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Mobile, Fast Response, and Interactive Measurement Tool of Psychological Disorders under Android Based Smartphone

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Abstract— Depression, anxiety, and stress are common psychological disorders that has been suffered by human. Since the number of sufferer has been increasing fast, recently, it becomes important to measure the level of those disorders and offer practical solutions. Usually, psychological disorders are measured by Psychologists using Depression Anxiety Stress Scale (DASS) – 21 form which consists of 21 questionnaires that should be filled, honestly. However this type of measurement is not attractive, time consuming, boring, and making the psychological disorders even worse. This research aims to develop a mobile, fast response, and interactive measurement tool of psychological disorders, in android based smart phones. Waterfall method which consists of system analysis, design, implementation, and testing is chosen to develop this application software. The measurement is based on the DASS-21 calculation scale to define the level of depression, anxiety, and stress. Black-box testing shows that the developed application software runs as expected. Validation result of the psychological disorder level which was examined by comparing it to the result from the test data demonstrates high accuracy.

INTRODUCTION

World Health Organization (WHO) estimates that 10-20% of the population of children and adolescents in the world are currently experiencing mental health problems and 50% of them occur before reaching the age of 14 and maintained until they are emerging as the adults [1]. Emotion is the broad aspect of mental health that plays a critical role in psychological state of being in which negative emotion tends to outcome the lower level of mental health. Depression, anxiety, and stress are negative emotional state that being recently common among the University students such as Malaysia (41.9%), India (53%), and Saudi Arabia (64.7%) [2,3,4].

In Indonesia, 52.7% of Indonesian university students experienced emotional problems [5,6]. More specifically, the emotional problems of Indonesian adolescents had emerged intensely at the level of junior high school, with higher anxiety and depression in girls compare to boys [7]. This condition is supported by the study which states that as many as 75% of mental health problems experienced by individuals, first perform in university students [8].

Depression is a human function disorder that is related to natural feelings of sadness and accompanying symptoms, including changes in sleep patterns, appetite, psychomotor, concentration, fatigue, hopelessness and helplessness, and suicide [9]. Stress is a condition caused by interactions between individuals and the environment, stress raises perceptions of demands that come from situations that originate from the biological, psychological and social systems

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of a person. Anxiety is a manifestation of various emotions that mix between panic, erratic feelings, and unclear fears when someone is experiencing pressure or frustration.

Depression, anxiety, and stress levels can be measured using Depression Anxiety Stress Scale (DASS) made by Lovibond & Lovibond [10]. DASS consists of two types, DASS-42 and DASS-21. DASS-42 has 42 statement questions while DASS-21 has 21 statement questions. The levels of depression, anxiety, and stress in DASS are divided into 5, namely normal, mild, moderate, severe, and extreme severe [11].

Psychologists may use DASS-21 to measure the level of depression, anxiety, and stress of their patients. The DASS-21 questionnaire is usually done by using questionnaire paper which then will be calculated manually by psychology experts. This type of measurement is not attractive, consumes time, bores, and makes the psychological disorders even worse. In other words, early assessment and prevention of mental health problems are crucial to develop in today's era. Recently, to make an interactive and more convenient system, people tend to develop an application under android based smart phone. Subhankar et al. has reviewed some procedures in developing android based application and its security in [12].

Stress meter application under Android based on combination of DASS-42 and Achievement Motivation Scale was developed by Mulawarman et al. The application has a moderate level of acceptability to identify the stress level. Data which were obtained from 30 final year college students showed that the higher the level of stress the lower of achievement motivation [13].

One innovative way for automatic stress measurements via smartphone technology was proposed by T. Stütz et al. In this work, automatically collected smartphone usage and sensor data were investigated to predict the experienced stress levels of a user using a customized brief version of the Perceived Stress Scale (PSS). A user study has been conducted in which smartphone data and stress (as measured by the PSS seven times a day) were recorded for two weeks. It was found that there were significant correlations between stress scores and smartphone usage as well as sensor data. [14]. In addition, the involvement of digital technology becomes important when the target of treatment is adolescents due to their level of familiarity, readiness and frequency of use of technology in interacting is quite high in the adolescent phase [15,16].

The goal of this research is to develop a more convenient way to measure the level of depression, anxiety, and stress. It is an application software under android based smart phone called SMILE.apk, (Self-Monitoring Interactive Learning Evaluation). Waterfall method which consists of system analysis, design, implementation, and testing is chosen to develop this application software. It utilizes the DASS-21 calculation scale to facilitate psychologists in measuring the levels of depression, anxiety, and stress.

SYSTEM DESIGN

The waterfall method is chosen to reach the aim. It has a systematic and sequential approach in developing the software. It consists of five steps, defining the system specifications, designing the system based on the system's specifications, implementation or developing the system, examining the system, and finally maintenance the system, including repair the errors and bug or add new functions to the system.

Use case diagram

To understand the function and behavior of this application, analysis of information and behavior is required and refers to the stage of system requirements analysis. **TABLE 1** shows an analysis of system user requirements.

