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Integration of Face Detection and Augmented Reality into Human Anatomy Education

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Abstract: This paper proposes an interactive augmented reality (AR) application to aid medical student in learning the human anatomy. Students will be able to take a photo of their friend using the camera in real time. Then, the system will detect their friend's face and relocate the human anatomy to the approximate position of their friends inside the augmented reality application. With this application, the learning process will be fun and could help in improving the student's retention in their studies while boosting their motivation in getting better in their learning. Besides, teamwork will be fostered along when the students are learning in a group. The experiment is conducted on the first-year medical related student in Universiti Tunku Abdul Rahman (UTAR). The result shows that there are 75% of the students agree and strongly agree that this application is able to facilitate them in the understanding of human anatomy. Based on the survey, it is concluded that the students are satisfied with this application and agreed to the effectiveness of Augmented Reality in their learning process.

Keywords: Augmented Reality, face detection, educational game, serious game, human anatomy

1. Introduction

Today's students are growing up in the information and communication environment era and traditional teaching and learning methods are becoming difficult to attain their interest (Bi, M. et. al., 2019). Students are able to obtain the knowledge in different ways, for example to study from books, laptop, desktop, tablet, smartphones and other electronics appliances (Lee, K., 2012). Although the choices to obtain knowledge are highly reliant on individual preferences, but the traditional way of getting knowledge from books is not a good choice for human anatomy studies as it can only displays in two dimensional.

Integrating the AR into teaching and learning methods can attract the student's attention. Besides that, implementing AR into education can make studying more interactive, less stressful and more productive. (Huang, T. C. et. al., 2016).

AR captures the real environment as the background and virtual assets are then added into the captured scene such as button, text, label, 3D models, 3D animations, 2D images and so on. Based on the results found by Wang, M. et. al. (2018), AR had proved its efficiency in various pedagogical perspectives, which are instructionism, constructivism and collaborative learning.

In AR applications, it can be divided into two types, marker and markerless Augmented Reality. Both types of AR are widely used in education field. Juanes, J. A. et. (2014) introduced a marker based augmented reality with the human anatomy contents where they scan a marker then display the relevant human anatomy information. There are also a few researchers who applied markerless AR such as Chien et. al. (2010) and Kegerlmann D. et. al. (2018) in human anatomy studies as well.

Based on the statement of Yung, R., & Khoo-Lattimore, C. (2019), due to financial problem, AR in education is hard to implement in school. In Malaysia, primary school and secondary school students are not allowed to bring smartphones to attend the school. However, the students in higher education do not facing this kind of problem because they are allowed to bring their smartphones to campus.

In this paper, an AR application called "capture your friend with human anatomy" (CapAnatomy) is

introduced to help first year medical students in memorizing the human anatomy. This application is able to rescale the virtual human anatomy based on the estimate location of the body to help the students to better understand the location of that particular human anatomy. This helps students in understanding the relationship of spatial between the real person and virtual human anatomy. When the student is moved while the application is targeted on him, the virtual human anatomy will move accordingly. The real or the physical virtual model of human anatomy is expensive and impractical for students to own it, but using AR application will allow them the access to the resources with lower cost and portability.

1.2. Research aims

The aims of this research are to apply interactive Augmented Reality application to helps medical students attain more focus, learning in less stressful condition and interactively to understand the human anatomy.

2. Methodology

This application is developed using Unity game engine and OpenCV library. OpenCV is used to detect the user's position in the camera and then find the approximated spatial for human anatomy. Firstly, the face of the user's is detected and it can be the user himself or his/her friend. Secondly, the calculation is carried out to find the approximate location of the human anatomy based on the ratio of face in the camera view. The size of the human anatomy will be rescale based on the ratio of face. Then the user is required to answer the quiz for the anatomy parts after 10 minutes by pressing the next button in the application. Then quiz questions will be ask regarding the human anatomy studied in the previous section. The score is calculated when the submit button is pressed in the application after they finished answering the questions. Figure 1 refers to the flowchart of the overall prototype for this system.

