using augmented reality in the production of interactive educational Aids for applied arts courses (With the application on the Electronic color separation system course)

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Research Introduction:

Applied arts courses lack Teaching Aids that help the lecturer to communicate the information to the student in a full form to acquire the required skills. Here, the Teaching Aids mean the Aids that were specially designed for Applied arts courses taught in colleges and institutes of applied arts, which require the professor of the course to make a double effort during the lecture to communicate the information to the student, the use of traditional educational methods such as presentations and video clips, which do not include any interaction or participation between the student and the Aids and do not take into account the individual differences among students and the different ways of their absorption of the information and thus acquired that they have the requisite skill, and as the Chinese sage Confucius said, "Tell me and I will forget, show me and I may remember, share me and I will understand." Augmented reality technology is considered one of the most important techniques that depend on interaction and dazzling at the same time, which contributes in the field of education with a great contribution especially in the recent years as it is characterized by its applicability in various fields so it is ideal in designing and producing educational Aids with specially designed designs that depend on participation and education with entertainment in the same time, which reflects positively on the student.

Research Problem:

Lack of Applied Arts courses for educational Aids that depend on active participation, which are specially designed for Applied Arts courses, which help the lecturer to communicate the information to the student in full form to acquire the required skills.

In pursuit of the research aim, taking the following point into consideration:

The use of augmented reality technology in the production of an interactive Teaching Aid for Applied Arts Courses with application on the Electronic color separation system course,

The important results of this research lied in:

Producing an interactive Teaching Aid for the Electronic color separation system course.

Research methodology:

The curriculum is the experimental method where the researcher to conduct experiments and draw conclusions to achieve the goal of the research.

Keywords:

Augmented reality - Teaching aids – Applied Arts courses - Electronic color separation system course.

Previous studies:

First study:

Mostafa Amin Soufy (2019) - Using Augmented Reality Techniques to Create an Interactive Educational Aid- PhD - Department of Printing, Publishing and Packaging - Faculty of Applied Arts.

The study aimed to devise a new interactive educational Aid by using augmented reality technology as one of the modern electronic publishing techniques. The research problem was the lack of benefit from modern scientific developments for electronic publishing in the production of educational aids. The most important results of the study were that there are already severe deficiencies in the use of modern educational methods within our educational institutions and that the use of augmented reality in the production of educational methods has a positive impact on students, whom the practical study is applied to them. The results of the questionnaires and pre and post tests conducted in this study were used to find out which educational Aids is the most common within the institutes and colleges of applied arts, and the use of these results in this research with the aim of making more interactive educational Aids to be used.

second study:

Lamis Hamdi Saeed (2017) - Raising the quality of educational Aids design in basic education using 3D vision techniques - Master Thesis - Department of Printing, Publishing and Packaging - Faculty of Applied Arts.

The study aimed to apply three-dimensional vision techniques to educational Aids design to raise its effectiveness, while the problem of the study was the deficiency in the use of three-dimensional design in the production of educational Aids in Egypt and the most important results of the study were that education using 3D technology at an early age and elementary classes in schools to allow to help our children in reaching a higher level of thinking and creativity. This study was used in this research in classifying educational media and explaining the cone of experience.

Third study:

Mustafa Amin Soufy (2014) - Improving the performance of the print media and its electronic version using Augmented reality techniques (with application to children's magazines) - Master Thesis - Department of Printing, Publishing and Packaging - Faculty of Applied Arts.

The study aimed to employ augmented reality to produce a print that integrates with an electronic version of it, with the aim of enriching the printed material and giving it the opportunity to compete with electronic publishing methods and increase their sale rates as well as benefit from the advantages of electronic newspapers and magazines, and apply that to a children's magazine. As the research problem was summarized in the presence of advantages in both the printed and electronic versions that cannot be combined if one of them is used without the other. The most important results of the study were that those advantages can be combined for both the printed and electronic version through the use of augmented reality technology, which is beneficial for achieving added values. This study was used within this research through the paragraphs that dealt with the definition of augmented reality and its uses in education.

Fourth study:

Lamia Mohamed Khairy El-Fekky (2008) - Virtual Reality as an Educational Tool in the Area of Printing Ergonomics - Master Thesis - Department of Printing, Publishing and Packaging - Faculty of Applied Arts.

This study aimed to employ simulation techniques with computers and virtual reality as a modern tool to raise the efficiency of the educational process in teaching ergonomics for students of printing, publishing and packaging, as well as the worker inside the printing press. The most important results of the study are that virtual reality has the ability to communicate the educational message significantly and that the provision of virtual reality through a clear system and a studied strategy give multiple effects on applying the same training in traditional methods. This study was used within this research to clarify the role of educational methods in improving the teaching and learning processes.

Fifth study:

Magdy Hussein El-Sayed El-Naheef (2001) - Employment of educational technology system activities in preparing graduates of the Faculty of Applied Arts - PhD thesis - Department of Printing, Publishing and Packaging - Faculty of Applied Arts.

