

# E.B.C.D Apps



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**Abstract:** Breast cancer is a life threatening disease that occurs when an unconstrained and irregular breast cell develops. There are five stages of breast cancer where stage 0 is considered as the early stage since the cancer cells are not spread outside of ducts yet. In this stage, the early symptoms are possible to be detected and if it is swiftly diagnosed, the probability that the cancer to be successfully treated is very high. Breast Self Examination (BSE) is one of the recommended screening methods but it is reported to be confusing and inconsistent. This is because BSE only provide guidelines for breast examination. It does not give any result that user can rely on. Therefore, this research aims to develop a mobile application which applies fuzzy logic method and adopts BSE process to help a person diagnose the early stage of breast cancer.

**Keywords :** Mobile Application, Breast Self Examination (BSE), Fuzzy Logic, Breast Cancer.

## I. INTRODUCTION

Cancer is a type of diseases that happens because of the existence of unwanted cells called tumor that grow uncontrollably in the body. Cancers are occasionally named after the part of the body where the tumor grows. Breast cancer is a kind of cancer that develops in the breast cells. It usually starts off in the parts of the breast tissue that are made up of glands for milk production called lobules, and ducts that connect the lobules to the nipple [1]. Early precaution of breast cancer should be taken when several symptoms are detected such as a lump in a breast, a pain in the armpits or breast, pitting or redness of the skin of the breast, a rash on one of the nipples, a lump in an armpit, change in nipple appearance or change in the size or the shape of the breast [2].

When a person experiences the breast cancer symptoms, he or she should immediately do a breast screening test. Among the screening methods available are breast self-examination

(BSE), mammogram, breast ultrasound, biopsy and magnetic resonance image (MRI) scan. All the methods require a person to seek help from a physician except for BSE method. BSE is performed by the person themselves. It is the most recommended method for the early diagnosis of a breast cancer. Once a person is diagnosed with breast cancer, the doctor will determine the stage of the breast cancer. The stage describes the degree to which the cancer has spread. Determining the stage helps the doctor to plan for the treatment. There are five stages of breast cancer namely stage 0, stage 1, stage 2, stage 3 and stage 4. Stage 0 describes a non-invasive cancer where abnormal cells found have not yet spread outside of the ducts or lobules whereas stage 4 is the most invasive and dangerous cancer where the cells spread outside the breast to other parts of the body [3]. It is said that stage 0 breast cancer is highly treatable unless it is left untreated or undetected. Thus, it is important for the breast cancer to be detected as early as possible [4].

Even though BSE is the most recommended method of screening for breast cancer, it had been claimed that without proper guidelines, it can be confusing and inconsistent [5]. The Canadian Task Force on Preventive Health Care also gave their opinion not to use BSE technique because of its harmful outcomes. They labelled BSE as a Grade D recommendation because there was evidence that BSE gave no benefits and there was also evidence that it could bring harm [6]. BSE was considered as irrelevant breast biopsy pointing to breast deformity, posed a potential harm, and scarring as well as potential negative psychological effect such as anxiety and depression [5].

Despite all the rackets, it is still believed that the effectiveness of BSE can be improved with the application of advanced diagnostic tool. Therefore, this research aims to develop a mobile application which applies fuzzy logic method that incorporates the BSE procedure to help detecting the early stage of breast cancer.

## II. LITERATURE REVIEW

### A. Fuzzy Logic

Fuzzy logic is used to model human's reasoning and decision making under uncertainty environment. Human's perception is usually expressed in verbal or linguistic description, and often the way people describe a thing or a situation is different from one another. For example, one person may perceive a room to be comfortable, but another person might have the opposite feeling. In addition, human's judgement is inexplicably vague and imprecise. We do not simply like or hate things or describe a particular thing to just be black and white, hot and cold, or good and bad. Instead, we use words like very, somewhat, fairly and so on. Fuzzy logic was introduced to deal with this situation.

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Unlike mathematical logic that uses two values (0 and 1) to assign an object to a class, fuzzy logic uses all the real values between 0 and 1 to represent the degree of membership of an object to a class or category.

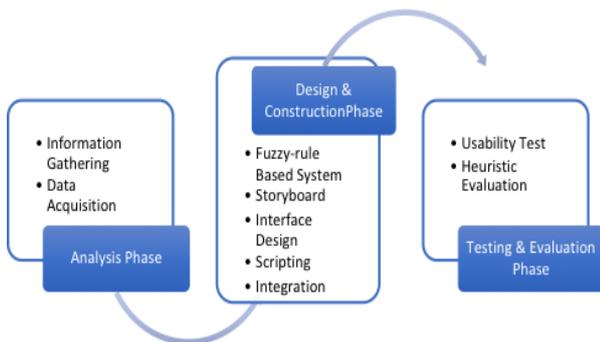
Thus, in general, fuzzy logic models a person’s vague judgements or perceptions which are expressed in qualitative linguistic terms by facilitating the rules and facts provided by the person and by assigning degrees of membership to the perceptions [7].