This AR application is a prototype and concept version only. Therefore, only digestive system is available at the moment. The application is being used by the students to test its effectiveness in teaching and learning process. A total of 41 respondents from UTAR have undergone the test. They are all first-year students from the Bachelor of Nursing, Bachelor of Physiotherapy and Bachelor of Traditional Chinese Medicine.

A Google form survey which incorporates their learning ways, satisfactory towards the AR applications, feeling and their experience with augmented reality are done by those students that undergone the tests and the results are studied.

Figure 2 refers to the prototype of the application. An input field, buttons, face detection technique, camera and 3D human anatomy's model are used.

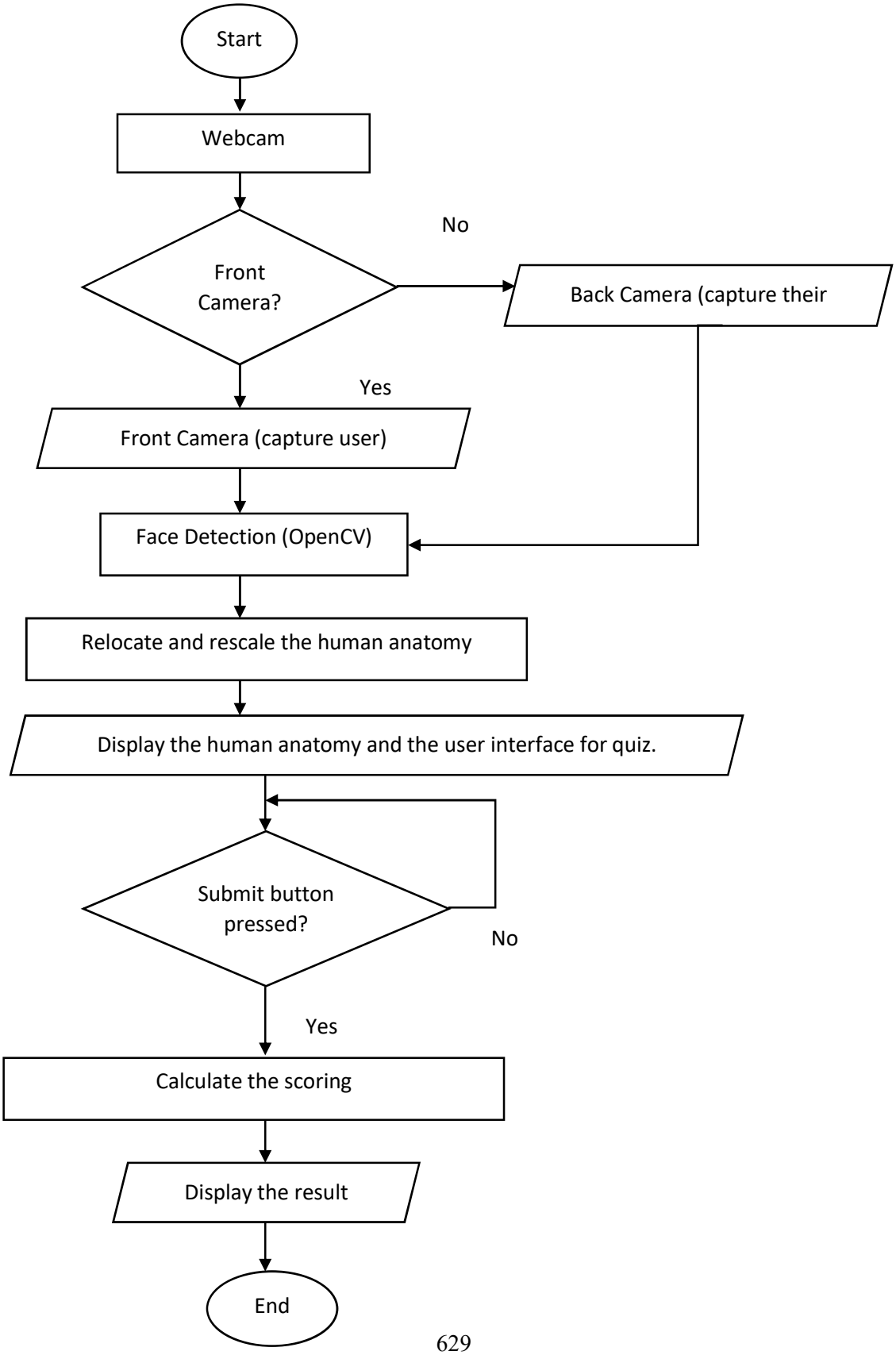
Start
Webcam
Front Camera?
No
Back Camera (capture their
Yes
Front Camera (capture user)
Face Detection (OpenCV)
Relocate and rescale the human anatomy
Display the human anatomy and the user interface for quiz.
Submit button pressed?
No
Yes
Calculate the scoring
Display the result
End