This study aimed at evaluating the educational system at the Faculty of Applied Arts and determining its inputs and the processes necessary for its interactions to achieve the necessary needs for students from lecturers, curricula, devices and equipment. In spite of the high technological development in the devices, equipment and machinery needed for production, which in most cases there is no optimal use for them due to the non-completion of the processing of production halls and laboratories. The most important results of the study were the necessity of choosing new educational philosophies using information technology in education, and this study was used within the research to define educational methods and their various classifications.

Definition of teaching aids:

There are many definitions of educational Aids, it is one of the axes in which the educational technology is concerned and which is used in the educational process, whether the Aids are simple or complex, individual or collective to achieve communication and understanding between the sender (the teacher) and the Receiver (the learner), it is an integral part with the elements of the educational communication process in teaching various subjects, and it helps the teacher to perform his/her duties and achieve the goals of education in general.[8] It is also defined as the method used by the lecturer to improve the teaching and learning processes and to clarify meanings and ideas of the recipient and thus it is easy for them to understand and absorb the lesson to be explained. [3 These Aids include all the media that the teacher uses to communicate ideas, facts, or meanings to students, in order to make the lesson more interesting and exciting, and to make educational experience direct and targeted at the same time. [10]

The role of teaching aids in improving the teaching and learning processes: [7]

The role that educational methods play in improving the teaching and learning processes can be summarized in the following points:

- Teaching aids help to stimulate student interest and satisfy their need for learning.
- Teaching aids increase the student's experience, making them more willing to learn.

- Teaching aids help to engage more than one sense of the learner.
- Teaching aids help to avoid verbal meaning. The teacher's use of the words that the student does not have the indication that the teacher has, and the educational means clarify such abstract words by physical means that help create visual images of them in the student's mind.
- Teaching aids increase the student's positive participation in gaining experience, as he/her develops the ability to meditate, accurately observe, and follow the scientific method in thinking.

Classification of teaching aids:

Educational Aids have been classified in more than one way, according to the following principles:

1- According to the time period in which the educational tool appeared: [9]

A- Traditional teaching aids

B - Modern teaching aids

2- Based on the used senses:

A- Visual aids (slides and pictures, silent and fixed motion pictures, blackboard, graphics, cards and plates, maps.

B - Audio (educational radio - audio recordings).

C- Audio-visual aids (speaking and animated films, films with sound recordings, educational television videos).

D- Means including other senses such as solids (models - real things - samples), educational plays, field visits, educational games, and simulation methods.

3- According to the projection:

A- Non-Optical Aids: blackboards of all kinds (ordinary - magnetic - fabric), and pendants.

B - Optical Aids: (transparencies - photographic slides - fixed films) that are projected by projection equipment.

4- Based on the number of beneficiaries:[5]

A- Individual means: such as the educational phone, the microscope, and the personal educational computer.

B- Collective means: such as exhibitions, scientific museums, educational television, educational broadcasts and field visits.

C- Mass media: such as cultural and educational programs that are broadcast on radio, open television or computer networks.

5- Based on the experience provided by the Aid:

Some teaching aids are tangible in the form of a product or device, while there are other educational aids that are abstract. Professor Edgar Dell (1959) has created a cone of experience in which he arranged the type of experience provided by the various educational methods in a picture that classifies them differently.
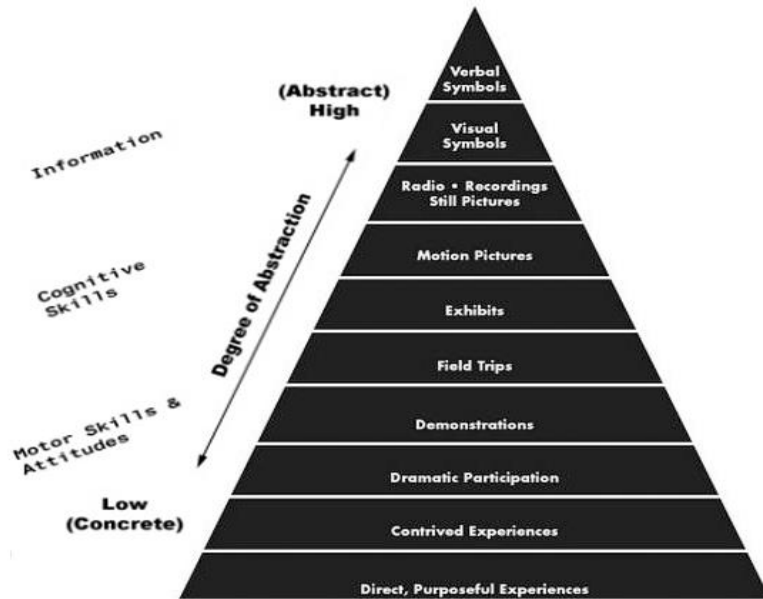
Figure (1) Classification of teaching aids according to the type of experience provided by the Aid

There are three types of education in the cone of experience:

1- Education through different practices and activities (direct targeted experiences - representative experiences).

2- Education through observations (practical illustrations - field visits - exhibitions - educational television and motion pictures - still pictures - audio recordings).

