Anaphy: An Augmented Reality Illustration

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Abstract: - Science as we all know is a wide subject to study; it is complicated because most part of it cannot be understood by students unless there is a demonstration or experimentation conducted. This research aims to create a mobile application that would help student s who finds it hard to learn science without visualization or illustration on an object. Science combined with modern technology will help students in this particular problem because it can provide the need of the student for visualization and illustration on the subject which is the Anatomy and Physiology. Using a human detection and an Augmented Reality applied in mobile the researchers develop a mobile app which is the Anaphy Augmented Reality that answers the problem of the subject.

Keyword:-Augmented Reality Anatomy Physiology Detection Android Studio.

I. INTRODUCTION

Figure 1 shows the different branches of Science. One of the branches in science is biology and then one of the branches of biology are physiology and anatomy. Anatomy is the study of human structure while physiology defines its functions. Anatomy and physiology cannot be separated to each other because they always go together for better understanding of the human structure.
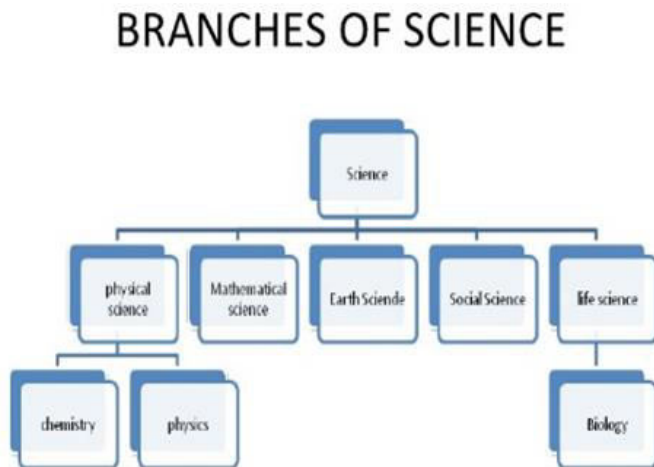

Figure 1: Branches of Science

Learning anatomy requires students to memorize a great deal of information and contextualize this within the range of body functions. Visualizing the relationships in three dimensional (3D) form of various organs and their interdependent functions is a difficult task (Dominguese, 2011. Anatomy can be a very important subject as fundamental towards many relevant fields, such as health science (Sakellariou et. al., 2009).

One of the prominent problems in learning anatomy is that it is impossible for the trainee to investigate in depth the layered structures, their spatial relations and visit these complex structures from different angles that might enlighten their perception and understanding (Yeom, 2011). Also one of the main difficulties in understanding anatomy is the gap between illustrations *per se* in textbooks or learning resources and the actual body or cadavers (Yeom, 2011).

Technology has become embedded in education and the results indicate a positive impact on learning and teaching styles (Published by Canadian Center of Science and Education, 2015). According to Shapley et al. (2011), lessons that are supported by technology will lead to more innovative forms of teaching and learning. This is because the use of technology involves real-world problems, current informational resources, simulations of concepts, and communication with professionals in the field. In addition, learning using technology is believed to complement the traditional forms of teaching and learning (Yasak et al., 2010).

The ability to overlay computer graphics onto the real world is commonly called Augmented Reality (AR). Unlike immersive Virtual Reality, AR interfaces allow users to see the real world at the same time as virtual imagery attached to real locations and objects. In an AR interface, the user views the world through a handheld or head mounted display (HMD) that is either see-through or overlays graphics on video of the surrounding environment. AR interfaces enhance the real world experience, unlike other computer interfaces that draw users away from the real world and onto the screen (Billinghurst, 2002).

Single user Augmented Reality interfaces have been developed for computer-aided instruction, manufacturing and medical visualization. These applications have shown that Augmented Reality interfaces can enable a person to interact

with the real world in ways never before possible. For example, Bajura, et al, have developed a medical interface that overlays virtual ultrasound images onto a patient's body, allowing doctors to have "X-Ray" vision in a needle biopsy task. In Feiner's work, users can see virtual annotations appearing over a laser printer, showing them how to repair the machine. In both of these cases the user can move around the three-dimensional virtual image and view it from any vantage point, just like a real object (Billinghurst, 2009).