Figure 1. Flowchart of the overall prototype.

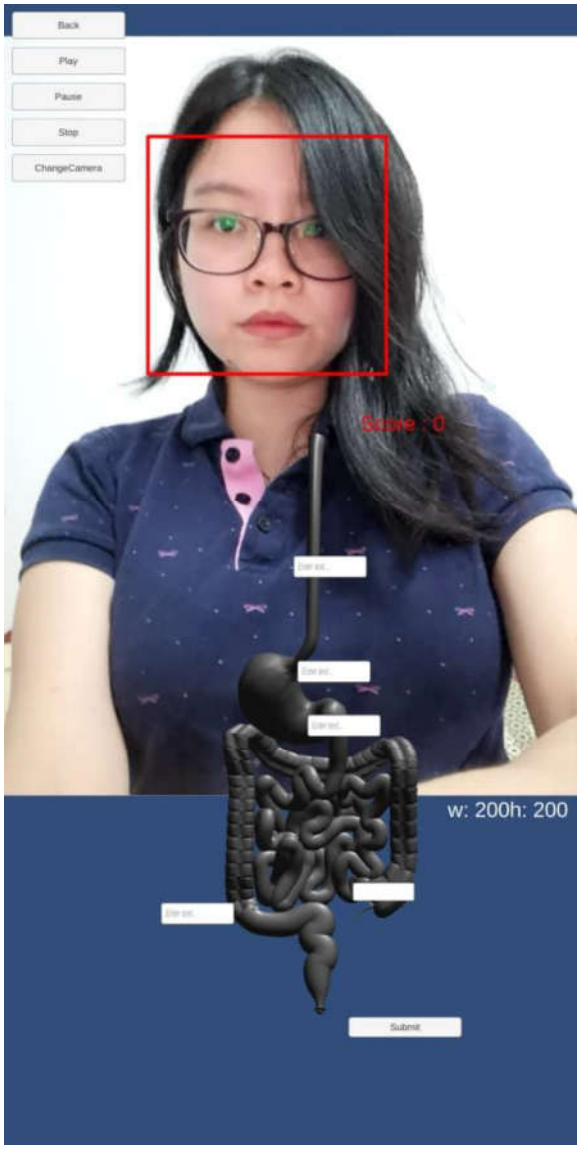

Figure 2. Prototype of CapAnatomy.

3. Results and discussion

From the results obtained, 80 percent of the students had never experienced Augmented Reality-based learning methods. In Malaysia, our education methods are conventional because the educators lack technological skills especially among older generations. The result is shown in Figure 3.