3- Education through abstract and mental analysis (visual symbols - verbal symbols).

It is logical that the more the senses through which the student can deal with the aids, the more positive is his/her participation and the stronger is his/her understanding of the information provided by the aid, therefore educational games and simulation are considered one of the most important aids that make this participation.

The augmented reality is considered one of the most important techniques by which it can make applications and educational games that make the student participate and interact with more than one sense. It also dissolves the differences between what is real and what is not real, which the research will review in some detail, explaining the reasons for choosing the application as follows:

Augmented reality:

Definition of augmented reality:

Augmented reality is a type of virtual reality that aims to duplicate the real environment in the computer and enhance it with virtual data that were not part of it. In other words, the augmented reality system generates a composite graphics objects for the user that mixes the real scene that the user is looking at and the virtual scene created by the computer that enhances the real scene with additional information. [6]

Computer-generated virtual scene aims to improve the perception of the real world that the user sees or interacts with. Augmented reality aims to create a system in which the difference between the real world and what is added to it is not realized using technology of augmented reality. When a person uses this technology to look at the surrounding environment, objects in

this environment are provided with information that floats around them and integrates with the image that is seen by the person who is there. [11]

Figure (2)
Augmented Reality

The use of augmented reality in education:

The concept of enhanced learning has been defined as a learning technique for the learner, whereby learning environments adopt their methods based on learners' needs and requirements. The term environment is not necessarily limited in this context to physical learning environments such as classrooms; Rather, it may refer to digital learning environments where learners can stimulate their ability to discover and this will ultimately contribute to acquiring a greater amount of knowledge. Usually, the techniques used in enhanced learning are closely related to touch screens and voice recognition techniques, and this can make learning contexts fit the needs of the learner by displaying clear text and images in addition to video clips, audio clips, or 3D models. [12]

Using Augmented Reality in Education:

Augmented reality technology has been used in many different fields of education, for example:

- Education by adding graphics, videos, and audios to the textbook.
- Learn about the different tourist attractions and their information when viewed directly, instead of reading this information through books.
- Understanding chemistry becomes quite easier and better by seeing molecules, atoms, and fusion and dissociation processes that happen among them.
- Augmented Books that are compatible with applications to add enhanced information.
- Seeing the educational lessons in the curricula in a three-dimensional form and moving this three-dimensional model by moving the book in front of the mobile devices camera. [13]

There are examples of applications, programs, and products in which this technology was used in education: [14]

Elements 4D software:

A product that uses augmented reality technology, through which to create virtual chemical reactions through smart devices.

Anatomy 4D application:

An application through which the learner can dissect the human body and explore its various systems in an interactive virtual way using augmented reality technology.

ITacitus.org Project:

A project adopted by the European Union to teach the history of Europe in a virtual way by directing the device's camera on the historical site to show the historical events that took place in it.

ARIS:

A program that uses augmented reality technology through which to create a virtual gaming environment supportive of the curriculum.

AURASMA application:

One of the most famous mobile applications that use this technology (Eurasma) where the user can design virtual educational materials that simulate realism by using augmented reality technology and can also share it with others. The application can be downloaded from Google App Store or Apple Store, and its use is accessible to all students and teachers.

Why augmented reality is appropriate for producing educational aids:

1- Because most of its uses are in the form of applications that work on smartphones and are widespread among most students and do not require the purchase of additional tools to deal with it.

2- The proliferation of free applications and sites that allow the production of applications that work with augmented reality, such as www.zap.works.com
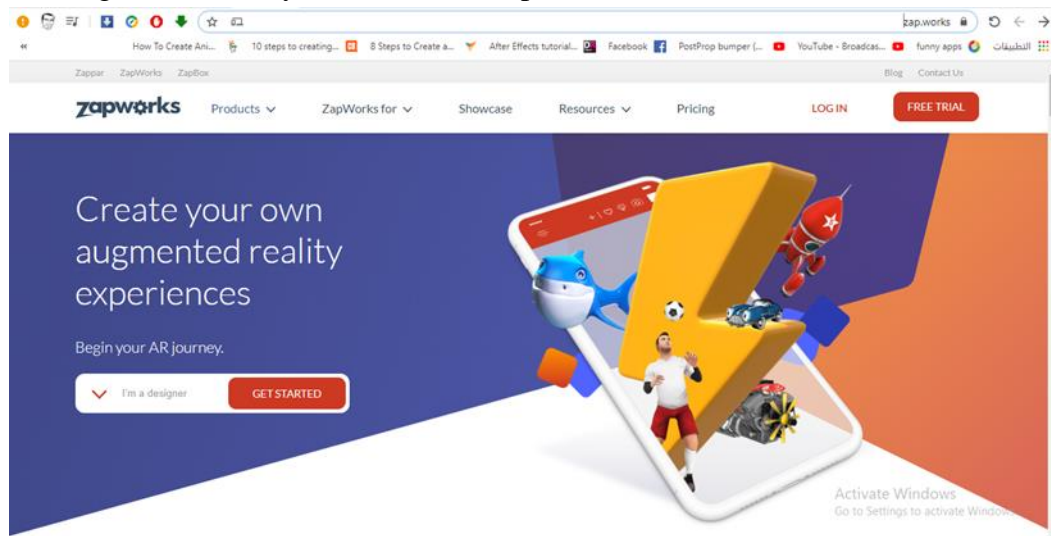

Figure (3)
www.zap.works.com

3- Because augmented reality depends on enhancing students 'educational experience by dropping or bringing digital information to the real world through camera lenses in a way that allows the user to interact with this digital information in his real world, which is one of the high levels of participation and interaction that allows the student to indulge his/her senses within the experience, which is reflected on the degree of understanding of the information presented through it.

