# International Journal of Advanced Trends in Computer Science and Engineering

# Development of Breast Cancer Self-Examination Three Dimensional Simulation

**Sarni Suhaila Rahim[1], Nur Aishah Jamal Akhshah[1], Shahril Parumo[1]**

[1]Center for Advanced Computing Technology, Fakulti Teknologi Maklumat dan Komunikasi (FTMK),
Universiti Teknikal Malaysia Melaka, sarni@utem.edu.my

## ABSTRACT

Breast Cancer Self-Exam: Do It Yourself is developed to teach the community about the steps of breast cancer self-exam. This project simulates about the structure of breast, symptoms of breast cancer and also steps to do breast cancer self-exam. Nowadays, the community really hard to do breast checkup because they are busy with their work and lack of awareness among them. Breast Cancer Self-Exam is really important as a first step to detect the breast cancer. This project produces a 3D animation effect, hence it is a new way to attract the community attention to use this project. There are four modules in this project which are, Module 1-Structure of Normal Breast, Module 2- Steps of Breast Cancer Self-Exam, Module 3- What To Do If Find Lump and lastly Module 4-Statistic of Breast Cancer. In this way, community will more understanding and easy to follow the steps of breast cancer self-exam. It is envisaged that this project will be useful to be used in clinics and hospitals as a new educational material and it can give an awareness to community about how important to do the breast cancer self-exam and prevent it before it is too late.

**Key words :** Animation, Breast Cancer, Simulation, Three Dimensional.

## 1. INTRODUCTION

Simulation of Breast Cancer Self-Exam: Do It Yourself presents the 3D animation on the steps of breast cancer self-examination to the users. All the steps and the structure of normal breast will be explained in details using simulation. This can increase the awareness of society nowadays about how to prevent breast cancer. This simulation can be used in the medical field which can assist the doctor in explaining to their patients how to perform the correct breast cancer self-exam.

According to the Breast Cancer Welfare Association Malaysia [1], the ratio of women in Malaysia has a risk of getting breast cancer in their lifetime is 1:20. Breast Health Education aims to help in delivering the facts understanding about the breast and to examine the normal changes in the adolescent girls and women breast. It is stated in [1] that among the methods of early detection of breast cancer are mammogram, clinical breast examination and breast self-examination. However, mammography screening is very costly, while clinical breast examination could be implemented in limited resource settings [2]. Therefore, this developed simulation will contribute to recognize signs of early breast cancer to the target users through the self-examination process.

Breast cancer is the most frequent cancer among women, which affect 2.1 million women yearly, and contributes the high number of cancer-related deaths among women. According to World Health Organization (WHO), about 627,000 women is estimated died from breast cancer in 2018, which is 15% of all cancer deaths among women [3]. Meanwhile, World Cancer Research Fund [4] revealed that the most common cancer in women and the second most common cancer is breast cancer. Moreover, in 2018, there were more than 2 million cases reported [4]. In a more recent report by American Cancer Society [5], it is estimated that 268,000 new cases of breast cancer diagnosed among women and 2,670 cases diagnosed in men in the US for the year of 2019. It is also highlighted in [5], all women should familiar with the appearance and feel of their breasts through the breast self-awareness and report any changes promptly to their physician. This shows the important of self-examination of breast cancer to find any lump or other symptoms developed.

Muthupalaniappen and others [6] conducted a study to investigate common presentation and method of detection of breast cancer. The study concluded that most women detected the lump suggested that Breast Self Examination (BSE) can be used for the detection of the disease to overcome the cost and availability constrains for mammogram, besides early detection with BSE can offer better treatment options and quality of life. In addition, a study to examine the knowledge, attitude and practice of Breast Self Examination among nurses in tertiary hospitals in Malaysia was conducted by Raja Gopal et al. [7]. The almost similar study proposed by Raja Gopal was conducted by Al-Sakkaf [8] aims to study breast cancer knowledge, perceptions and breast self-examination practices among Yemeni women.

Nowadays, people hard to perform their breast cancer screening. This happened due to some reasons, such as busy with their life and work which brings to limited time to check at the clinic or do the self-exam, secondly, lack of awareness and the other reason is feel shame. The objectives of the proposed project is to develop a 3D simulation about breast cancer and self-exam. In addition, the other objectives are to evaluate the effectiveness of 3D simulation technique in conveying the information and to evaluate the user understanding about the breast cancer among the target users. The target audience for this project are women aged between 40 to 49 and men aged between 50 to 60. Besides, the project could be used in the clinics and hospital as an educational material. The content of the project is 3D animation and include four modules, which are structure of Normal Breast, Steps of Breast cancer self-Exam, What Should I Do If I Find Lump and lastly Conclusion and Statistic module.

