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Short Paper*

Muni-Muni: Mood Analyzer and Screening Tests for the National Center of Mental Health using Sentiment Analysis

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Abstract

Purpose – In the technological era we are living in today, advancement and innovation became mainstream that almost everything we do is now easier and more efficient. Psychological welfare is a vital part of one's life yet most often than not, it is disregarded, especially in the Philippines.

Method – For this reason, this project aims to develop a web and mobile application, under the guidance of the National Center for Mental Health, that will promote mental health to the users. The system took advantage of Sentiment Analysis where the application analyzed the text input of the users and process the information using Lexicon Based Approach that produced polarity results such as Positive, Neutral, and Negative.

Results – Overall, the entire system is based on Cognitive Behavioral Therapy (CBT) and Dialectical Behavior Therapy (DBT) used by behavioral specialists. To test the effectiveness of the software, the proponents surveyed 40 students and 10 behavioral field professionals. Using the PERFS model, the result showed a weighted mean of 4.61 score which was equivalent to the Excellent tier.

Conclusion – The developers' client, National Center for Mental Health, was looking for tools, aids, and platforms to raise the mental health awareness of Filipinos and this Capstone Project is the solution.

Recommendation – The Sentiment Analysis utilized in the system is only at the entry-level. It can only understand the direct context of the English language. A plethora of words and phrases were not properly recognized either being by Negation of Words, Sarcasm, Proverbs, Jargon Words, and Emojis among others.

Research Implications – If future developers will decide to continue this project and follow the recommendations of the proponents, they can help and guide more users in improving their mental health, especially in today's time.

Keywords – mental health, sentiment analysis, CBT, DBT, screening tests

INTRODUCTION

In the technological era, we are living in today, advancement and innovation became mainstream, and almost everything we do become easier and more efficient. From entertainment, communication, agriculture, to transportation – technology is very much evident. According to Ismail (2017), in the world today, people cannot live without technology. These innovations have slowly become an essential part of people's day-to-day lives. Truly, anything is possible, with the right tool and proper steps. Moreover, the very essence of technology is to improve the quality of human life. One way to utilize it is through the promotion and advancement of human well-being, particularly in mental health. Dr. Xiong (2018) says that mental health welfare is important because it's a fundamental part of one's life and it impacts a person's thoughts, emotions, and behavior. Being healthy in the mental aspect can promote productivity and effectiveness in different parts of one's life – work, school, or in relationships with other people or one's self. Without a doubt, mental health is a vital part of one's growth and yet, it is often disregarded. With this in mind, the researchers decided to create a system where it can boost and improve the state of mental health in the Philippines and counter some of the issues and problems surrounding it, with the help of their partner organization the National Center for Mental Health.

The current state of mental health in the Philippines is poor. There are 19 million Filipinos who are diagnosed with schizophrenia, major depressive disorder and are considered bipolar as of 2018. Intentional self-harm is also the 9th leading cause of death among the 20- to 24-year-old range according to Medenillia, Ordinario, and Manawis (2019). These are only the numbers of reported cases from mental health institutions but there are far more people who are struggling with psychological illness but are too scared to disclose their problem because of the stigma that presents around it. According to Medenillia et al. (2019) and Montemayor (2019), because of stigma, Filipinos tend to not open up about their feelings relating to mental health because they are either embarrassed or scared to be judged and discriminated against. Tanaka et al. (2018) also added that Filipinos hesitate to seek help for fear of being labeled "crazy" and spoiling their family's name. Truly, there is a need to address the current condition of the mental health of Filipinos. That is why, with the technological era we live in today, the team proposed an innovative solution to integrate technology with mental health care as a form of Muni-Muni.

LITERATURE REVIEW

Mental health is an essential component of a person's entire well-being (Untivero, 2019). Proper mental health is needed for a human being to grow in a normal way, build robust relationships, and can adapt to change and deal with life's challenges. Our psychological well-being should be given the same treatment and attention the way a healthy person treats their physical health, and yet, mental health is often disregarded

and considered as a low priority especially to those who live in low-middle class countries such as the Philippines (Poblacion, 2018).

The state of mental health discourse and awareness in the Philippines is substandard and alarming. There are 19 million Filipinos who are diagnosed with schizophrenia, major depressive disorder and are considered bipolar as of 2018. Intentional self-harm is also the 9th leading cause of death among the 20- to 24-year-old range (Medenilla et al., 2019) The increasing number of people with psychological disabilities is mainly due to the stigma present in the country; On a survey conducted in 16 countries, the Philippines had the second-highest proportion of citizens who agreed that persons with mental disabilities should not be hired even if they are qualified, and the highest proportion of respondents who agreed that mental illness would improve on its own (Tanaka, 2019). Tanaka (2019) also added that Filipinos hesitate to seek help for fear of being labeled "crazy" and spoiling their family's name.