About the electron Color separated course:

This course is taught to students of the third year in the printing, publishing and packaging department in the colleges and institutes of applied arts, and it is a decision that has theoretical teaching hours and practical teaching hours.

 The course aims to acquire students' knowledge and skills related to the fundamentals of color and theories of color separation and printing, as well as types of color assets and direct and indirect color separation on mechanical imaging cameras in addition to color separation on scanners and color blocking for correction and digital color correction and photographic and digital color experiments.

After completing the course, the student should become able in terms of information and concepts to explain the theories and methods of producing color-separated films in the traditional way (direct and indirect) and also in the electronic way. They will also be able to explain the theories and fundamentals of color, its management systems, psychology and applications, and be acquainted with the various basic sciences from laser science and optics and their applications in film-making machines.

In terms of mental skills, the student should be able, after completing the study of the course, to compare between different color systems and methods of managing them, as well as methods of color characterization and their applications, and be able to solve design and production problems through the application of the method of scientific thinking sequential. The student's ability to acquire previous skills can be increased by exploiting the advantages of augmented reality in building a mental image that affects the student's mind, which deals with dynamic visual elements and attractive interactivity [4] instead of the stereotype that they are accustomed to.

As for the professional skills of the course, the student should be able, after completing the study of the course, to apply the appropriate technology in the production of color-separated films, to use materials, devices and equipment used in traditional and electronic color separations, and to use computer and specialized programs in color separations electronically. Student's professional skills can be developed through the use of augmented reality in the environment of scientific laboratories, which has emerged recently to conduct various experiments in the real classroom.

With regard to general skills, the student should be able, after completing the course study, to develop his knowledge and skills with continuous learning, which can encourage him to use augmented reality technology as it is a technique that combines pleasure and knowledge at the same time, and this would motivate learners to discover More in educational content. It has been proven that learners, when they experiment with technology of augmented reality, describe it as saying it is a magical world, which is what drives them to delve deeper into educational content and learn more about it [15]

They will also be able to use information technology, and perhaps the use of augmented reality technology has a major role in that, given the student's use of augmented reality applications on smart phone, personal computer and tablet devices, etc. and to be fluent in effective presentation and communication.[1] The study presents an experiment to use augmented reality in effective presentation and communication with students by explaining parts of color theory using an educational method based on augmented reality. The student can also develop his skills in presentation and communication by repeating what the lecturer explained and presented, using

the method again in front of students in addition to the possibility of the student producing simple applications using free sites and applications that produce augmented reality to prepare his presentation later.

Teaching aids used in applied arts courses:

According to the results of a questionnaire that was conducted on more than 220 students of faculties of applied arts [2] it was found that most of the methods used in teaching arts courses depend only on a video presentation explaining parts of the course and viewed only by students, and watching them may be accompanied by an audio comment from the lecturer. The lecturer draws or explains some of the required exercises from students on the blackboard or displays of slides that contain pictures, texts and video clips within a presentation of the power point program, and all of the above does not participate or interact with the student greatly and what the research proposes is the production of an educational method that mainly depends on sharing the student and is specially designed for some parts of the arts courses that require that, in a way that confirms the information in the student's mind through his experience similar to the games he plays on his smartphone and based on enhancing the students 'educational experience by dropping or bringing digital information to the real world through the camera lenses in a way which allows the user to interact with this digital information in his real world, which is one of the high levels of participation and interaction that allows the student to indulge his senses within the experience, which is reflected on the understanding of the information provided through it.

The practical application of the study:

The production of an educational aid linked to an application using augmented reality that allows the lecturer to explain the theory of color addition and its relationship to the primary colors together and the results of their overlap together, and explain the complementary colors to them (cyan, magenta, and yellow) through a poster printed with graphic elements and through interaction with them within the application which bring Graphic elements to appear through the camera of the smartphone, and the student can interact with them and experiment with the results of mixing colors with each other to understand the theory of color addition and complementary colors, using the Educational Aid:

Applications used to produce the medium:

1- Adobe Illustrator:

Adobe Illustrator was used to design the layout for the paper to be printed and used within the experiment:

Figure (4) Layout

When printing the paper and putting it in front of the Aid and pressing the following keys on the paper, the following happens:

When the key is pressed, the paper is colored red.

When the key is pressed, the paper is colored green.

When the key is pressed, the paper is colored Blue.