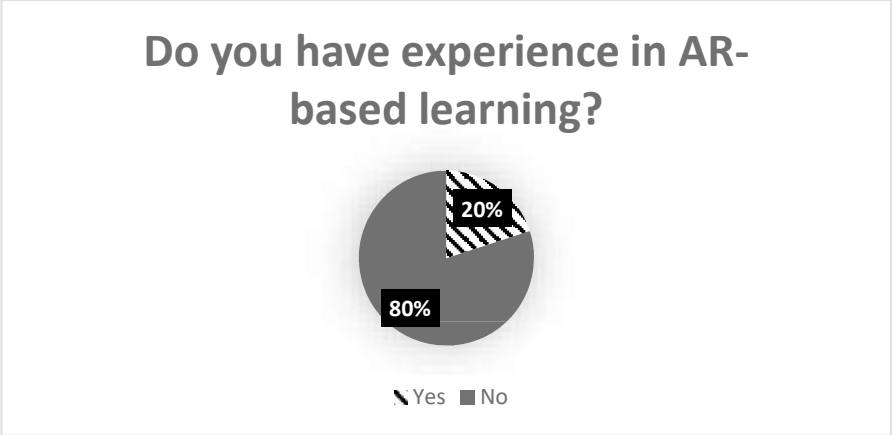

Figure 3. The pie chart shown the experience of students in AR-based learning

There are over half of the respondents which is 58% spend more than two hours using electronic devices for learning purpose. This numbers are considered low for the current generation of university students. The result is shown in Figure 4.

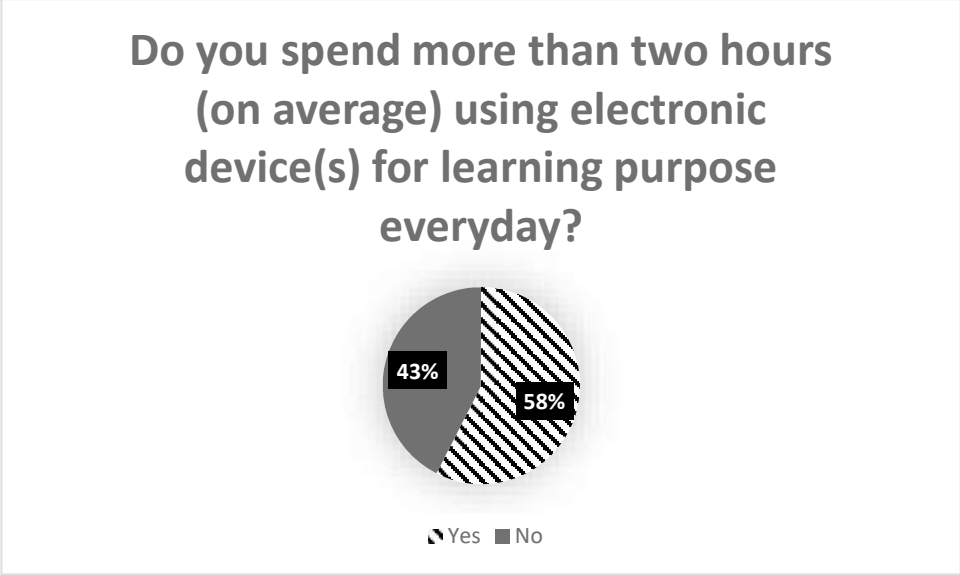

Figure 4. The pie chart shown if the students spend more than two hours using the electronic device for learning purpose.

There are 73.2% of the respondents agree and strongly agree that the AR application is able to facilitate their understanding toward the human anatomy and 19.5% of the students had neutral agreement on this. At the end of the tests, most of the students can score 100% for the quiz. The result is shown in Figure 5.