Furthermore, another benefit of integrating innovation into the promotion of mental health is mood tracking. Creating a technology that will encourage self-care with mental health may benefit users by encouraging them to be more involved in their well-being (Calderia et al., 2017). Mood tracking is about noticing something and then influencing it to be better. Calderia et al. (2017) also defined mood tracking as an approach to help healthy individuals to stay in healthy emotional states, assist individuals with mental diseases, and establish a correlation between the tracked data and their health conditions. With all of these in mind, the researchers would consider the various approaches present while also integrating unique and innovative features such as Sentiment Analysis. In research conducted by Patacsil, Malicdem, and Fernandez (2015), this method resulted in 91.50% accuracy in the training set. Sentiment Analysis poses as a feasible component in developing applications that require analysis of textual data to get the mood of the user.

METHODOLOGY

The data gathering chosen by the developers was quantitative research. The type of research followed was applied research. In the sampling technique, purposive sampling was used. Under the project development, rapid application development was applied to the study.

The proponents used one formula in the statistical treatment to interpret the data that was gathered. The weighted mean formula was used for interpreting the data gathered. Where x is the weighted mean, n is the frequency of the answer, X is the weight of each item, and N is the sample population. Table 1 shows how the researchers determine the assessment of the respondents regarding how they rate the overall system.

Table 1. Weighted Mean Rating Table

Rating	Remark	Scale	Interpretation
4.51 – 5.00	Strongly Agree	5	Excellent
3.51 – 4.50	Agree	4	Above Average
2.52 – 3.50	Neutral	3	Average
1.51 – 2.51	Disagree	2	Below Average
1.00 – 1.50	Strongly Disagree	1	Poor

Figure 1 shows the operations that were performed by the entities. On the left side is the Administrator who had access to all accounts. The administrator received the trend of moods from the data gathered by the users. While the users were the ones who recorded their mood through pre-defined text and journaling. Also, the administrator will be provided support and recommendations on how to handle, improve, or prolong their mood depending on their current status. Whereas Figure 2 shows how the system architecture worked. First, the users ran the application using an android phone and a computer device. After having it run through the devices with an internet connection to connect to the system. After going to the last phase, which was the database, the database was then saved in the web system as well as in the mobile system.

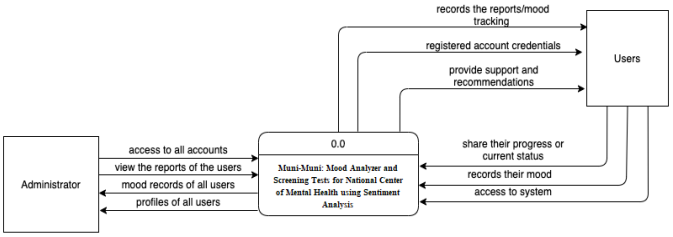

Figure 1. Context Diagram

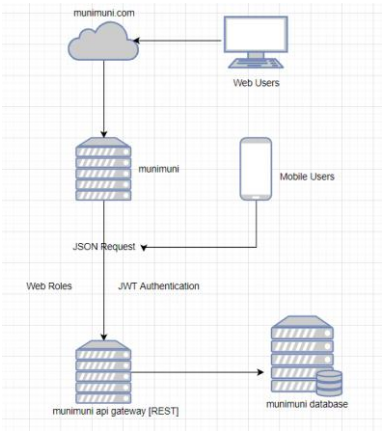

Figure 2. System Architecture

According to Gupta (2018), Sentiment Analysis is the process of contextual mining of string data to which it identifies and extracts subjective information from the root material. Understanding the user's emotions is the core of the system and people can articulate their feelings and thoughts more willingly than ever before. As such, the researchers chose to utilize the power of Sentiment Analysis to incorporate innovation in aiding human development. There are many types of Sentiment Analysis, from those which detect feelings and emotions, ones that focus on polarity, and models that can identify intentions. For the system, the researchers decided to use the Lexicon-Based Approach where the system identifies the polarity of data input into a positive, negative, or neutral statement based on an external dictionary. The semantics then are extracted from the data source and the score is calculated.