When you press any black key, the corresponding light turns off.

2- Visual Studio 2017:

To write C ++ programming codes that enable the user to click places on the printed sheet to control the lighting sources inside the scene.

3- Unity3D:

It is a multi-platform game engine and an integrated development environment and was used in building the database for the application in a way that allows loading the required when pressing the keys on the printed paper.
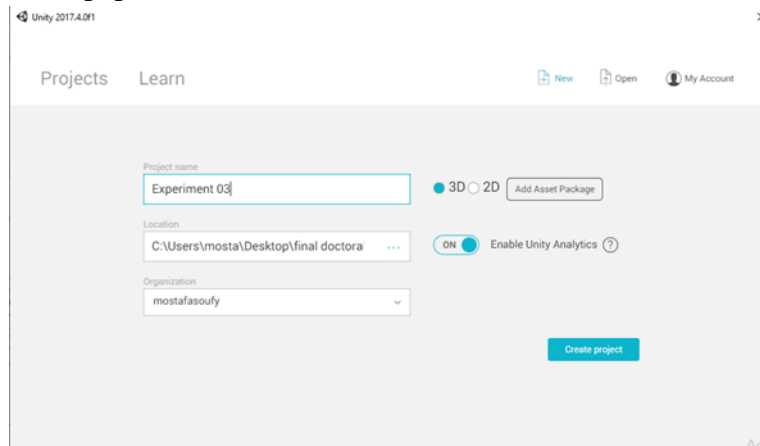
Figure (5) A new file creation window

A new scene was created inside the file and placed inside a folder under the name 03 inside the assist folder and then another folder is added, where the code files are placed inside it under the name of scripts as Vuforia, Augmented Reality library was activated inside the program.
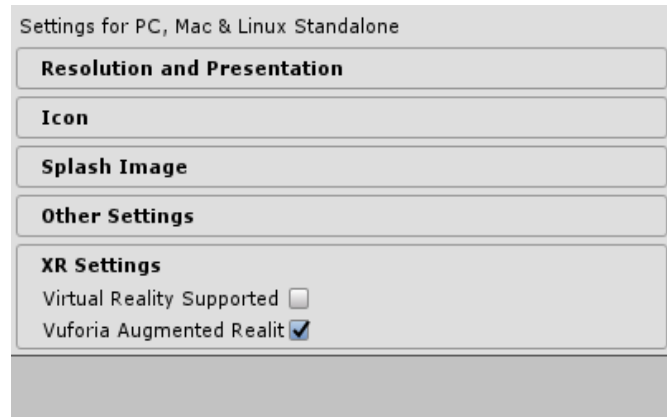
Figure (6) Activation of Vuforia Augmented Reality library

And then a database is created for the design required to be printed on the paper and interact with it, and the hierarchy of the application was built as follows:
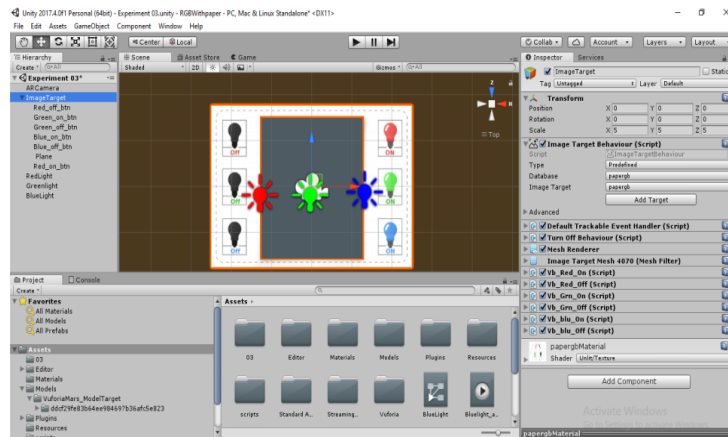

Figure (7)
Building the application's Hierarchy

Then the application was saved as an EXE file to run automatically when pressed without the need for Unity 3D. This is from the File menu and then Build Settings. It can also be Export to work on smart phones that are running Android or IOS softwares.
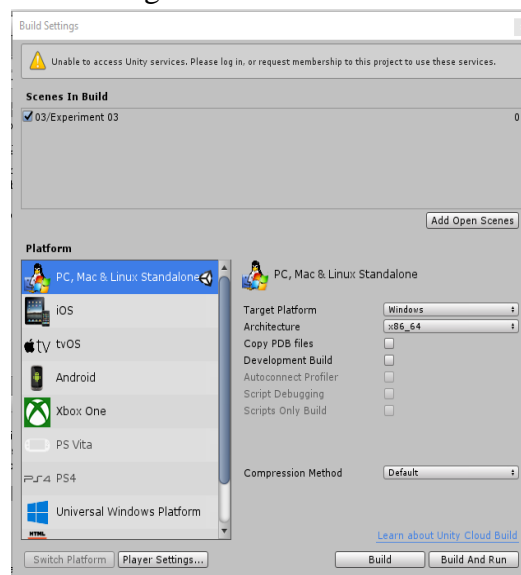
Figure (8) Save the application