A. Statement of the Problem

The existing Human Anatomy and Physiology Augmented Reality App lack some important feature for more efficiency. The following are the specific problems that the researchers would like to address:

- the viewing angle of AR model cannot be rotated in 360 degrees;
- it cannot detect human body in real time and use it as the basis for the AR app;
- functionalities and description of anatomy and physiology are not complete in the AR model; and
- Existing applications are dependent on images of certain body parts. AR will only function if the app will be focused on an image, once the image is removed, it will not be retained in the app.

B. Objectives

The purpose of the study is to help students understand science, specifically in the branch of biology; the anatomy and physiology easily and for them to like the subject much better.
Specifically, this study aims to:

- design a mobile app that uses Augmented Reality for the illustration of object that will be used in education in the field of science;
- develop a mobile application that will help students in their education for better understanding particularly in science; and
- Evaluate the usability of the mobile app to the intended users.

C. Significance of the Study

This study will benefit the following:

Students for their advance learning of the subject which is the Physiology and Anatomy. It will benefit student for their studies in the science subject. High school, college or even elementary students can use the app, for it can be easily accessed through a mobile phone. With the help of the app the student can now easily illustrate and visualize the subject since the app uses a 3D model as an illustration for better learning of the subject.

Teachers especially science teachers can use the app for better teaching of the subject for student to catch their attention easily on the discussion of the teacher, to avoid boring discussion for student and to make them interact on the subject for the development of their critical thinking in the subject since teacher uses technology as a tool for teaching.

School, since the project is a mobile application and the app is intended for all users who uses smartphones it would be less expensive for the school to apply or use this app. The school need not buy expensive facilities to demonstrate the subject to the students.

The app is conceptualize in AR where the user must point their camera to a human body for it detect in real-time the human body parts. If it detects a human body part, a 3D model of that part will then appear with the name of the part and when you click you can view the description or function of the model. The user can rotate it to 360 degrees. There is also a detection of the human body parts namely full body, head, upper body and lower body.

The detection of the app is limited in the branch of science which is the anatomy and physiology. The application will not include sound, and is not applicable for non-android phones. The larger the distance of the camera, the harder it detect the parts of the human body.

D. Review of Related Literature

a). Pokemon GO

It wouldn't be a list of the best AR apps without mentioning Niantic's *Pokémon Go*, a game that has quickly captured everyone's attention and given them a reason to go out into the world, walk around, and catch Pokémon. The game uses GPS to mark your location, and move your in-game avatar, while your Smartphone camera is used to show Pokémon in the real world. For the most part, it works, provided the game hasn't crashed or frozen. There aren't a lot of instructions when you first start, or information regarding game mechanics like the colored rings around wild Pokémon, but thanks to the nature of the internet, figuring out what to do isn't that tough (Widder, 2017).

Players of *Ingress*, another creation from Niantic, will see many similarities between the developer's two games, right down to the locations marked as PokéStops and Gyms. The implementation of the original 150 Pocket Monsters is definitely the biggest thing *Pokémon Go* has, well, going for it compared to its predecessor. Niantic is set to continue updating the game to improve its performance, however, and add new features like trading, so hopefully *Pokémon Go* will stick around for a good, long while (Widder, 2017).

b). Google Translate

Google Translate isn't strictly an AR app, but it does have one AR feature that's incredibly useful for translating text. That particular feature is part of the app's camera mode. Simply snap a photo of the text you don't understand, and the app will translate the text in your photo in real time. When connected to Wi-Fi, the app supports a vast number of languages — 13 of which were added in a recent update — but users can also download a number of language packs if they want to continue using the instant translation feature while offline or without a cellular connection. Next time you take a trip to a country with a language you don't fluently speak, Google Translate could be your best friend and the very thing that will keep you from getting lost in a strange land (Widder, 2017).