## 2. EXISTING SYSTEM

There are several related existing systems that have been developed by other researchers. The first related system is the simulation by Howcast [9], represents a simulation of how to recognize breast cancer symptoms including step by step perform breast cancer self-exam. In this video, some text for the description of the process, voice over and background music are included. However, the complete anatomy of breast is not shown and only covered 2D animation, where it does not fully attract the target user on performing their self-exam breast cancer.

Breast Cancer: Anatomy of the Breast [10] is a video showing the anatomy of the breast in 3D simulation. Nonetheless the simulation only displays parts of breast but does not show to do the breast cancer self-exam. In addition, this developed simulation only provide voice over for explaining each part of breast and there is no background music included which resulted the simulation less attractive and interesting to use.

Table 1 shows a comparison between these existing systems. Therefore, the proposed project will highlighted the limitation and provide a combination of all elements from the systems. Among the features presented in the proposed project are voice over, text or subtitles, video and also color anatomy of breast in order to enhance the understanding and attraction of the target users.

In addition to the related systems presented above, there are some recent research implementing information technology in medical field, for example for breast cancer [11, 12] and other disease in [13]-[17].

## 3. METHODOLOGY

The methodology used to develop this project is Multimedia Production Process (MPP). The first phase is pre-production refers to the task undertaken before production phase begins. This phase consists of four steps to create an outline of the project, which are concept or idea, brainstorming, storyboarding and animatics. The second phase called production, consists of five major steps to complete the animation. They are modelling, texture mapping, lighting effect, animation and simulation and finally rendering. The third phase, which is production phase consists of process where the effects such as, voice over, subtitles, titles, are added to accomplish the product.

**Table 1:** Comparison of Existing System

| Features | How to Recognize Breast Cancer Symptoms | Breast Cancer: Anatomy of the Breast |
|---|---|---|
| Product Type | 2D animation | 3D animation |
| Format | FLV | FLV |
| Multimedia Element | Text, animation, video | Video, animation |
| Duration | 3:01 sec | 1:19 sec |
| Software | Flash | Flash |
| Content | Overview of how to recognize breast cancer | Overview of anatomy of the breast |

### 3.1 Analysis

Requirement analysis will identify project, software, hardware and other requirement in order to produce a product that meet the entire requirement needed.

In this simulation there are four modules included which are:
  i.  Module 1: Structure of Normal Breast
      For this module, this simulation will show the structure of the normal breast. Each part of the breast will be showed in text.

  ii. Module 2: Steps of Breast Cancer Self-Exam
      There are four steps underlined for breast cancer self-examination presented in this module.

  iii. Module 3: What Should I Do If I Find Lump?
       This module shows where should you go and who will you see if you find the lump. This module will explain that you must see your health care provider if you discover any breast change and lump.

  iv. Module 4: Conclusion and Statistic
      This module will show the updated statistic about breast cancer and conclusion about this simulation.

In this project, there are some animations produced especially in Module 1 where steps of breast cancer self-exam are presented. The camera will focus on movement of hand at breast according to the five steps of breast self-exam. In this project also, some text are included to add understanding of the user on the information conveyed. Besides, in order to give more interest and understanding about this project, audio also is included. Narrator will explain some part in each of the module, so that user can understand more about the information presented in this project.

In order to develop this project, several software are required. The main software used in developing this project is Maya Autodesk. It is used to create and animate the character or component, besides setting the background. Adobe Photoshop and Adobe Illustrator are used to edit the picture to create the texture for the character or components in the project. For editing all the sounds included in the project, Adobe Audition is used, while Adobe After Effects is used to include the effects to the video.

## 3.2 Design

Scene sequence diagram is designed to show the linear sequence against time to visualize the scenes arrangement of this project. Figure 1 shows the scene sequence diagram of the proposed project.