TABLE 1. Analysis FF system user requirements

Actor	Right	Actor	Right
Admin	manage user data, questionnaire history data, view demographic data, view DASS-21 data, view, change, and delete user data from the application, view and delete the user questionnaire history from the application, view demographic data containing statistical data from user applications based on age, gender, ethnicity, current level of education, parental education, and parental income. View the results data from DASS-21 in the form of the number of levels of depression, anxiety, and stress that have been generated by the user.	User	Access rights to retrieve questionnaires, view the results of questionnaires, view profiles of personal identity data, view the history of questionnaires that have been taken, and delete the history of questionnaires that have been taken.

A diagram is made to show how the relationship between the actors and the menus that can be accessed by each actor. The use case diagram of the SMILE application is shown in **FIGURE 1**.

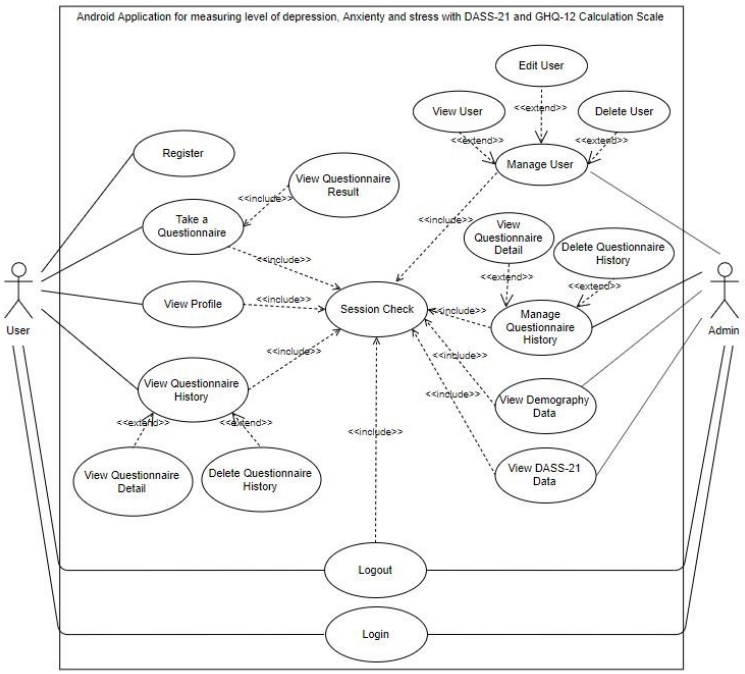


FIGURE 1. Use case diagram of SMILE.apk.

DASS-21 is used in this application to measure the level of depression, anxiety, and stress. It consists of 21 questions within three scales. The scale of depression is represented by statements number 3, 5, 10, 13, 16, 17, 21. The scale of anxiety is represented by statements number 2, 4, 7, 9, 15, 19, 20.

The scale of stress is represented by statements number 1, 6, 8, 11, 12, 14, 18. Each statement is divided into four categories, as listed in **TABLE 2**.

TABLE 2. Four categories FF statement.

No	Category
0	It doesn't suit me at all, or never.
1	It suits me to a certain extent, or sometimes.
2	In accordance with me to the extent that can be considered, or quite often.
3	Very suitable for me, or very often.

To define the level of depression, anxiety, and stress, the points of each question are multiplied by two. The total score then would be matched to **TABLE 3**.

TABLE 3. Categorizing the depression, anxiety, and stress.

	Range of Scores		
	Stress	**Depression**	**Anxiety**
Normal	0-7	0-4	0-3
Mild	8-9	5-6	4-5
Moderate	10-12	7-10	6-7
Severe	13-16	11-13	8-9
Extremely severe	>17	>14	>10

As the target users of this application are Indonesian, **TABLE 4** lists an Indonesian translated version of DASS-21 questionnaire by Damanik [17].

TABLE 4. Questionaires of DASS-21 for Indonesian.

No	Statement	No	Statement
1	Saya merasa bahwa diri saya menjadi marah karena hal-hal sepele.	12	Saya merasa telah menghabiskan banyak energi untuk merasa cemas.
2	Saya merasa bibir saya sering kering.	13	Saya merasa sedih dan tertekan.
3	Saya sama sekali tidak dapat merasakan perasaan positif.	14	Saya menemukan diri saya menjadi tidak sabar ketika mengalami penundaan (misalnya: kemacetan lalu lintas, menunggu sesuatu).
4	Saya mengalami kesulitan bernafas (misalnya: seringkali terengah-engah atau tidak dapat bernafas padahal tidak melakukan aktivitas fisik sebelumnya).	15	Saya merasa lemas seperti mau pingsan.
5	Saya sepertinya tidak kuat lagi untuk melakukan suatu kegiatan.	16	Saya merasa saya kehilangan minat akan segala hal.
6	Saya cenderung bereaksi berlebihan terhadap suatu situasi.	17	Saya merasa bahwa saya tidak berharga sebagai seorang manusia.
7	Saya merasa goyah (misalnya, kaki terasa mau 'copot').	18	Saya merasa bahwa saya mudah tersinggung.
8	Saya merasa sulit untuk bersantai.	19	Saya berkeringat secara berlebihan (misalnya: tangan berkeringat), padahal temperatur tidak panas atau tidak melakukan aktivitas fisik sebelumnya.
9	Saya menemukan diri saya berada dalam situasi yang membuat saya merasa sangat cemas dan saya akan merasa sangat lega jika semua ini berakhir.	20	Saya merasa takut tanpa alasan yang jelas.
10	Saya merasa tidak ada hal yang dapat diharapkan di masa depan.	21	Saya merasa bahwa hidup tidak bermanfaat.
11	Saya menemukan diri saya mudah merasa kesal.		

