Mental Balance: A Goal-oriented Well-being Mobile Application for Self-monitoring

Mohammed Al-Kandari, Rakan Al-Halak, Rony Hamza, Rawan Mostafa and Iyad Abu Doush

Computing Department, College of Engineering and Applied Sciences, American University of Kuwait, Salmiyah, Kuwait

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Abstract: In today's digital age a lot of people get caught in an overwhelming data flow being delivered through their smartphones and one can quickly forget to see the big picture and how each aspect of his life plays a critical whole in his overall wellbeing. Well-being is the experience of health, happiness, and prosperity. It includes having good mental health, high life satisfaction, and a sense of meaning or purpose. Smartphones can improve the well-being of the individual and people already are using many applications to do so. The problem is that these applications tend to focus on a single aspect of someone's life or try to do everything at once and end up being a bloated app with a steep learning curve. In this paper, we propose Mental Balance, a goal-oriented wellbeing tool for people with mental illness. It takes a holistic approach in improving the wellbeing of the user by letting him set goals for different aspects of his life and then perform daily self-assessments to record their level of commitment to the goal, their mental state, and a journal summarizing their day. The assessment of the user's well-being is based on a recommended measure called MARS. The application will present personalized recommendations of hand-picked educational materials over time that will target specific aspects of the user's life based on his progress over time. Giving users the ability to look at their well-being from multiple perspectives. The application was evaluated on 3 target users. The results show the effectiveness and efficiency of the developed solution, especially in behavior-changing and information quality.

1 INTRODUCTION

According to World Health Organization (WHO, 2021), mental health is defined as a state of well-being in which every individual realizes his or her potential, can cope with the normal stresses of life, can work productively and fruitfully, and can contribute to her or his community. Well-being is the experience of health, happiness, and prosperity. It includes having good mental health, high life satisfaction, and a sense of meaning or purpose. More generally, well-being is just feeling well (Rickard et al., 2016).

According to the Mental Health First Aid England, more than 90 % of people who commit suicide have a diagnosable mental disorder[1]. The National Institute of Mental Health statistics shows that in the United States 26.2 % of the population suffers from at least one type of mental disorder[2]. Unfortunately, less than 40 % of people with serious mental illnesses get access to proper stable treatment.

There are several reasons for this number of people such as financial barriers, many people believe that they are the best at solving their problems and trust problems and confidentiality with a psychiatrist. Monitoring people daily activities can help in tracking if there is any possibility of developing depression, anxiety, or reduced physical health.

According to Latham & Locke (2013) goals are specific aims of the action to achieve a specific standard or professionalism during a predefined amount of time. They are the level of competence that we wish to achieve and create a useful lens through which we assess our current performance. Goal setting is the process by which we achieve these goals. The importance of the goal-setting process should not go unappreciated as every person's life relies on selecting an appropriate goal to achieve (Latham & Locke, 2013; Isakadze et al. 2018).

Clinical and professional health services would prefer daily monitor of the users' daily progress. Such a real-time daily process is a challenge. Self-

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[1] https://mhfaengland.org/mhfa-centre/research-and-evaluation/mental-health-statistics/

[2] https://www.hopkinsmedicine.org/health/wellness-and-prevention/mental-health-disorder-statistics

monitoring can be used as an alternative for mental health care as many patients do not look for professional support (Burns and Rapee, 2006).

Mobile phones are considered powerful tools to track users' behaviour and emotional condition (Abu Doush and Jarrah, 2019; Al-ghurair et al., 2021). This paper introduces a tool to help users with mental illness to be aware of their life to achieve mental balance and general wellbeing. The tool allows users to set goals on different aspects of their life and rate their progress every day and write a short journal about it. The proposed solution is evaluated in terms of usability using the Mobile Application Rating Scale (MARS) (Macias et al., 2015; Kim et al. 2018). In addition, users are asked if the application helped them in improving their lives. The proposed solution automatically collects information related to the user's physical activity and sleep pattern to see if these habits are improving which is demonstrates users' general wellbeing.

The rest of the paper is structured as follows: The background is presented in Section 2. The methodology is described in Section 3. Section 4 provides the results and discussions. Finally, the conclusion and some future directions are drawn in Section 5.

2 BACKGROUND

According to World Health Organization mental health is defined as a state of well-being in which every individual realizes his or her potential, can cope with the normal stresses of life, can work productively and fruitfully, and can contribute to the community (WHO, 2021).

According to Latham & Locke (2013) Goals are "the object or aim of an action, for example, to attain a specific standard of proficiency, usually within a specified time limit." They are the level of competence that we wish to achieve and create a useful lens through which we assess our current performance. Goal setting is the process by which we achieve these goals. The importance of the goal-setting process should not go unappreciated as it can provide meaning for someone's life and improve mental health.