In addition, preliminary design consists of the storyboard design for the character profile, which is a description of the 3D object. Human body, breast, hand, nipple, structure of breast, lobes, ducts and lump are the 3D objects that have been designed using Autodesk Maya, illustrated in Figure 2.
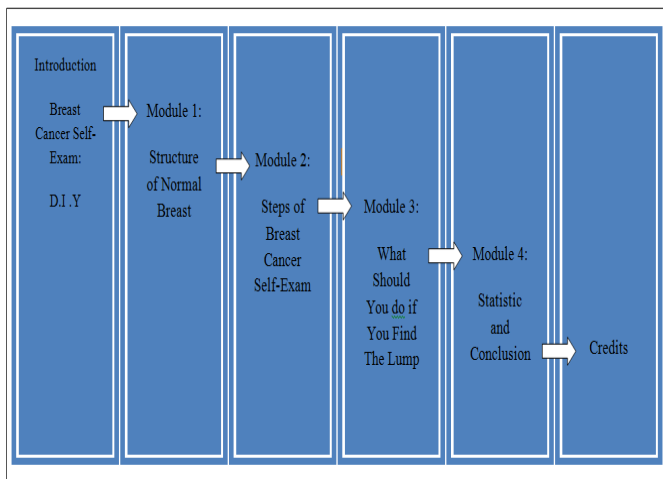


**Figure 1:** Scene Sequence Diagram

## 3.3 Implementation

Text is one of the delivery of information and message. In this project, text is used as a main criteria to make user understand about this simulation. Adobe After Effects is used to create the text in this simulation, as this software provides various types

| Object | Character |
|---|---|
| Human body |  |
| Breast |  |
| Hand |  |
| Nipple |  |
| Structure of breast |  |
| Lump |  |

**Figure 2:** Character Profile

of fonts and easy to insert in the simulation. Text will be used in all modules and credits. Since this project is a learning content, thus it is very important for the target user to understand clearly each of the content presented.

Graphics are visual presentations on some surface. Graphics are often combining with text, illustration and color. In this project, production of graphics is used to design and create 3D model. Adobe Photoshop is used to design the character's modelling surface and also as a guideline to design the model such as human body, where the 2D graphic will be edited using this software. Later, the edited graphic will be imported into Autodesk Maya as a guideline to create the 3D modelling.

An audio is a sound element to give the target user feeling and more understanding on the contents. The audio will be combined with other multimedia elements like graphic, animation and text in order to synchronize them together. Adobe Audition software is used as the project audio editor and two audio types for this project are background music and voice over.

Autodesk Maya is a software used in modelling and animating 3D model for this project. Basically, there are two steps before an animation can be rendered, which are modelling, where all the characters and model will be created, and second step is animating, where the complete model will be animated.

A series of editing and combining all the multimedia elements of this project have been done using Adobe After Effects software. This software is used to combine all the multimedia elements and also credits for thus project. Then, in order to get better and smooth video, it will be rendered into avi file format. After rendering process in Adobe After Effects, the video will be imported into Adobe Media Encoder to get a smooth video and finally save as f4v file format. Figure 3 shows the process of media integration that involves all the elements. The interfaces of the project are shown in Figure 4, Figure 5, Figure 6 and Figure 7.
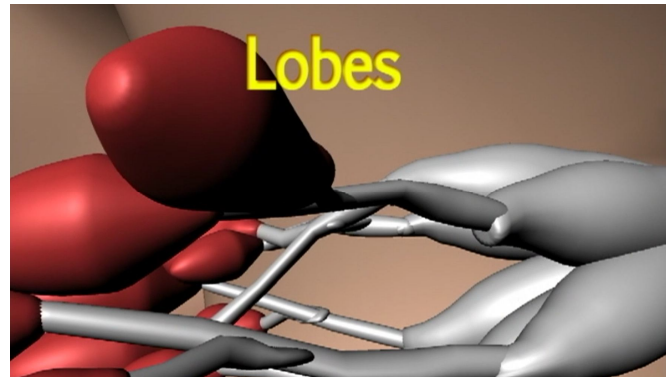