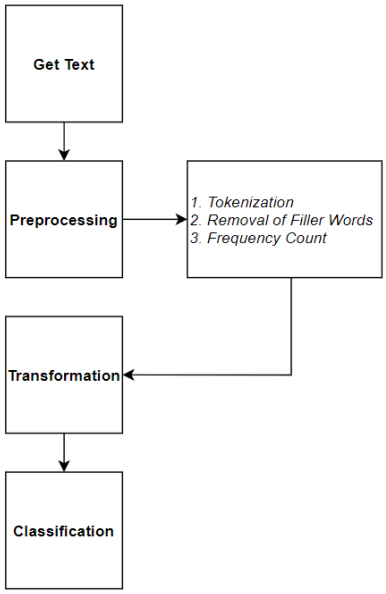

Figure 3. Process of Sentiment Analysis

The Preprocessing step of the Sentiment Analysis Process consists of three sub-steps. The first one is the tokenization of the string data. The journal entry of the general user is then tokenized per word using string manipulation. After the data has been divided, the system then will undergo a screening process where it eliminates unnecessary words or "filler words" such as determiners like articles (e.g., *a, an, the*), demonstratives (e.g., *this, that, these, those*), pronouns and possessive determiners (e.g., *my, your, his, her, its, our*) among others. After that, the remaining words then are counted based on frequency then compared using Liu and Hu Opinion Lexicon which contains around 6800 positive and negative sentiment words for the English language. Lastly, the classification of the data will fall into three categories: Positive, Neutral, and Negative.

RESULTS

After completing preliminary preparations and interviews with behavioral field professionals, the proponents started designing and developing the system. Creation of mock-ups and prototypes that are in-lined with the rules and suggestions of NCMH was created. The team also conducted user-acceptance testing to determine if the system initially created satisfies the needs of the client, NCMH, as well as a software evaluation testing of the system to all end-users, to see if future users will optimize the integrated system features and whether if it is effective.

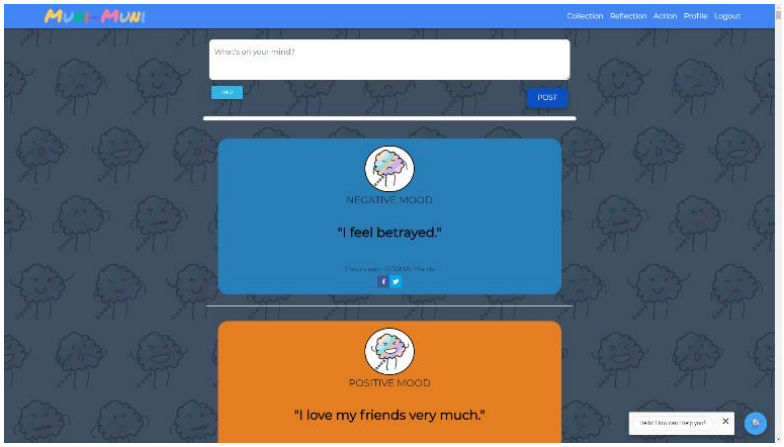

Figure 4. Collection Module - Web

Figure 4 shows the Collection Module of the system. This page contains the main features of the system such as the Sentiment Analysis process where users can journal their mood and in return, the application will determine the mood of the text entered. Present here as well is the Chatbot created to guide the users.

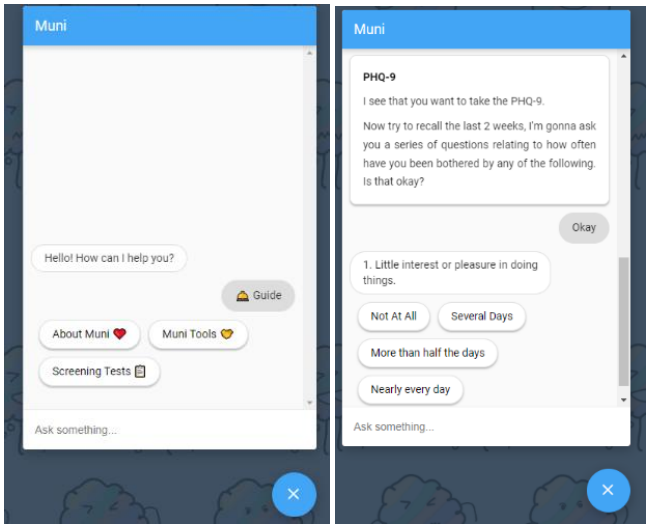

Figure 5. Chatbot - Web

Figure 5 shows the Chatbot integrated into the Collection Module of the system. In the Chatbot, users can talk to Muni and ask her basic questions and guides about Mental Health and the system. They can also take screening tests like (PHQ-9 and GAD-7) to determine the current status of their mental wellbeing and simple activities like breathing exercises to help users relieve tensions they are currently feeling.

