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Chemix: An Android-App Augmented Reality of the Periodic Table of Elements

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The periodic table is the arranged form of chemical elements that are usually presented using regular paper and in plain text form which is less interesting and harder for students to learn. Augmented reality is a technology or application that visualizes objects in 3D. In this study, Augmented Reality was used to provide a more interesting application for Android phones to visualize each element in the periodic table. The researchers created an application based on Augmented Reality called Chemix, an Android-app Augmented Reality of the periodic table of elements that aims to provide a more interesting and easier way to learn the chemical elements. It allows the use of Android devices for users to see the elements as if they are just in front of them. The Augmented Reality application provides a 3D presentation of the elements and shows the meaning and information on the elements. It also has a feature where users can combine two different elements to create a compound.

Keywords: chemistry, periodic table, elements, augmented reality

Introduction

Science and Technology is an interdisciplinary field that is related and entangled with humans and institutions, including their meanings, values, and practices. Over the past 200 years, the field has evolved to be among the most substantial types of human activity and inseparable from social, political, and economic organizations. It has also proceeded to be an instrument towards army power, economic innovation, democratic governance, moral judgment, political imagination, and cultural difference. Increasingly, Science and Technology has permeated the social and material fabric of daily life via the explanatory strength of scientific models, the qualification of metrics of individual and organizational performance, and the globalization of information, communications, energy, transportation, and different technological infrastructures (Ulrike, et al., 2017). Ultimately, it shapes how humans experience, imagine, assemble, and order the worldthey live in.

Yilmaz (2018) described Augmented Reality (AR) as a new technology that acts as a bridge between the real world and the virtual environment by providing synchronous interaction. Virtual reality objects can be brought to the real world through AR. In other words, throughout the recording of the real world with the camera, AR makes use of pre-determined target points in the real world by using connecting digital objects and decoding the results through certain programs. It can distinguish itself from other technologies by combining indirect and real objects by providing real-time interaction, and by way of involving 3D objects. It is a technology that is increasingly popular and can be used on dissimilar platforms such as desktop and laptop computers, portable devices, and smartphones. Applications developed with AR technology permit the use of 3D objects, images, text, videos, and animations. This technology allows the

use of these devices together at the same time. For that reason, users can naturally interact with events, objects, and information.

This study proposed an Android-app Augmented Reality of the periodic table of elements to eradicate the students' behavior of being disinterested in reading plain text books. The application offers an augmented use of chemicals for educational purposes. It allows visualization of the elements using mobile phones making learning a lot easier. Based on anecdotes of different students, traditional learning through memorization is not at all attractive or inviting enough especially when studying chemistry as it takes a long time to recognize the elements. With the use of Augmented Reality, users can interact with virtual objects in the real world. Such applications used in the field of education can greatly enhance the users' memory while injecting entertainment with education. Through the Android mobile phone devices like smartphones and tablets, users can visualize the properties of every element in the periodic table as they appear in the smartphone's screen. This is an innovation and deemed to be a more efficient and effective way of learning the periodic table of elements.

Method

The conceptual framework is shown in Figure 1.