To run the application when clicking on the following file:
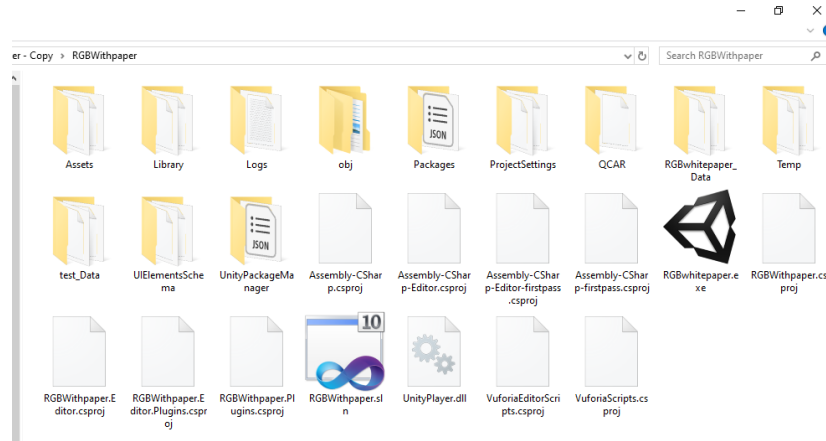
Figure (9) Application run file

The lecturer holds the printed paper in his hand to explain that we are in the process of explaining the color addition and explaining that the white paper is printed with keys representing the primary colors in the color collection system, and he completes an explanation of how to make the lighting keys all now closed so the paper will appear in black.
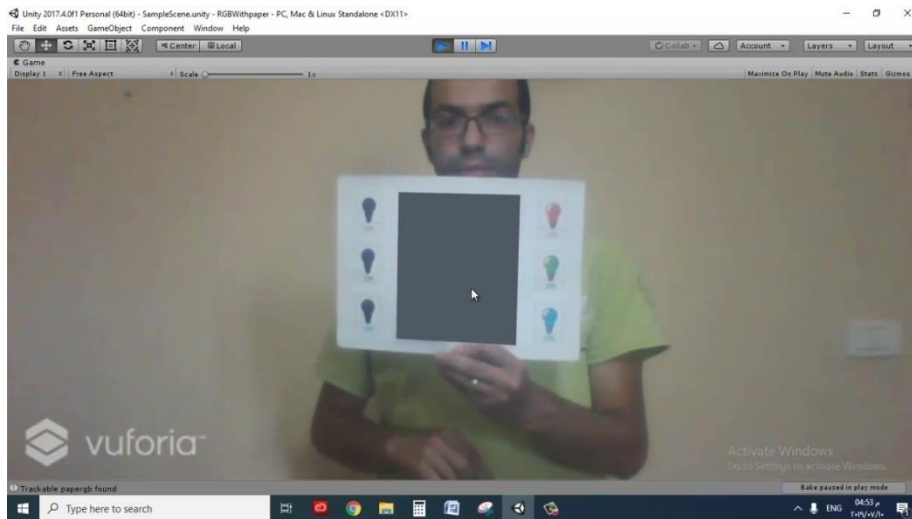

Figure (10) The paper appears black

He continues that we are now pressing the paper on the red key and is already pressing it to turn the paper to red.
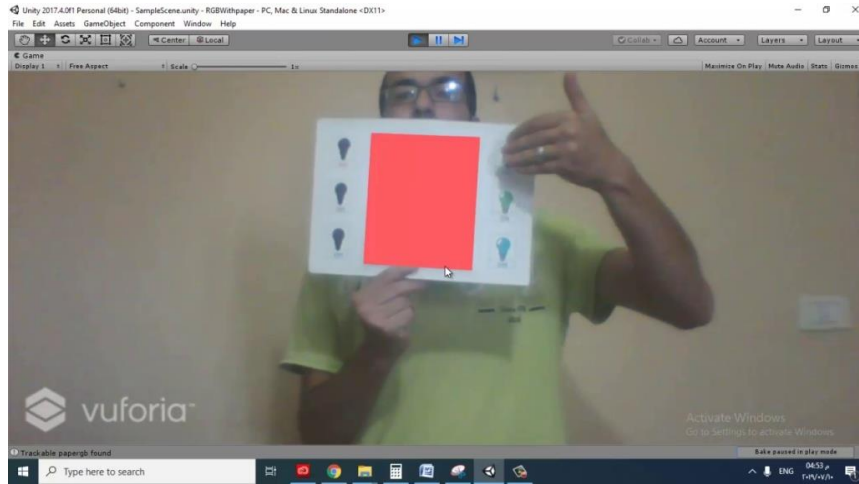
Figure (11) The paper turns red when the red key is pressed