c). SnapShot Showroom

Retail isn't everyone's cup of tea, but there will likely come a day when you'll consider purchasing a decent sofa in lieu of the ratty, college-curated piece of work you call a couch. With SnapShop showroom, users can see what potential furniture may look like in the comfort of their living room, kitchen, bedroom, or any other desired area of their home. Once you capture an image of the room you wish to furnish, you can quickly browse and place assorted items (chairs, lamps, beds, tables, etc.) from the likes of big-name retailers like IKEA, Pier 1 Imports, Crate & Barrel, and Horchow, among others. Users can then resize the furniture, reposition it in the virtual environments, and try various patterns and color combinations until they find the right fit for their home. The furniture can even be purchased directly within the app afterward, conveniently saving you a trip to the store or the accompanying headache that goes hand-in-hand with the discovering you had the wrong dimensions all along (Umar, 2010).

d). Augmented Car Finder

We've all done it before — you finish up your grocery shopping and head out into the parking lot to make your way home, but unfortunately have no idea where you parked. Fortunately, Augmented Car Finder is an app specifically designed to help guide you to your hiding vehicle. Once the car's location is set, the app creates a visible marker showing the car, the distance you are from it, and the direction you should walk to find it. We've found that it's most useful for places like stadiums, convention centers, outdoor concert venues, and other crowded areas or those lined with massive parking lots. Users can also utilize the app to find their seats in large theaters and concert halls. The freemium version of the software should suffice for most users, but the premium version does remove the ads and include additional tools for marking your favorite parking spot or specifying the arrow color. Augmented Car Finder may be an iOS exclusive, but

Android users can always purchase the similarly-equipped (Widder, 2017).

e). Anatomy

Anatomy is a natural science dealing with the structural organization of all living things. You will often encounter a course in gross anatomy as part of a medical school program. During such a course, you are required to attend lectures as well as participate in dissection laboratory sessions, which provide you with hands-on exposure to various biological systems and organs. Specific topics you might be introduced to include the structure of the musculoskeletal, nervous, circulatory, immune, respiratory, digestive, and reproductive systems. You might also look at anatomy on a microscopic level, examining the structure of organs and tissues via their cells (http://learn.org/articles/What_is_Anatomy_and_Physiology.html).

f). Physiology

Much like anatomy, physiology is concerned with the principal organ systems, such as the musculoskeletal and nervous systems. However, when studying physiology, you will be looking at the functions of cells and organs within their biological systems, rather than their structures. You could study physiology on a broad level, such as the physiology of mammals, during which you would study the manner in which organs function in the body of a mammal as a whole. You might also study with a narrower focus, such as the physiology of the cardiovascular system. For example, during this course, you might take a look at how the heart performs its particular function (http://learn.org/articles/What_is_Anatomy_and_Physiology.html).

g). *4D Anatomy*

Through this free app and a simple printed image, Anatomy 4D transports students, teachers, medical professionals, and anyone who wants to learn about the body into an interactive 4D experience of human anatomy. Visually stunning and completely interactive, Anatomy 4D uses augmented reality and other cutting edge technologies to create the perfect vehicle for 21st century education (http://anatomy4d.daqri.com/).

So much more than an app, the Anatomy 4D experience takes viewers on a journey inside the human body and heart, revealing the spatial relationships of our organs, skeleton, muscles, and body systems. This simple-to-use 3-dimensional learning environment is great for use in the classroom, or anytime.

Designed by DAQRI, the Anatomy 4D app enables you to:

- Learn about and explore the human body and heart in intricate detail.
- Highlight various organ systems individually, so for instance, you can focus on just the skeletal, muscular, or respiratory system.
- Change the view back and forth between a male and female body.
- Zoom in to experience each organ or body part in-depth.
- Use new image targets including the new heart target (this new app release still supports the original image target) (http://anatomy4d.daqri.com/).