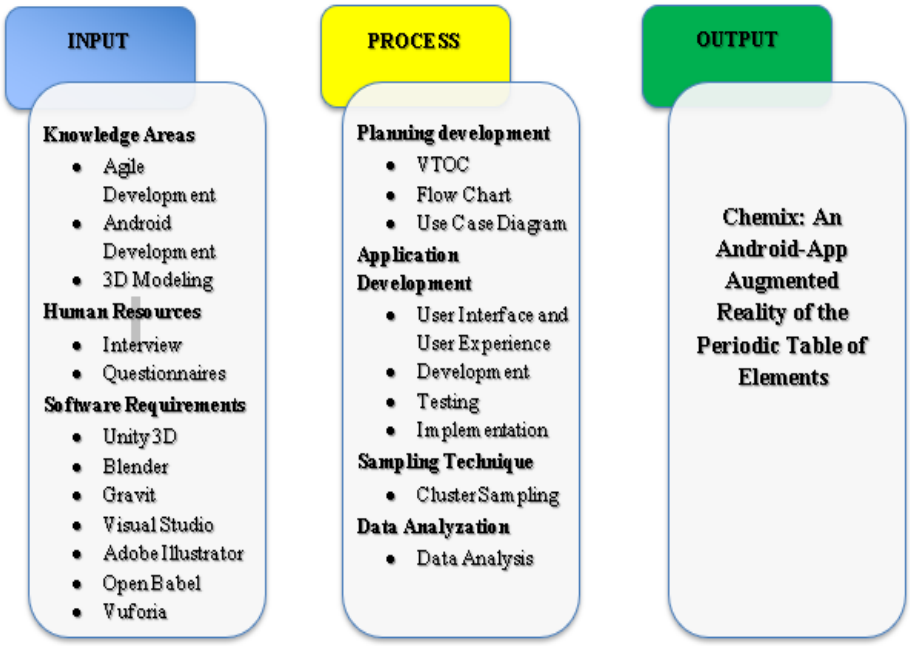

Figure 1. Conceptual Framework of the Study

The conceptual framework maps out the activities required throughout the examination given the past information on other analysts' perspectives and perceptions regarding the matter of research (McGaghie, et al., 2015). The conceptual framework exists in a lot more extensive structure called a theoretical framework. The latter draws support from time-tested theories that embody the findings of many researchers on why and how a particular phenomenon occurs.

The system development methodology is shown in Figure 2.

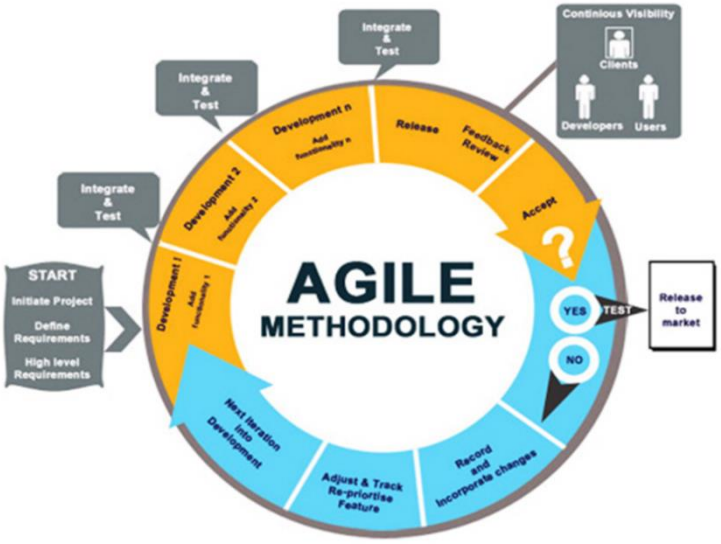

Figure 2. System Development Methodology

Agile methodology is useful for the researchers because it is a practice that promotes continuous iteration of development and testing throughout the software development lifecycle of the project. Waters (2007) cited that one of the key standards of agile development was that trying was incorporated all throughout the procedure. By the use of the said method, the researchers provided a quick response to the feedback on their research. It created opportunities to assess a project direction during the development cycle. The team assessed the research in a regular meeting called sprints or iterations.

1. Plan is a project planning method that estimates work using self-contained work units called iterations or sprints.
2. Development is the process of creating software based on a defined plan. The researcher designs and develops the system based on the plan and information gathered from the respondents.
3. Testing is an activity to check whether the actual results match the expected results and to ensure that the software system is defect-free. Test the developed system to know if there are things that need improvements or changes.
4. Delivery integrates and delivers the working iteration into production. Show the finished product to the respondents for them to examine.
5. Feedback accepts student's feedback and works it into the requirements of the next iteration. Ask the respondents if they have suggestions on how to improve the system and what are the best options or opinions they can provide.

The use case diagram is shown in Figure 3.