Students are asked what to expect when they press the green key and wait for their expectations to be
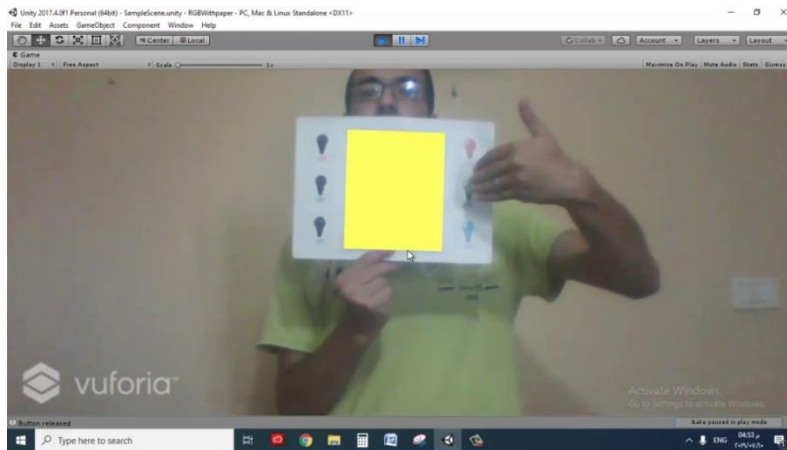pressed afterwards.

Figure (12) The paper turns yellow when the green key is pressed.

In front of the students, the color of the paper is shown, and it has turned yellow. This means that if red is added to green, the result is yellow, which is the complementary color to the third color, which is blue. Then on the black key opposite the green light.
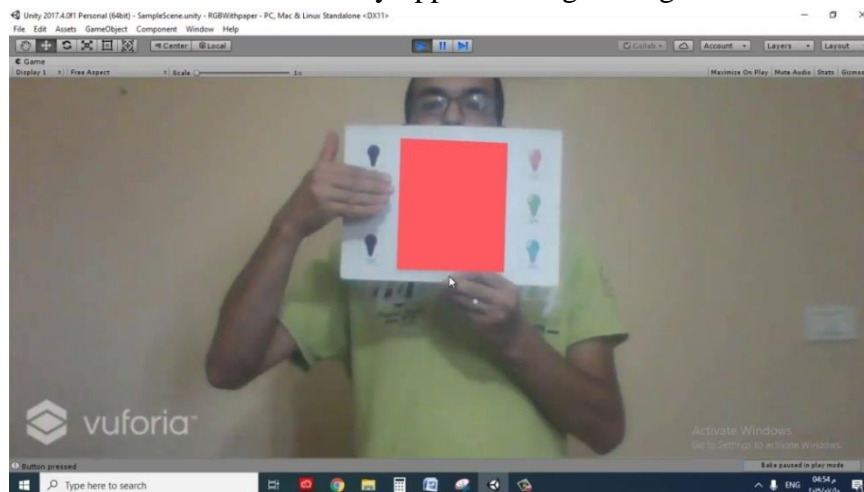

Figure (13) The paper turns red when you press the green off key

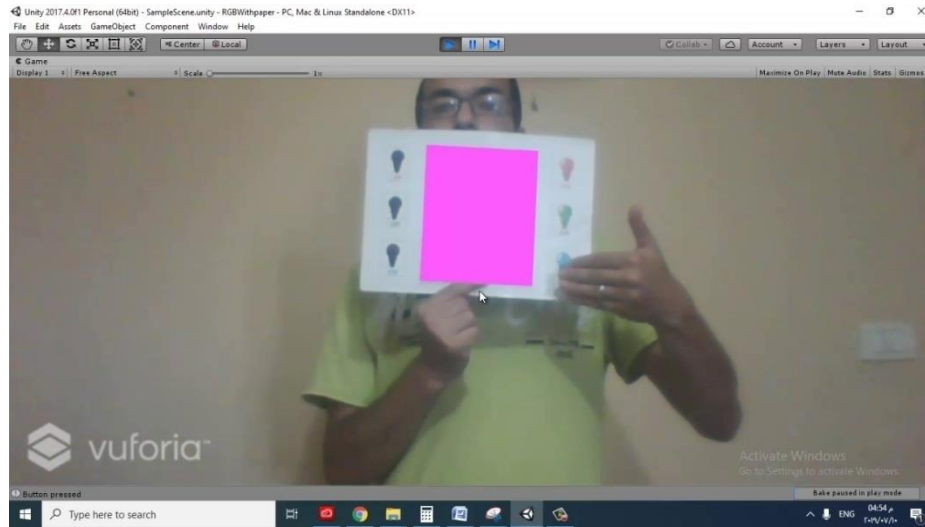Then the students asked what do you expect now when you press the blue key to find the result is the color magenta.

Figure (14) The sheet turns magenta when the blue light switch is pressed.