According to Gravenhorst et al. (2015) there are six main uses for mobile phone applications as medical devices for mental disorder treatment. The first type is **self-reporting** in which the patient is self-reporting. It allows users to input their daily progress independently. Users can answer questions that can help in collecting data on behavioural and cognitive factors like stress, mood, sleep, and daily activities. The second type is **automatic data sampling** as user's behaviour is a core factor in mental disorders to track users' progress. This technique utilizes sensors that calculate the users surrounding environment. Activity and mobility data can be tested through the accelerometer and the location sensors such as GPS. It has been proven that there is a solid correlation between a mentally ill patient's state of her or his illness and social activity. Being able to connect the daily activities with the state or illness is a core factor for the treatment. The third type is **behavioural patterns recognition** which combines self-reporting and activity analysis. It is useful for the psychiatrist to find the correlation in the data given. Activity recognition is crucial for the psychiatrist to track users' progress. Behaviour recognition could identify walking, running, sleeping, shopping, and attending work. This level of recognition would be more useful and important to the psychiatrist to track rather than the low level-accumulator. The fourth type is **data visualization** to track users' progress by using charts. The patient or psychiatrist would investigate the visualization of the tracked activity such as sleep, mood, stress, or physical activity. The fifth type of application is **therapeutic feedback** in which psychiatrists can adjust prescriptions and advise through the designed platform by the ability to track the user's daily progress. The platform allows daily real-time analysis of the patient, and the psychiatrist would be able to modify the prescriptions accordingly. For example, in a case of observing the patient going from a high-level of depression to a low-level of depression, modifying the dosage of medicine is vital. Lastly, the sixth type is **communication** which allows direct communication between patient and psychiatrist. A mobile phone can be used for supporting remote, real-time communication using text, video, and images. Several studies have shown that a simple message from the psychiatrist to a schizophrenic patient can benefit him/her through the treatment.

The well-being we all strive to achieve comes through considering the many aspects of one's life and how they are connected and how one can improve each one of these aspects. Goal setting and habit formation are one of the most important skills one can learn to achieve their goals in reaching wellbeing and mental stability. Lent (2019) experiment to see how does goal setting help in the performance of students. Students were asked to set goals for their study but also can include goals for other aspects of life. The results show that goal setting allowed students to avoid working too hard and in return lowering their stress levels and focus on goals that are not related to their studies. Goal setting can be used to increase life satisfaction and improve overall well-being.

Goal setting can be better if it is paired with helpful habits that can help the person in achieving goals. Habit formation can be improved using smartphone applications (Stawarz et al., 2015). According to Stawarz et al. (2015) applications that contain elements of encouragement through reminders and game elements through points and rewards are the best as they made users use them regularly.

Macias et al. (2015) investigate the engagement rate of adults using a mobile application to promote physical and psychiatric wellbeing. A solution is developed for adults with schizophrenia, major depression, or bipolar disorder. The results show that the application encouraged users to engage in healthy behaviours such as taking a walk for example.

3 PROPOSED SYSTEM

In this paper, a system to help people with mental illness called Mental Balance is developed. It was developed and designed after several visits to a professional mental health clinic in Kuwait. The recommendation was to add a general well-being scale (GGWBS) (Gravenhorst et al., 2015). During the system design, we utilize the recommendations from the literature (Stawarz et al., 2015; Macias et al., 2015) to design an efficient solution.

3.1 System Outline

The proposed solution is developed for iOS. The solution utilizes HealthKit in the iOS SDK[3] to grab information related to the user's physical activity and sleep pattern. It records user data by acquiring user reviews (**self-reporting**) about different aspects of life which are sleep, work, family, health, food, and money (see Figure 1).

In addition, users would rate their mental state by answering a questionnaire with a scale from 1 to 10 and by writing a small journal about their feelings.

Users can set goals and set reminders to achieve these goals. They can also record assessments using journal writing. The obtained information is then retrieved and presented as charts (**data visualization**) to show users their performance in different aspects and display educational contents based on users' needs (e.g., the aspect in life that has low performance). The solution uses the phone sensor to track users' sleep patterns and physical activity (**automatic data sampling** and **behavioral patterns recognition**).