**Figure 3:** Integration Process



**Figure 4:** Main interface



**Figure 5:** Structure of Normal Breast



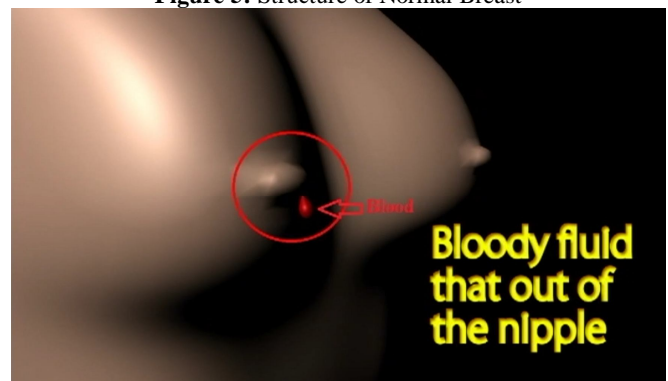**Figure 6:** Breast Cancer Symptoms



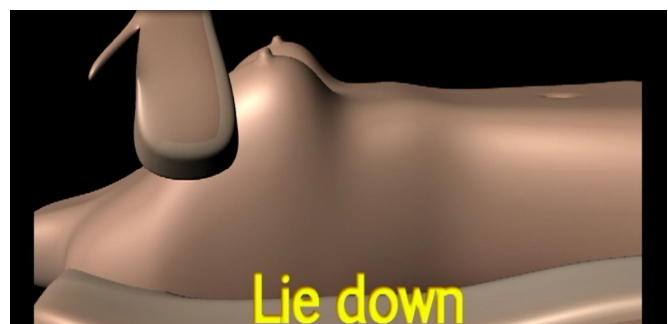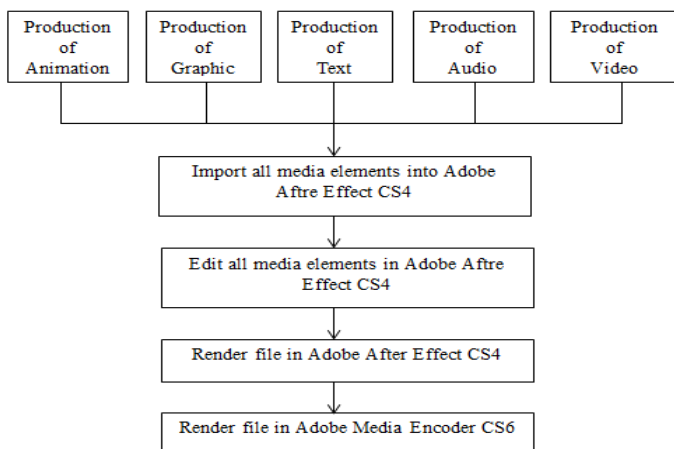**Figure 7:** Steps of Breast Cancer Self-Exam

## 4. TEST RESULT AND ANALYSIS

The testing has been conducted by the target user according to the objective of the project. Target user for this project is divided into three groups which are; firstly, waiting patients at Klinik Kesihatan Hutan Percha, Melaka, Malaysia, secondly, lecturer and Diploma of Information and Communication Technology (ICT) students, from the Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka (UTeM), and thirdly, medical doctor and staff at Klinik Kesihatan Hutan Percha, Melaka, Malaysia. Table 2 summarized the test plan for this project, including the test user, test environment and test strategy.

**Table 2:** Test Plan

|  | **Respondent 1** | **Respondent 2** | **Respondent 3** |
|---|---|---|---|
| Respondent | Doctor and staff | Waiting patients | Lecturer, students |
| Type of Testing | Content and other features | Simulation content | Functionality, usability, user interface |
| Number of Respondent | 1 doctor, 9 staff | 20 patients | 1 lecturer, 14 students |
| Location | Klinik Kesihatan Hutan Percha, Melaka | | UTeM |
| Duration | 14 min | 20 min | 30 min |

Table 3 shows the questionnaire questions prepared for the first type of respondent, which is the doctor and staff, consists of two types of testing involving content and other features testing. The results for the doctor and staff are presented in Figure 8 for the content testing and Figure 9 for the other features testing. The questionnaire for public which is the waiting patients is focusing on the content in the simulation. For this group of respondent, the questionnaire is in dual language, which are in English and Bahasa Melayu for the ease of the respondent in understanding and answering the questions given. Table 4 below shows the ten questions for the public and the graph for the result is shown in Figure 10. Meanwhile, for the third group of respondents, the strategy part is divided into three sections, which are functionality, usability and user interface testing. The questions for the lecturer and the students are presented in Table 5. The result of these questions can be referred in Figure 11, Figure 12 and Figure 13 for functionality, usability and user interface testing, respectively.