**B. Android**

Android is a new smart phone platform developed by Google Company. It is a software load up for mobile devices that consist of an operating system, middleware and key application. Android consists of a Linux kernel and some key applications such as Java-based object-oriented application framework [8]. Android application normally engages dealings between user interface and user. To develop android application like email, calendar, maps, browser, and contacts, Java language is used. In addition, a developer can use Application Programming Interface (API) application framework to attain their goal in developing Android.

**III. RESEARCH METHODOLOGY**

In this section, as shown in Fig. 1, the research workflow that was designed to be used throughout the project is elaborated. There are 3 main phases involved starting with data analysis phase. During this phase, all the information gathered was analyzed in order to obtain required data for the project. The acquired data then was fed in fuzzy rule-based system to be applied in the diagnostic tool. Since the tool would be deployed using the mobile application platform, the storyboard was prepared before the interface design. After the tool was integrated as a mobile application, it undergone several testing and refinement process in the testing and evaluation phase.



**Fig. 1. Research Workflow**

**A. Analysis Phase**

For this project, apart from collecting the data based on the article review, the interview session was also conducted with the domain expert. The interview was done several times with Dr. Rosmawati from Health Unit in UiTM Perlis. Besides obtaining accurate data regarding early symptoms of breast cancer, the interview sessions was done to gather the requirements in developing the mobile application. From the discussion, the expert convinced that it was possible to adopt the BSE into a mobile application.

**B. Design and Construction Phase**

*i. Fuzzy Rule-Based System*

For this mobile application, the fuzzy rule-based systems acted as control system, which consist of three main steps namely Fuzzification, Inference and Defuzzification.

In fuzzification phase, the variables of input and output were defined and transferred into linguistics variables. During the data procurement process, 11 early symptoms were identified. Thus, the control system will be fed with 11 inputs. The attributes were then defined by the membership function. The outputs or classification results were then classified into the following clusters:

- i. Have Breast Cancer (C1)
- ii. Might have Breast Cancer (C2)
- iii. Not Have Breast Cancer (C3)

Cluster 1 represents possible situation of having breast cancer because at least five of the symptoms are pronounced while cluster 2 represents might have breast cancer because only four of the symptoms are pronounced. Cluster 3 represents not have breast cancer because only one of the symptoms of breast cancer is pronounced.

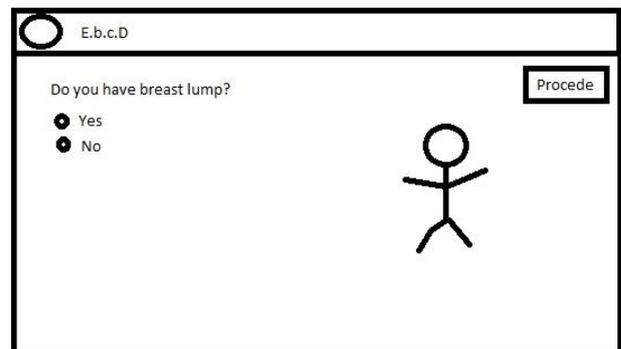
Once the input and output variables and the membership function were defined, the rule-based system which composed of IF-THEN rules was designed. Finally, the output was defuzzified to yield a non-fuzzy value. For this study, numerical values range between 0 and 100 percent were used to represent the output as tabulated in the following Table I:

**Table- I: Percentage of the Probability Result**

Cluster	Percentage Description (%)
1	75
2	50
3	25

*ii. Storyboard*

After the control system had been designed, the storyboard was prepared to be a guideline in the real interface design. Storyboard is the best way to illustrate the idea before the implementation phase and also to make sure the application is standardized. Fig. 2 below shows the sample of storyboard involved in this project.



**Fig. 2. Research Workflow**

iii. Interface Design

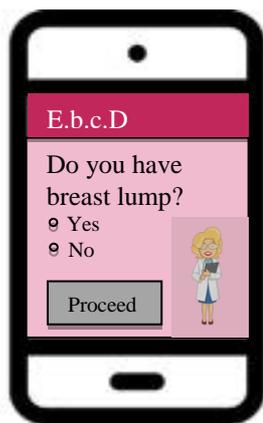


Fig. 3. Sample of Interface Design

Fig. 3 above illustrates the sample of interface design that was adopted from the storyboard. Since the interface will be the connector between the application and the end user, the criteria such as type of font, foreground and background color, graphic and theme were taken into account during this phase. This was to ensure the application is interactive, attractive and user friendly.

iv. Scripting and Integration

The interface design later on was translated into android application. The scripting was written using Java language in Android Studio software. The integration activity was accomplished by an android application prototype named as Early breast cancer Detection (E.b.c.D).

C. Testing and Evaluation Phase

In the testing phase, Usability Test and Heuristic Evaluation were conducted. A set of questionnaires was also prepared in order to collect the users' feedbacks. All the feedbacks were analyzed so that the application could undergo the refinement process. The modification on the systems was vital to ensure the system met the requirements of end users.