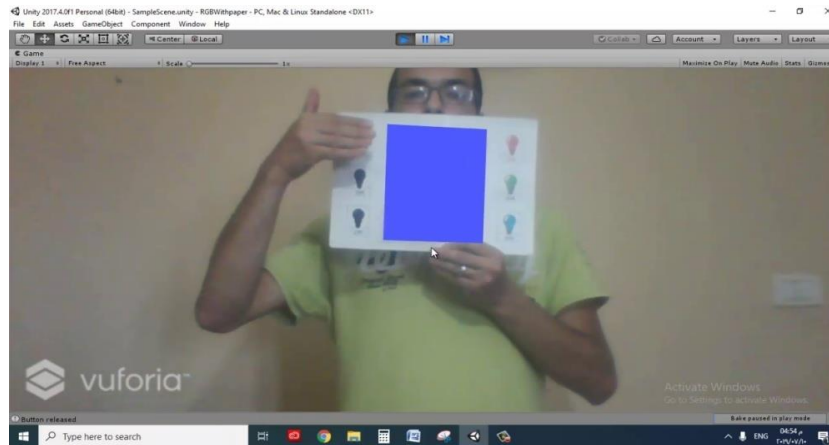The lecturer then turns off the red light to keep the blue color.

Figure (15) The paper turns blue when the red light switch is pressed.

Then, he presses the green light switch to create the Cian color.
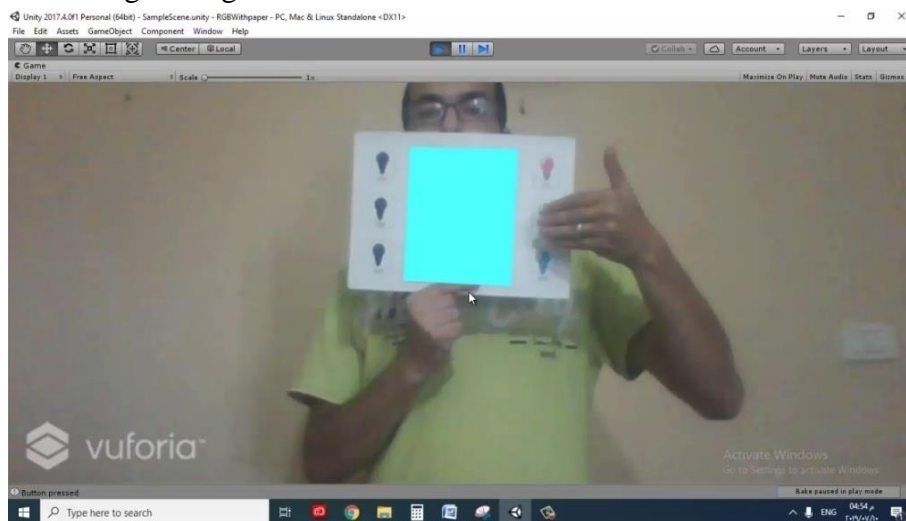

Figure (16) Then, he presses the green light switch to create the Cian color....

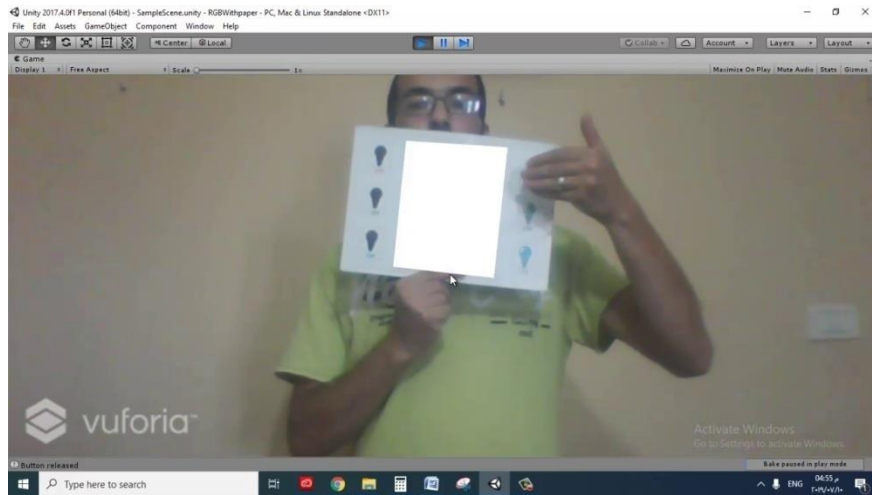Then press the red key to create white light.

Figure (17) The paper turns white when the red light switch is pressed.

Thus, the theory of color gamut and its relationship to the primary colors together and the results of their superposition have been proven together.

Results:

1- Using unity 3d is an ideal way to produce augmented reality applications.

2- Through the use of the program, the theory of color and its relationship to the primary colors can be explained to each other and the consequences of their overlap together, where the magenta color appeared when pressing red and blue together, and the cyan color appeared when pressing blue and green together and yellow appeared when pressing red and green together.

3- The Educational Aid allows the participation and interaction of students with them, where they can press keys inside the aid and obtain different results. The lecturer can also be asked about their expectations of the result and test the validity of this expectation or not.

4- Unity 3D allows the production of applications to run on different operating systems windows - android - IOS - lunix, which allows the output of applications that work with all smart phones.

Recommendations:

1- It is recommended to use augmented reality to produce educational aids.

2- Developing educational curricula according to the modern Aids of learning because of its ability to increase student participation...

3- It is recommended to produce the application to work on the mobile phone in a way that facilitates the student to use the application easily in any place.

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