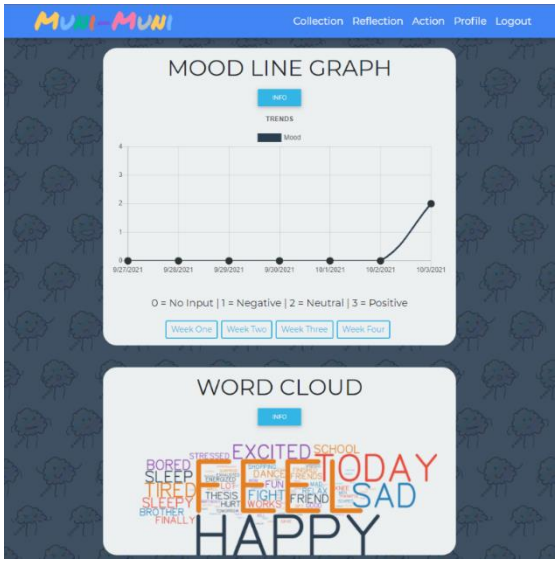

Figure 6. Reflection Module - Web

Figure 6 shows the Reflection Module of the system. On this page, users can see visual representations of their mood data like daily pie charts, trend graphs, and word clouds.

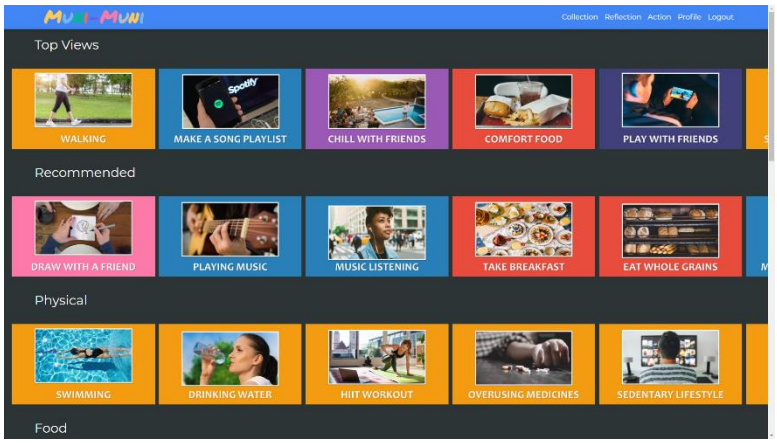

Figure 7. Action Module - Web

Figure 7 shows the Action Module of the system. On this page, users can choose activities that could help them relieve and prolong their current mood. Top Views are activities, popular across users; Recommended uses Recommender System where it takes into account the interests selected by the user and their last mood input, and other variants as well. The action module is connected to the current mood of the user in a way that it adapts its recommended activities based on the last previous mood analysis of the user.

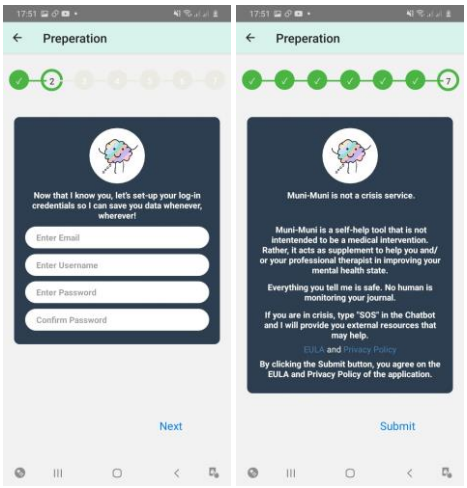

Figure 8. Preparation Module - Mobile

Figure 8 shows the mobile version of the Preparation Module. In this module, users can register an account as well as be prepared on what to expect in using the application. They will be given instructions and visual guides in utilizing the various features of the application.