IV. RESULTS AND DISCUSSIONS

A. Usability Test

Usability Test refers to evaluating a product or service by testing it with representative users. Typically, during a test, participants will try to complete typical task while the observers watch, listen and take notes. The Usability Test was done for twenty random female students from different faculties at UiTM Perlis. Table I shows the list of tasks that the respondents were asked to complete in order to test the application.

Table- II: Usability Test

Task	Description
1	Respondent successful click the "CONTINUE" button to move to the next page
2	Respondent read the question carefully
3	Respondent take time to understand the question
4	Respondent know how to use the radio button provided for answering the question
5	Respondent successful click "PROCEEDE" button after answering the question

- 6 Respondent successful click the "ANALYZE" button to get the result
- 7 Respondent understand the probability result generated by the application
- 8 Respondent understand the purpose of "RETAKE TEST" and "CLOSE APPS" button
- 9 Respondent show their interest when used the application

The Usability Test can be categorized into four main criteria, which are contents, navigation, interface and general feedback. Fig. 4 illustrates the Usability Test result based on each criterion.

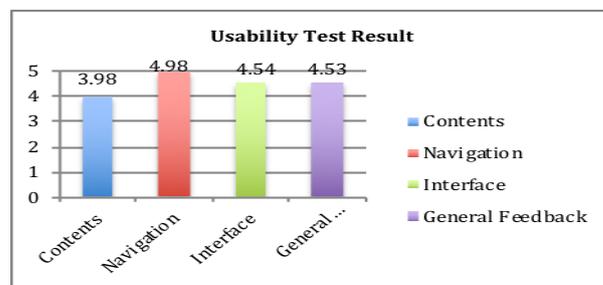


Fig. 4. Usability Test Result

From Fig. 4, it can be observed that the respondents were satisfied with the application since all of the criteria yielded almost full score. Although the contents got the average score, it can be said that the users could accept the application as one of the diagnostic tools in detecting the early stage of breast cancer.

B. Heuristic Evaluation

Heuristic evaluation is used as a systematic examination of a user interface design for usability. Heuristic evaluation involves only a small number of evaluators to examine the interface and judge its compliance with recognized usability principles.

For this application, two experts in the related fields were asked to complete the heuristic evaluation. Both experts had to evaluate the possibility result generated by the application based on the inference rules produced in fuzzy rule-based system as indicated in Table II. From the evaluation, it can be said that the application gave an accurate probability result since the heuristic test result showed no difference between both experts.

Table- III: IF-THEN Rules for Heuristic Evaluation

IF-THEN RULES	CLUSTER
<b>R1:</b> IF the patience is having breast lump THEN he/she has class C3	C3
<b>R2:</b> IF the patience is having breast lump and breast thickening THEN he/she has class C3.	C3
<b>R3:</b> IF the patience is having breast lump, breast thickening and dimpling of skin THEN he/she has class C3.	C3
<b>R4:</b> IF the patience is having breast lump, breast thickening, dimpling of skin and hard painless breast lump THEN he/she has class C2.	C2

<b>R5:</b> IF the patient is having breast lump, breast thickening, dimpling of skin, hard painless breast lump and underarm lump THEN he/she has class C1.	C1
<b>R6:</b> IF the patient is having breast lump, breast thickening, dimpling of skin, hard painless breast lump, underarm lump and nipple discharge THEN he/she has class C1.	C1
<b>R7:</b> IF the patient is having breast lump, breast thickening, dimpling of skin, hard painless breast lump, underarm lump, nipple discharge and warm breast THEN he/she has class C1.	C1
<b>R8:</b> IF the patient is having breast lump, breast thickening, dimpling of skin, hard painless breast lump, underarm lump, nipple discharge, warm breast and red areola THEN he/she has class C1.	C1
<b>R9:</b> IF the patient is having breast lump, breast thickening, dimpling of skin, hard painless breast lump, underarm lump, nipple discharge, warm breast, red areola and nipple inverted THEN he/she has class C1.	C1
<b>R10:</b> IF the patient is having breast lump, breast thickening, dimpling of skin, hard painless breast lump, underarm lump, nipple discharge, warm breast, red areola, nipple inverted and Scaly areola THEN he/she has C1	C1
<b>R11:</b> IF the patient is having breast lump, breast thickening, dimpling of skin, hard painless breast lump, underarm lump, nipple discharge, warm breast, red areola, nipple inverted, Scaly areola and breast skin pitting THEN he/she has C1.	C1

## V. CONCLUSION

A mobile application that applied fuzzy logic method and BSE process in detecting early stage of breast cancer had been successfully developed in this research. The result of the test conducted by experts showed that the mobile application produced an accurate and reliable result. In addition, the users who had tested this mobile application found that it was an interesting and user-friendly application. The users also felt that this mobile application was helpful and convincing in determining the potential of having breast cancer.

As for future research, it is advisable for this mobile application to have some visual aids on certain terms or parts of the breast so that the users can have a clear view in understanding the questions. The mobile application should also provide database of the users' past information so that it will be easier for the users to track and monitor their results.

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