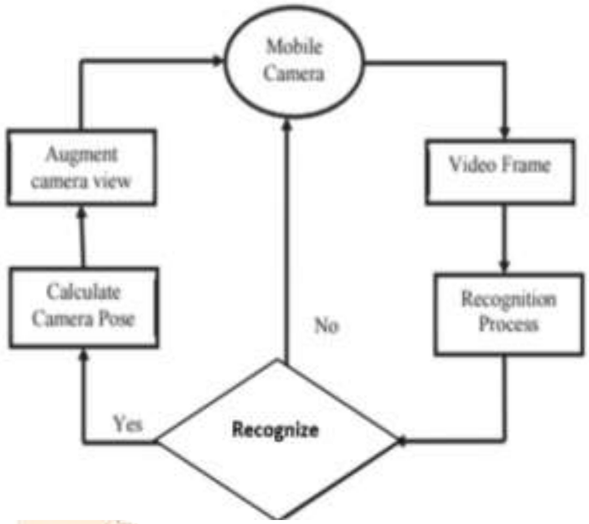


Fig. 5.b. Image Recognition Flow diagram.

(iv). Deploying Or Augmenting 3d Model And Video:

Handheld displays such as Tablet PCs and smartphones are special types of screen-based displays with small-sized screens that fit a user's hand. Mobile handheld displays have become popular because of computing and sensor capacities (e.g. camera). Handheld displays support high mobility and ease for the autism children to handle. It helps in communication and learning. The image targets, scanning AR camera in an android phone is modeled using c#. The developed model was implemented using java programming language. After the target recognition, if there is a match, then the Target Recognition System responds with the corresponding metadata of the matched target if there is no match an appropriate error message is sent as a response. The information was retrieved and finally, a 3D texture overlay will be created on top of the marker or a video will be augmented over the marker (target image) and will be made visible to the user. The 3D texture overlay or the video able to scale as the user moves closer and farther from the AR markers.

VI. CONCLUSION

As we have number ideas and application in learning process but this is a new method proposed for Autism children where they can have fun and comfortable learning. The augmented reality technology employed uses the feature based tracking and augment related standard development kit (SDK) is used in the work.The autism children towards the learning can be achieved through this work, where their lesson texts are converted into a augmented images along with the audio and videos. The children's through this can experience the imaginary world. In future, the work could be improved by converting the text into braille letters.

VII. REFERENCES

1. Students' perception of mobile augmented reality applications in learning computer organization

Nazatul Aini Abd Majid*, Hazura Mohammed and Rossilawati Sulaiman Fakulti Teknologi dan Sains Maklumat, Universiti, Kebangsaan Malaysia, 43600 Selangor, Malaysia

2. Botella, C., Breton-López, J., Quero, S., Baños, R. M., García-Palacios, A., Zaragoza, I.,et al. (2011).

Treatment for cockroach phobia using a serious game on a phone and augmented reality exposure:A single case study. Computers in Human Behavior, 27(1), 217–227.

3. Azuma, R., Y. Baillot, R. Behringer, S. Feiner, S. Julier & B. MacIntyre 2001. Recent Advances in Augmented Reality. IEEE Computer Graphics and Applications 21(6): 34-47

4. Mustafa, B. 2011. Modern computer architecture learning and teaching support: An experience in evaluation. Information Society (i-Society), 2011 International Conference on. pp. 411-416

5. The development of an augmented reality game-based learning environment.Ching Hui Chen, Chia-Huei Ho, Jau-Bi Lin 2014.

6. Chu, H. C., Hwang, G. J., Tsai, C. C., & Tseng, Judy C. R. (2010b). The two tier experiment approach for developing location-aware mobile learning systems for natural science courses. Computers & Education, 55(4), 1618–1627.

7. Using augmented reality as a medium for teaching history and Tourism Jiří Kyselaa, Pavla Štorkováb aUniversity of Pardubice, Faculty of Electrical Engineering and Informatics, Pardubice 532 10, Czech Republic b University of Pardubice, Faculty of Arts and Philosophy, Pardubice 532 10, Czech Republic

8. The Interactive Educational Content based Augmented Reality and 3D Visualization Sergey. Sannikov, Fedor Zhdanov, PavelChebotarev, Pavel Rabinovich Mordovia State University named after N. Ogarev, postgraduate in the Department of Applied Mathematics, Differential Equations and Theoretical Mechanics, Russia, Saransk, sannikov@funreality.ru Exciting Reality OOO, Lead Developer, Russia, Saransk, zhdanovfv@gmail.com.

9. An Innovative Self-learning Approach to 3D Printing Using Multimedia and Augmented Reality on Mobile Devices Vianney Lara-Prieto, Efraín Bravo-Quirino, Miguel Ángel Rivera-Campa, José EnriqueGutiérrez-Arredondo.

10. Decreasing Failure in Programming Subject with Augmented Reality Tool Laura Del Bosquea, Raquel Martinezb, Jose Luis Torresc..

11. El Sayed, N. A. M., Zayed, H. H., & Sharawy, M. I. (2011). ARSC: Augmented reality student card an augmented reality solution for the education field.Computers & Education, 56, 1045–1061.

12. Fonseca, D., Redondo, Marti, N., E., Navarro, I., & Sánchez, A. (2014). Relationship between student profile, participation, tool use and academic performance with the use of augmented reality technology for visualized architecture models. Computers in Human Behavior, 31, 434–445.

13. Harle, M., & Towns, M. (2011). The review on spatial ability literature, connection to chemistry, and implications for instruction. Journal of Chemical Education, 88(3), 351–360.

14. Hwang, G. J., & Chang, H. F. (2011). The formative assessment-based mobile learning technique to improve the learning attitudes and achievements of students.Computers & Education, 56(1), 1023–1031.

15. Iordache, D. D., Pribeanu, C., & Balog, A. (2012). The Influence of specific AR capabilities on learning effectiveness and efficiency. Studies in Informatics and Control, 21(3), 233–240.

16. De Lucia, A., R. Francese, I. Passero & G. Tortora 2012. The collaborative augmented based on location-aware mobile technology. International Journal of Distance Education Technologies 10(1): 55–73.

17. Dunleavy, M., C. Dede & R. Mitchell 2009. Limitations and affordances of immersive participatory augmented reality simulations for teaching and learning. Journal of Science Education and Technology 18(1): 7–22.

18. Billinghursta M, Katob H, Poupyrev I. The MagicBook: a transitional AR interface.Computers & Graphics 2001;25:745-753.

19. Kaufmann H, Schmalstieg D. Mathematics and geometry education with collaborative augmented reality. Computers & Graphics 2003; 27:339-345.

20. Garza Luis E, Pantoja G. Augmented Reality Application for Maintenance of a Flapper Valve of a Fuller-Kinyon Type M Pump.ProcediaComputerScienceJournal2013;25:154–160.