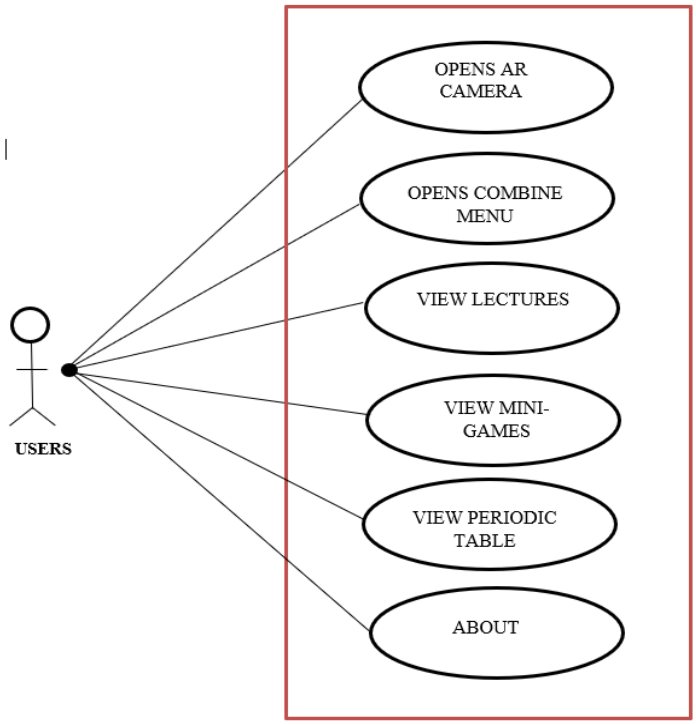

Figure 3. Use Case Diagram

The Use Case diagram is referred to as a behavior diagram used to depict resources of activities that the system should perform in a collaborative effort with at least one outside client otherwise called "actors". Use actors and use cases to demonstrate the usefulness of a framework. Users can access the features such as the camera, combine menu, view lectures, mini games, and periodic table.

Results

The User Interface (see Figures 4-7) shows the different views that can be seen in the application.

Figure 4. Main Menu

Figure 4 shows the main menu of the mobile application that has AR camera, combine menu, mini games, lessons and periodic table.

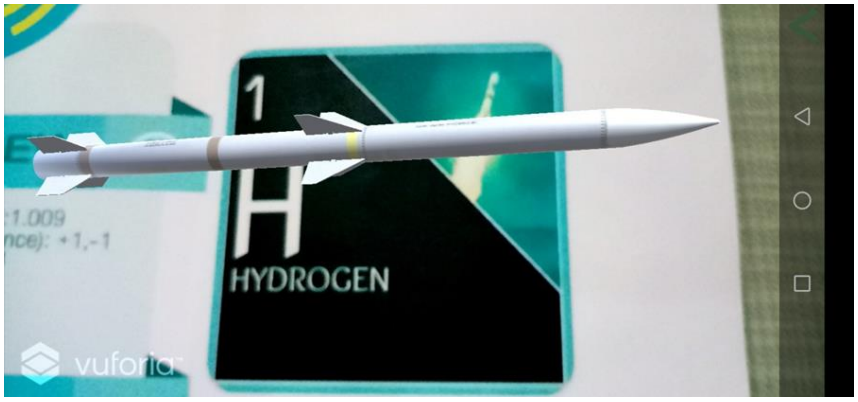

Figure 5. Camera when an element was scanned

Figure 5 shows an AR image when the picture of an element is scanned using the camera. The AR image shows an object that is related to the element.

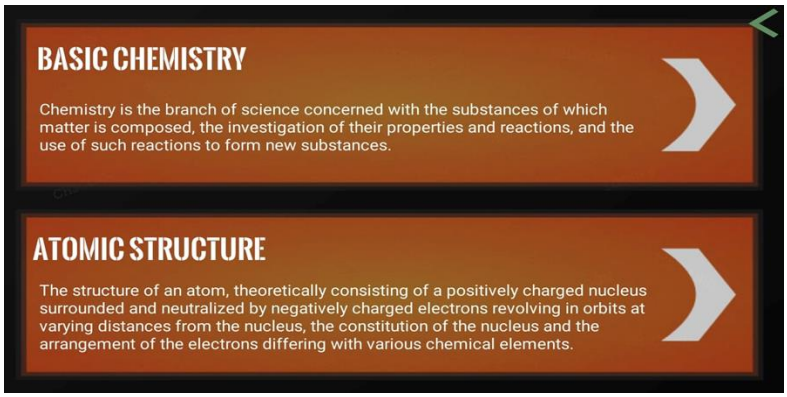

Figure 6. Lesson

Figure 6 shows the sample lesson that is presented on each element.