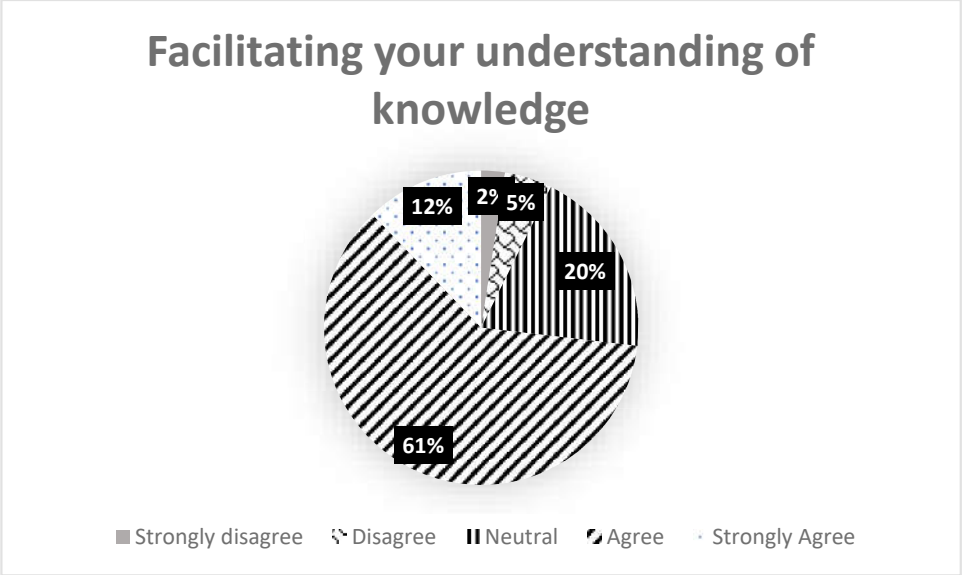

Figure 5. This pie chart shown if the aplication is able to facilitate their understanding of knowledge.

There are 70.7 percent of the students who admitted that this application brings them enjoyment in their learning process. It is important to make learning fun. It allows students to engage in the contents studied better and less stressful. The result shown in Figure 6.

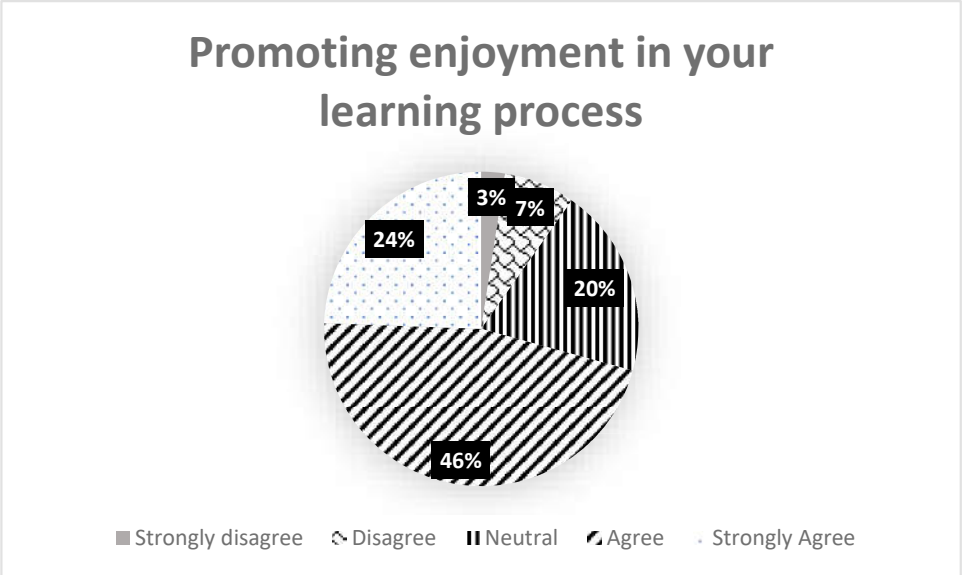

Figure 6. This pie chart shown if the application is able to promote enjoyment in their learning process.

A total of 68.3 percent of the respondents are willing to do self-learning if they are given this application. The integration of Augmented Reality in education is able to motivate the students in doing self-learning. The result is shown in Figure 7.