This can help us track if the application is improving these habits and the user's general wellbeing.
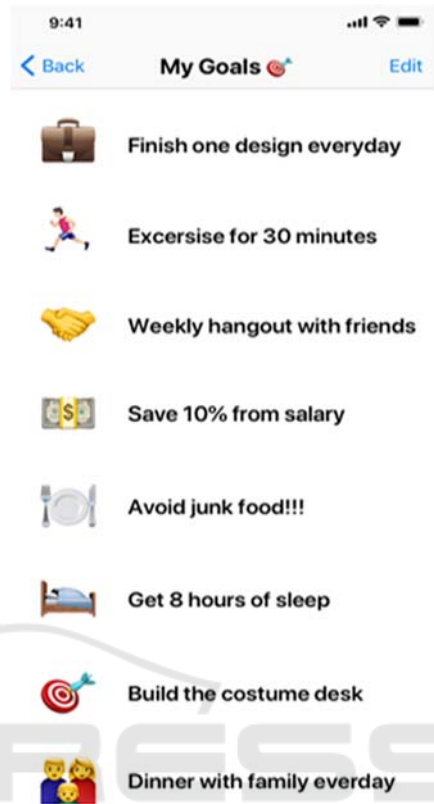

Figure 1: Personal goals list.

When we design the solution, we consider the following choices: first, personalization by collecting information to profile user's data to tailor the output on users' needs. Second, a holistic approach by covering a wide spectrum of health and well-being in the areas of users' physical, mental, and social well-being.

As shown in Figure 2, the proposed solution allows users to record the goal on each life aspect and then record the commitment level on a scale from 1 to 10 (e.g., record 4 on how the use is committed to the sleeping goal).

The proposed solution shows the user trends on his goal progress. Also, it analyses users' data and if the user had a low level at a certain goal criterion within a specific timeframe, then it suggests an educational material with a topic specific to that goal and an app suggestion that might help the user improve their progress on that goal as shown in Figure 4. A demo video of the proposed solution is presented here[4].
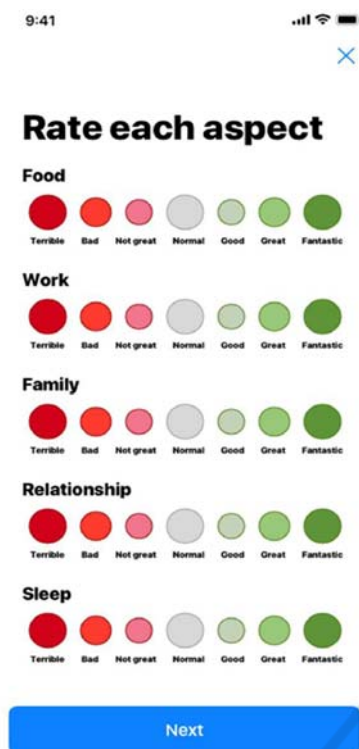
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[3] https://developer.apple.com/documentation/healthkit

[4] https://www.youtube.com/watch?v=pn1mC47zllU
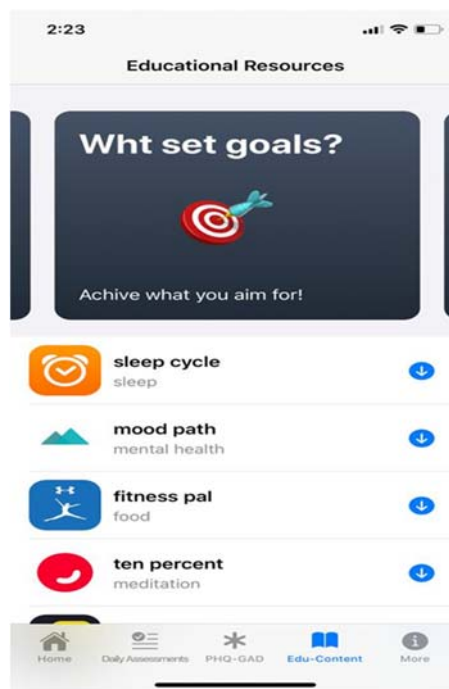
Figure 2: Daily goals rating.

Figure 3: Resources suggestions based on the user performance.

4 SYSTEM EVALUATION

4.1 Participants and Settings

We asked 3 mental health patients to use the app and we discussed on the phone which included doing the Mobile Assessment Rating System and then listening to their suggestions on how we can improve the usability of the app and what changes should we add. The participant's information is presented in Table1.

Table 1: Participant's information.

ID	Gender	Age	Type of mental illness
user-1	M	26	Depression
user-2	M	31	Obsessive-compulsive disorder (OCD) and attention deficit hyperactivity disorder (ADHD)
user-3	F	25	Generalized anxiety disorder (GAD)

4.2 Procedure

The method in which the users are being instructed to test the app is as follows:

1. The user will install the app manually by plugging their devices in our development computer.

2. Users are asked to set goals through a goal-setting view. Evaluate your progress through the day in the daily assessment input view. View the details of the day and the progress statistics from the stat view.