**Table 3:** Question for Expert

| **Question for Contents** |
|---|
| Question 1: All the structure of normal breast is clearly presented. |
| Question 2: The steps shown in this video are clear and easy to remember. |
| Question 3: The steps of breast cancer self-exam are easy to followed by the patient. |
| Question 4: The explanation of breast cancer symptoms is clear. |
| Question 5: The content of this simulation is easy to understand. |
| Question 6: I am able to understand well the topic and explain after viewing the simulation. |
| Question 7: I am satisfied with the content of this project. |
| Question 8: This video is suitable to be used in every clinic or hospital. |
| **Question for Other Features** |
| Question 9: The audio of this video is clearly and easy to understand by all users. |
| Question 10: The simulation on this video is smooth. |
| Question 11: The color that used in this video is suitable. |

**Table 4:** Question for Public

| **Question for Simulation Contents** |
|---|
| Question 1: I know the structure of normal breast after watch this video. |
| Question 2: I know the symptoms about breast cancer after watch this video. |
| Question 3: All the steps about breast cancer self-exam are clearly presented. |
| Question 4: After watch this video, I can remember all the steps of breast cancer self-exam. |
| Question 5: All this steps of breast cancer self-exam in this video is easy to follow. |
| Question 6: If I find the lump, I know what should I do after watch this video. |
| Question 7: I can hear clearly the explanation about breast cancer self-exam. |
| Question 8: This video about breast cancer self-exam is easy to understand. |
| Question 9: I can do by my own self breast cancer exam after view this video. |
| Question 10: I can remember all in this video very well. |

**Table 5:** Question for Lecturer and Student

| Question for Functionality |
|---|
| Question 1: This simulation has met the main objective. |
| Question 2: The different between normal breast and abnormal breast are clearly shown. |
| Question 3: I can remember well what have been explained in this simulation. |
| Question 4: This project is suitable to be used in every clinic or hospital. |
| Question 5: The object in this simulation is animated smoothly. |
| **Question for Usability** |
| Question 1: The explanation of each module is detail. |
| Question 2: The content of this simulation is easy to understand. |
| Question 3: This project is suitable for medical field. |
| Question 4: I am able to understand well the topic and explain after viewing the simulation. |
| Question 5: I am satisfied with the content of this project. |
| **Question for User Interface** |
| Question 1: The color that used in this simulation is suitable for each module. |
| Question 2: The background music is suitable for this simulation. |
| Question 3: The title on each module is readable and suitable for this simulation. |
| Question 4: The simulation of each module in this project is clear and smooth. |
| Question 5: The audio helps target user to understand about the simulation. |



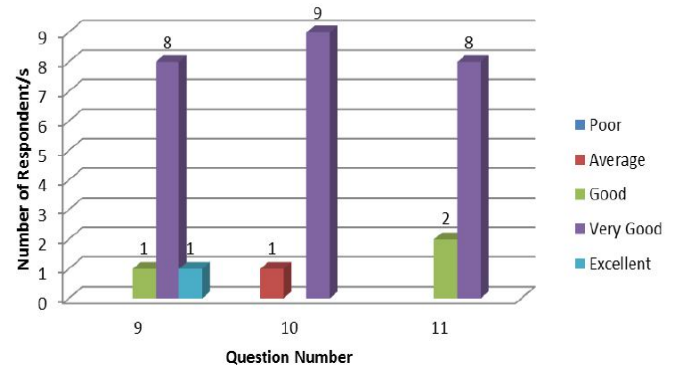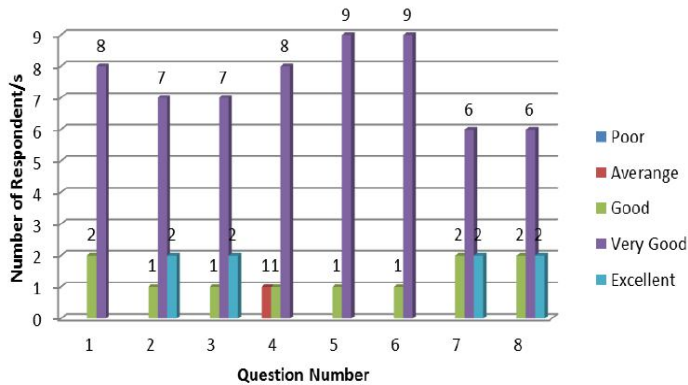**Figure 9:** Result of Other Features Testing