II.   RESEARCH METHOD

The project requires a (3D) model for the illustration, tracking or detection and augmentation. In order for the project to be developed, there are some tools that this project requires. The researchers plan is to use the blender in creating a 3D human body model for the illustration and it can be viewed in 360 degree and for easy manipulation and clearer visualization. The researchers will also use OpenCV for the detection of the model. The language that the researchers will be using for detecting is c++ because it is recommended by many people.

In creating a 3D body parts model of a human body, the researcher uses the software blender in modeling an object. By using the different tools of a blender such as merge, knife, fill, etc., and other components of the blender that the researchers created the full body, hands, arm and skeletal hands to get our desired output. Blender has the ability to put a grid to scale your model and it also uses an image to view it into right, back front, left views etc. to trace the image in order for us to create the model.

Another component that the researchers used in blender is the modifier mirror and they used it to create the full human body model. The researchers cut half of its body and mirror it in order for them to make the model balanced (left hands and right hands). After creating an object or importing we use blender to export model in to Obj files to use in overlaying.

Figure 2 show that the user will detect human body parts in real-time using their smart phones or devices. From the device the app will fetch the detected data and tries to match the detected data to the database. Once the detected data matches with the database, the AR model of that part is displayed on the smart phones of the user along with its information and functions.
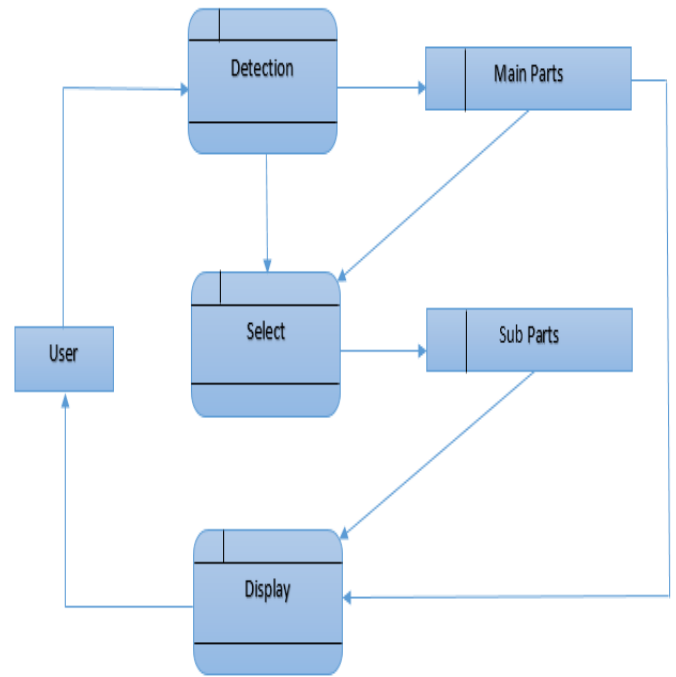

Figure 2: System Architecture

Figure 3 shows that the app detects the main parts of the body which are the; head, upper body, lower body, and whole body. When one of the parts are detected the user can select a sub part depending on which part of the main parts it is under. The 3D model is then displayed when the main part is detected as well as when you select a sub part.
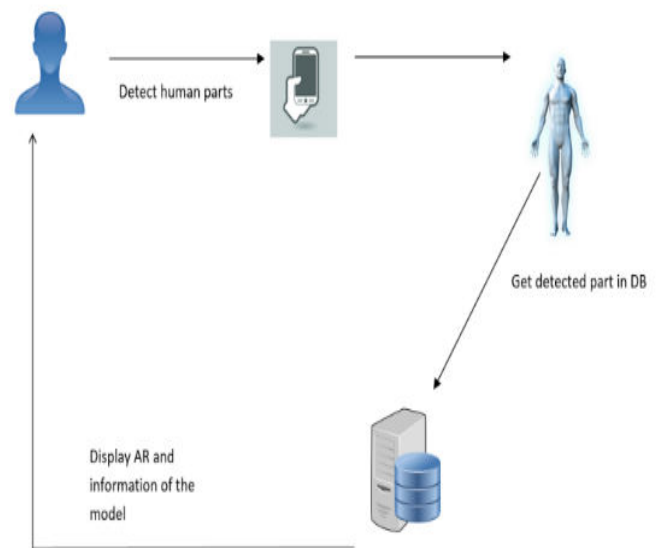