IMPLEMENTATION AND SYSTEM TESTING

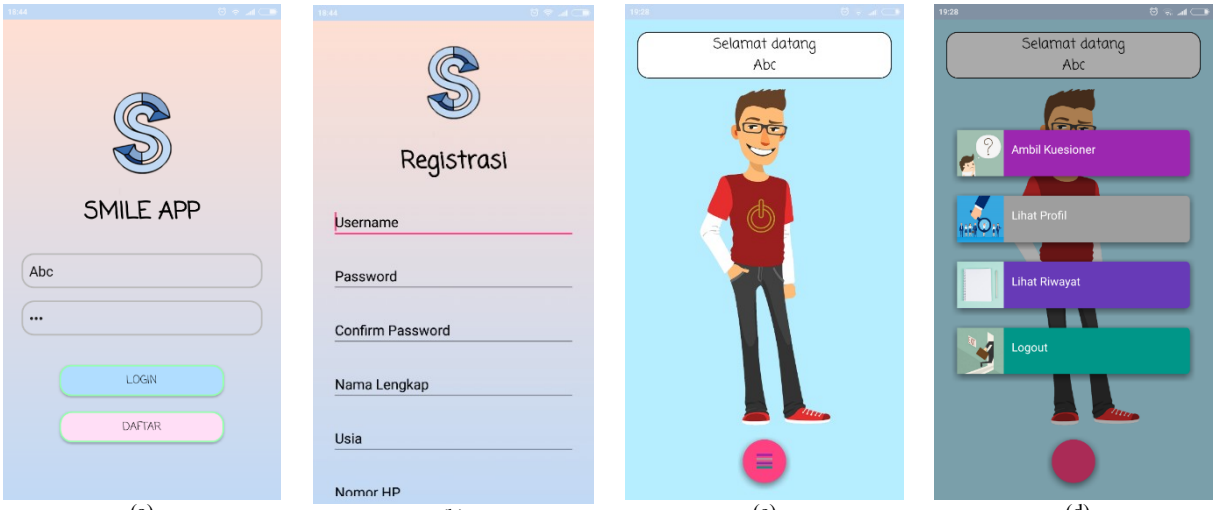
This section deals with the implementation of DASS-21 in digital form and testing the developed system.

Main Menu

The main menu of the developed SMILE application is shown in **FIGURE 2** (a). This page is used to enter the system. Registered user can directly enter the system after login using user name and password. When the user is not recognized by the system, user must register via registration page as shown in **FIGURE 2** (b).

User Menu

If registration is success, each user will be granted a personal page. The welcome page is shown in **FIGURE 2** (c) and the main menu for registered user is shown in **FIGURE 2** (d). After finish filling the digital form of DASS-21, user can verify his level of depression, anxiety, and stress, whether they are normal, mild, moderate, severe or extreme severe.



(a) (b) (c) (d)

FIGURE 2. (a). Main menu. (b). Regsitration page. (c). Welcome page and (d). Main menu of user.

Admin Menu

Admin has responsibility to manage the user and data base. After login to the system, Admin enters the main menu, which has five submenus, i.e. Manage User, Manage History, Demographic Data, DASS-21 Data, and Logout. **FIGURE 3** (a) shows Admin menu which consists of five sub menus and (b) shows the example of searching the user in Manage User submenu. Admin also be able to view the Demographic data and DASS-21 data which presents the profile of all users, as shown in **FIGURE 3** (c) and (d). Based on these data, admin can give information to the upper manager to take next action.

(a) (b) (c) (d)

FIGURE 3. (a). Admin menu consists of five sub menus (b). searching function in Manage User submenu. (c). Demography data and (d). DASS-21 data.

CONCLUSION

The mobile, fast response, and interactive measurement tool of psychological disorders based on DASS-21 has been developed under android based smart phone. This application can be used to measure the level of depression, anxiety, and stress by taking questionnaires of DASS-21 digital form. User can obtain the results, view personal profile

data, and delete the history of measurement that has been taken. Admin can manage user's personal profile data, change user data, delete user, view user history, delete user history, view demographic data, and view DASS-21 data.

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