**Figure 10:** Result for Waiting Patients



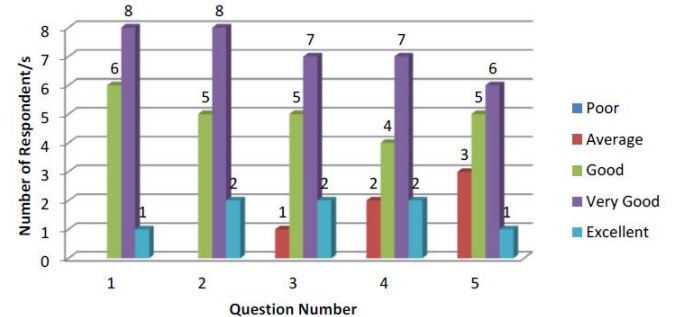**Figure 8:** Result of Content Testing



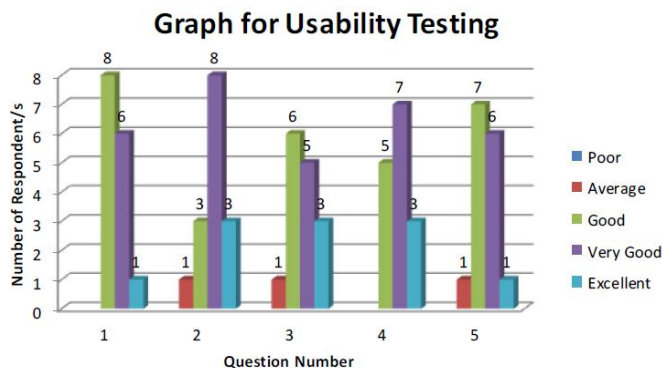**Figure 11:** Result of Functionality Testing

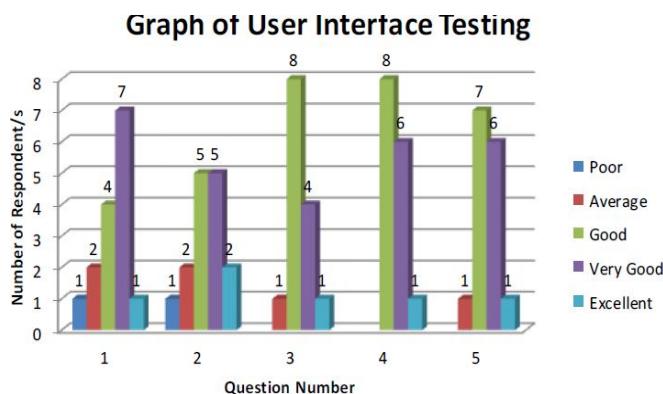**Figure 12:** Result of Usability Testing



**Figure 13:** Result of User Interface Testing

It can be concluded from the result analysis generated by variety of respondent types that this product can be attractive in order to gain the public or patient attention and interest in breast cancer self-examination topic rather only using the conventional method, which are books and 2D animation. In addition, by using 3D animation as learning contents, it provides a better way to illustrate, where a good illustration will provide a good understanding to the audience. Moreover, the text size in this project is bigger and easy to read by the user. The other strength of this product is the transition for each module is attractive. Overall, it can be summarized that the product is accepted to be used by the target users.

## 5. DISCUSSION

In the development of the project, some limitation was discovered by gathering all the test result analysis. Firstly, more detail information on the symptoms of breast cancer and steps to do breast cancer self-exam subtopics should be included for better understanding. In addition, the condition of low voice over can be improved by providing better pronunciation in English to ensure user understand the content of the project. Moreover, background music is not suitable for the medical content especially background sound for each module and suggested to be changed according to the type of the project. The animation in this product also are not much as expected as there should be more animation because the proposed product is a 3D based-content. Besides, the

transition for each module is discovered too fast, hence the user does not have ample time to read the module.

Propositions for improvement is one of the way to overcome the weaknesses that occurred. Among the future improvement is to include more animation since animation is the core element for this product. By adding more animation, this product would be more attractive and also able to provide better illustration to the user. It is suggested to add the subtitle, as the subtitle is important to certain group of user that do not understand English well. By doing this, user can be more understand about the content of the project. Besides the main menu offered by this product, it is recommended to add more related details of information so that user will understand and get more information on the presented topic.