Figure 3: Context Diagram

III. RESULTS AND ANALYSIS

Figure 4 shows the detection of one of the main parts which is head. The green box indicates that the face is detected and ready to view. And to see the 3D model of the detected part just click the button view.

Figure 4: Illustration of Face Detected

Figure 5 shows the 3D model of the detected part of head. This model will appear when you click the button view in figure 4.1 above. The 3D model can be rotated 360 degree with labels on it. The button icon which has a background color of blue is to show the information of the 3D model. And the button icon which has a background color of orange is to see the other sub parts of the given 3D model.

Figure 5 shows the information about the 3D model head. This information will appear in clicking the button icon with the background color of blue.

Figure 5: Illustration of the 3D Model of Head

The researchers conducted a test that would prove the accuracy, functionalities and usability of the application. The researchers try to detect the main parts of the human body if the accuracy of displaying the model is always right. And the functionality of the app is all passed see table 1.

Mobile functionality test shows how the application works. In this test, the researchers conducted a survey in which the students and teachers can benefit it. Researchers used the mobile application with a real time detection of the app to test if it can effectively display and visualize the human body parts.

The Mobile Usability conducted above shows average percentage per question on each of the survey questions that was provided to 50 random respondents specifically 25 students from Senior High School and 25 teachers who teach in Science. It was held in University of Science and Technology in Southern Philippines on February 16, 2017 just to test the functionality of the application we created. Results show that almost half of random respondents like the application and find it easy to use without any help of any person. Also they find the application very integrated and confident to use.

Table 1 shows the application run. The mobile application has passed on the following tests that was been conducted for its functionality, it was being shown that the application can detect the human body parts and can display its three dimensional (3D) model using the application.

Mobile Functionalities	Remarks
Detecting	Passed
Displaying 3D Model	Passed
Displaying information	Passed
Can rotate 360 degrees	Passed

Table 1: Functionality Test

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application and find it easy to use without any help of any person.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. Overall, I am satisfied with how easy it is to use this application.			20	30
2. It was simple to use this application.			10	40
3. I feel comfortable using this application.		5	10	35
4. It was easy to learn to use this application.				50
5. I believe I became productive quickly using this application.	3	7	25	15
6. It is easy to find the information I needed.			30	20
7. The information provided for the application is easy to understand.		3	37	10
8. The information is effective in helping me complete my homework (e.g. Science Anatomy and Physiology).	2	3	10	35
9. The organization of information on the apps screen is clear.		5	25	20
10. I like using the interface of this application.	5	30	15	
11. The interface of this application is pleasant.	10	20	20	
12. This application has all the functions and capabilities I expect it to have.		10	20	20
13. Overall, I am satisfied with this application.			15	35

Table 2: Usability Scale Result

IV. CONCLUSION

A. Conclusion

The researchers concluded that implementing a mobile application of Augmented Reality that provides a visualization of a human body. With the entire test conducted, it can be concluded that the application provides a real-time access from their android phones and the respondents are satisfied how easy to use the application and they are comfortable in using it. It is concluded that the functionality of the app is easy to learn and to find the information needed and can easily understand the structure of a human body. Furthermore, it also helps students understand science, specifically in the branch of biology; the anatomy and physiology easily.

B. Recommendation

The researchers recommend some improvements of the applications like clickable labels instead of the list. And proper texturing of the models. And more specific definition and functions of the parts. And make the detection faster and also in displaying the models. And separate the different view button like skin, muscular and skeletal button view. And applying zooms in and zooms out.

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