3. Use the assessment view to evaluate the depression and anxiety levels.

4. Read the educational content in the educational content and download recommended apps from the list.

Due to the unfortunate events of COVID-19, the rest of the evaluation was done through phone calls. After the users used the application for 4 weeks, we called each one of them and sent them a copy of the MARS questionnaire to evaluate the application usability. We went through every question and explained it to the user and recorded the user's results. After that, we asked each user if they have any specific points regarding specific areas in the app where they would like to be changed and improved.

4.3 Results and Discussion

The application is tested by the researchers and app developers to fix any bugs or issues. The users used the app for 4 weeks and write feedback about their experience. The information about the study and electronic consent is required before they use the app.

The evaluation results for the 3 users using MARS are presented in Figure 4. Note that section A measures the app engagement, section B measures functionality, section C measures aesthetics, section D measures information quality, section E measures app subjective quality, and section G measures behavioral changes.

It is worth mentioning that the highest users' satisfaction was in the part of behavior changing and information quality which is expected as the app is meant to improve the lifestyle of the users to enhance their mental health.

The users presented recommendations to enhance the app. User-1 recommended adding visual feedback for actions if possible (e.g., when deleting an item display an alert, when adding an item display added successfully). Also, he suggested allowing viewing more time frames in the charts instead of just the previous 7 days. Also, user-2 suggested adding a tutorial on how to use the app when first launching the app and recommended allowing that the educational section is to be shared with others. In addition, he suggested adding a color code for the score for easier identification of that life aspect state. Finally, user-3 suggested adding the option to display the chart on the home screen so progress can be viewed easily.

These issues mentioned by users have been addressed in the next version of the app. For instance, we added colors to determine how good or bad the user is doing in progress on a certain goal. We used three color codes green (good), blue (average), and red (bad) as shown in Figure 5.
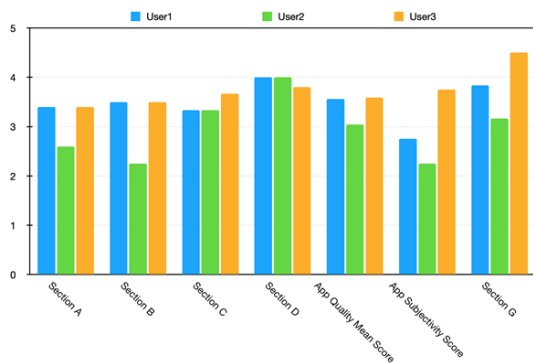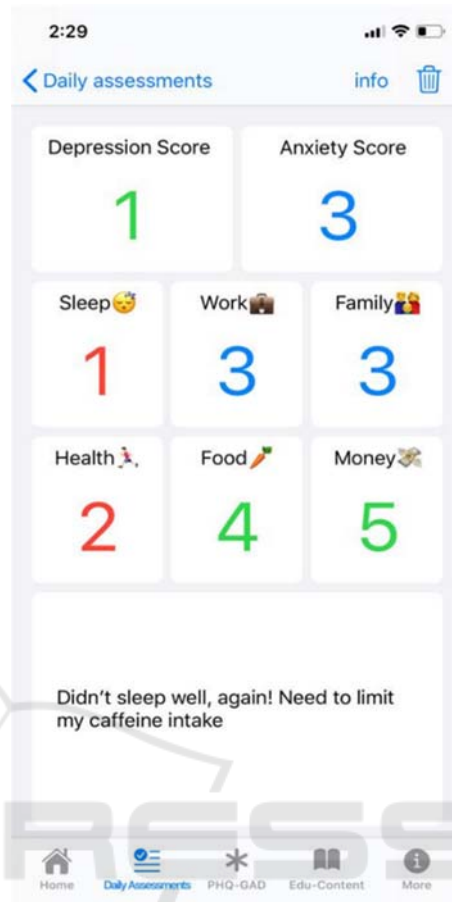

Figure 4: MARS score results for the 3 users.

Figure 5: Color indicator.

5 CONCLUSIONS AND FUTURE WORK

The mobile apps can help in monitoring users and help to improve their mental health. People check their mobile phones regularly and this can help them to get regular feedback which can improve their mental state.

The developed mobile solution utilizes self-reporting, data visualization, and behavioral patterns recognition to provide a holistic approach for tracking mental health users' progress and to provide educational recommendations to improve their mental health. The evaluation results using MARS show the effectiveness and efficiency of the proposed solution. Such a solution can help users to overcome daily challenges and promote their emotional well-being.

As a future direction, we can automate the recognition of users' self-reported journals by using a machine learning method (e.g., IBM API Tone

Analyzer [5]) to detect the tone of the used language such as joy, fear, sadness, and anger. In addition, we plan to evaluate the proposed solution on the users after having the updated version of the solution.

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[5] https://cloud.ibm.com/apidocs/tone-analyzer