## 6. CONCLUSION

As a conclusion, this proposed application will contribute in medical and education fields. This product can be used in hospital or clinics in order to convey the information of breast cancer self-examination in an effective way. In addition, this multimedia application contributes to education field focusing in multimedia, where the technology used 3D animation could be explored as a teaching and learning purpose. By using this project, user can get more understanding because 3D model in this project looks real and it is one of ways to attract the user to keep watching the video. The product able to overcome the limitation of current existing systems in breast cancer awareness. All multimedia elements, i.e., graphic, text, audio and animation that have been included in this product are mainly to help user follow the steps of breast cancer self-exam. It is envisaged that the usage of multimedia elements will provide a big potential to attract user attention in following the project.

## REFERENCES

1. Breast Cancer Welfare Association Malaysia. **Breast health education**, 2018, available at https://www.breastcancer.org.my/about-breast-cancer/what-you-need-to-know/breast-health-education/

2. World Health Organization. **Breast cancer: Prevention and control**, 2020, available at https://www.who.int/cancer/detection/ breastcancer/en/

3. World Health Organization. **Breast cancer**, 2020, available at https://www.who.int/cancer/prevention/diagnosis-screening/breast-cancer/en/

4. World Cancer Research Fund International. Breast cancer statistics, 2018, available at https://www.wcrf.org/dietandcancer/cancer-trends/breast-cancer-statistics

5. American Cancer Society. **Breast cancer facts & figures 2019-2020**, 2019, available at https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/

6. L. Muthupalaniappen, Y. Sak, G. Pa, and A. Faa. **Breast self-examination: To do or not to do?**, *Medicine & Health*, vol.1, no.1, pp.1-4, 2006.

7. R. R. L. Raja Gopal, Z. Md Isa, D. Wahida, N. Mohd Said, and S. Z. Syed Zakaria. **Knowledge, attitude and practice of breast self- examination among nurses in tertiary hospitals in Malaysia**, *Malaysian Journal of Public Health Medicine*, vol. 14, no. 3, pp. 54-62, 2014.

8. A. K. Al-Sakkaf, and H. O. Basaleem. **Breast cancer knowledge, perception and breast self- examination practices among Yemeni women: An application of the health belief model**. *Asian Pacific Journal of Cancer Prevention*, vol. 17, no. 3, pp. 1463-1467, 2016. https://doi.org/10.7314/APJCP.2016.17.3.1463

9. Howcast. **How to recognize breast cancer symptoms**, 2010, available at http://www.youtube.com/watch?v=yTHyMNBkbOY&feature=fvsr, 2010.

10. Nucleus Medical Media. **Breast cancer: Anatomy of the breast**, 2010, available at http://www.youtube.com/watch? v=Fs4WsWfxTzM&feature=relmfu

11. J. E.T. Akinsola, M. A. Adeagbo, and A. A. Awoseyi. **Breast cancer predictive analytics using supervised machine learning techniques**. *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 6, pp. 3095-3104, December 2019. https://doi.org/10.30534/ijatcse/2019/70862019

12. M.Y. Alzahrani, and A. H. Alahmadi. **Breast cancer image classification using the convolutional neural network**. *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 6, pp. 3447-3453, December 2019. https://doi.org/10.30534/ijatcse/2019/120862019

13. A. Nagarajan, and J. V. Wason. **Machine learning approach to predict lung cancer using CT scan images**. *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 6, pp. 2974-2976, December 2019.

https://doi.org/10.30534/ijatcse/2019/48862019

14. A. M. Alqudah, H. Alquraan, I.A. Qasmieh, A. Alqudah, and W. Al-Sharu. **Brain tumor classification using deep learning technique- A comparison between cropped, uncropped, and segmented lesion images with different sizes**. *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 6, pp. 3684-3691, December 2019. https://doi.org/10.30534/ijatcse/2019/155862019

15. J. Desan. **Diagnosis of brain hemorrhage using KNN based Radial Basis classifier**. *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 6, pp. 3658-3664, December 2019. https://doi.org/10.30534/ijatcse/2019/151862019

16. D. K. Kirange, J. P. Chaudhari, K. P. Bhagat, and N. Chaudhari. **Diabetic retinopathy detection and grading using machine learning**. *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 6, pp. 3570-3576, December 2019. https://doi.org/10.30534/ijatcse/2019/139862019

17. V. Rachapudi, T. K. Sai, S. H, Priya, and K. Pushpahas. **An effective approach to classify retina images for diabetic retinopathy**. *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 8, no. 6, pp. 3345-3350, December 2019. https://doi.org/10.30534/ijatcse/2019/106862019