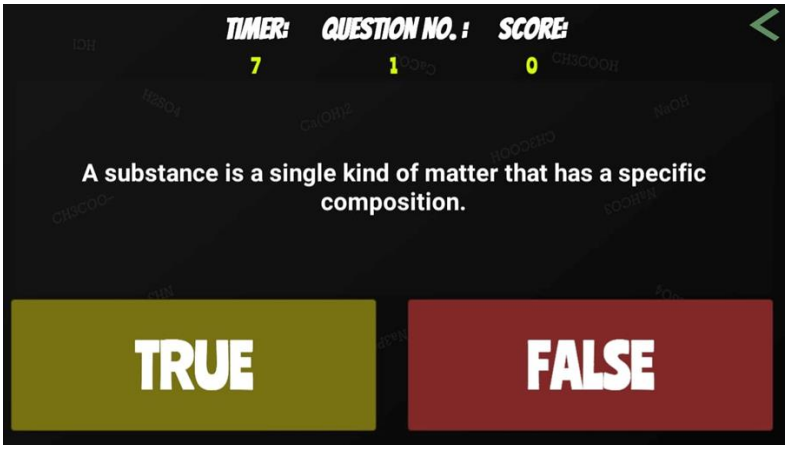

Figure 7. Mini Game

Figure 7 is a screenshot of one of the activities in the application.

This part of the study presents the complete result of the evaluation conducted by the users and IT experts. The evaluation criteria were based on the characteristics or metrics of ISO-25000 or the Software Quality Assurance. The respondents for the evaluation consisted of ninety-two (92) users from three (3) different Grade 9 sections in Angeles City National High School and three (3) IT experts.

Table 1. Assessment of Users

Indicators	Mean	Description
Functional Suitability	4.73	Excellent
Performance Efficiency	4.51	Excellent
Usability	4.70	Excellent
Reliability	4.51	Excellent
Portability	4.51	Excellent
Overall	4.59	Excellent

Table 1 shows the result of the evaluation from the users. The overall rating given to the application has the mean of 4.59 which is equivalent to an “excellent” rating. This shows that the application met the users’ requirements.

Table 2. Assessment of IT Experts

Criteria	Mean	Descriptive Rating
Functionality	3.78	Very Good
Performance efficiency	3.78	Very Good
Compatibility	4.00	Very Good
Usability	3.67	Very Good
Reliability	3.83	Very Good
Maintainability	3.80	Very Good
Portability	4.00	Very Good
Overall	3.84	Very Good

Table 2 shows the result of the evaluation of IT Experts. The overall rating given to the application is 3.84, that is, very good.

Discussion

Based on the evaluation results of the 92 students from Angeles City National High School and three I.T experts, the system was deemed suitable for students who take up Chemistry. It is also rated as completely functional and reliable. The project was found to be “excellent” by the students/users, while a “very good” rating was given by the IT experts. Functional suitability got the highest rank among the students/users while reliability got the highest rank among the IT experts. There are still features in the application that need to be improved in terms of usability. The researchers also looked into the comments and suggestions of the respondents for further development of the application.

Conclusion

Based on the results, the following conclusions are drawn:

1. The researchers successfully produced an appropriate and interactive application using the Augmented Reality (AR) marker-based Android application and a booklet that the students can use if they want to see 3D models of a specific element. The success of the said application was backed up by its very good rating from the IT experts and its intended users.
2. The application has different functionalities which led the researchers to successfully provide a user learning application that can trigger the students' familiarity and knowledge.
3. Students do not need to buy real elements for educational purposes because the Chemix application can provide 3D models for the use of each element and 3D compounds that can be used for combination in the application.

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