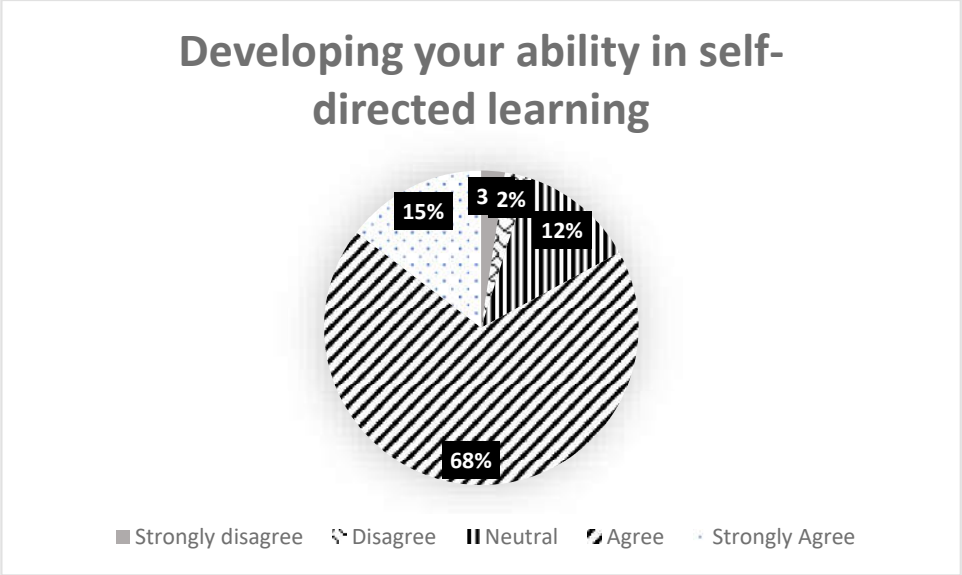

Figure 7. This pie chart shown if the application is able to develop their ability in self-directed learning.

There are 32 out of 41 respondents who agree and strongly agree that this application is able to consolidate their memory of the contents of the subject. As we all know that, human anatomy is a topic that requires high level of cognition. The result is shown in Figure 8.

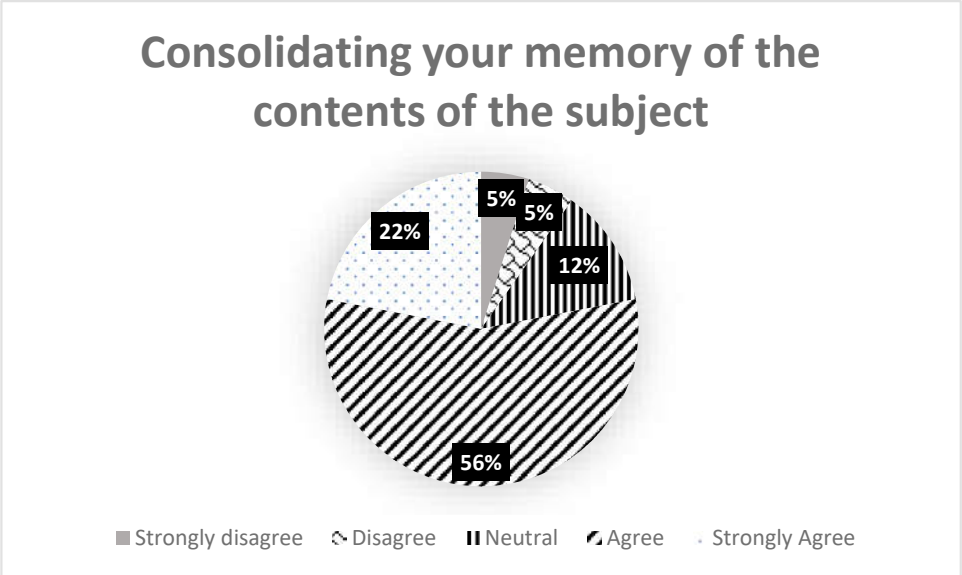

Figure 8. This pie chart shown if the application is able to consolidate their memory of the contents of the subject

The average score obtained by all the respondent after answering the quiz using the AR application is 80%. This shows that the application is effective in the learning process.

4. Conclusion

Based on the survey filled by the respondents from medical student from Universiti Tunku Rahman (UTAR), this augmented reality application is able to help them to consolidate the memory, motivate them to self-learning and have fun in their learning process. Besides, almost everyone has a smartphone today and the students are more willing to study if their learning resources are more portable compared to books which are bulky to carry. Therefore, it can be concluded that the integration of augmented reality in the subject of high level of cognition is very effective and this application should continue to be developed to aid students in their learning process.

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