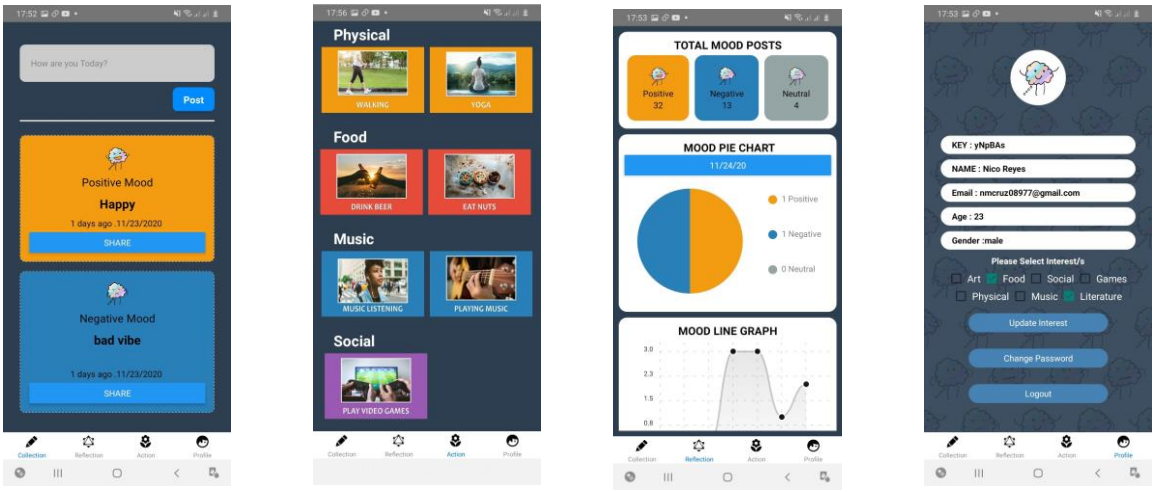

Figure 9. Muni – Mobile Version

Figure 9 shows the mobile version of the Collection, Reflection, Action, and Profile modules. The mobile version has almost the same features present in the web version, the only difference is that the former was optimized to be used in mobile phones, particularly in Android smartphones.

The admin privileges of the system were given to the client, National Center for Mental Health, and were accessible through the web application of the system. These privileges were:

- Management Module – the admin has access to all accounts and their data where he or she can add, edit, or block them depending on the circumstance;
- Overview Module – the admin can also view the records of users, their history, and other necessary information related to the user;
- Trend Module – the system can also provide the trend of the mood of all users through statistics or visualization depending on the specific date or time;
- Audit Trail – the admin can view and track the actions of the users; and
- Content Management System – the admin can also manage the creation and modification of the content of the website.

On the other hand, General Users, referring to the end-users of the system, could access all the main features in both the web and mobile application. As such, the modules which the General Users can utilize were:

- Registration Module – users can create their account with e-mail verification;
- Login Module – to provide some privacy, users need to login their credentials to access their account;
- Preparation Module – the system will provide essential information about the mechanism of tracking mood and its benefits;
- Chatbot – users can chat with "Muni" to discuss the system and their progress;
- Collection Module – the application allows users to record their mood through pre-defined text and journalizing;
- Reflection Module – the system provides mood visualization using graphs, charts, and trends;
- Screening Tests – if the system detects that the user is feeling down after some time, the application will opt for a screening test for the user;
- Action Module – the application will provide support and recommendations on how to handle, improve, or prolong their mood depending on their current status; and
- Share Module – users can also share their progress or current status to seek support or inspire other people.

DISCUSSION

The results section summarized the outcomes obtained from the evaluation process. The proponents used the quantitative method approach by conducting online surveys for the end-users along with the system. The developers selected a total of 50 respondents: 10 from a staff of NCMH and 3rd-party behavioral field professionals, and 40 based on the factors selected on the Data Gathering technique. The evaluation process of this project consisted of 5 main factors: functionality, reliability, performance, and supportability. The purposive sampling method was also used to simplify the results gathered by the proponents.

Table 2. Summary of Weighted Mean

Criteria	Weighted Mean	Response Description
Functionality	4.61	Excellent
Usability	4.79	Excellent
Reliability	4.33	Above Average
Performance	4.73	Excellent
Sustainability	4.60	Excellent
Overall	**4.61**	**Excellent**

Table 2 shows the summary of the weighted mean of the 5 criteria. Each criterion showed the weighted mean that had been gathered based on the score on the survey of the respondents. Based on the table above, Functionality scored 4.61 which was equivalent to Excellent; Usability garnered a score of 4.79 belonging to the Excellent tier as well; Reliability fell short with 4.33 total weighted mean that corresponded with Above Average; Performance amounted to 4.73 which indicated Excellent; and lastly, Sustainability got 4.60 weighted mean that signified an Excellent score. The total weighted mean of all the criteria amounted to 4.61 which was classified as an Excellent response.

CONCLUSIONS AND RECOMMENDATIONS

After the proponents have gathered all the data using thorough, research, interviews, and surveys, the proponents had come up with the result of the system. The developers' client, National Center for Mental Health, was looking for tools, aids, and platforms to raise the mental health awareness of Filipinos and this Capstone Project is the solution.

According to the gathered comments and feedbacks of the system, and the results of the tallied surveys, the desired outcome, and objectives that were given have been met. Users can easily register with email verification and log in to their account using their credentials in either web or mobile applications. They can also input their journal on the Collection Module where the system can analyze it using Sentiment Analysis. Furthermore, this process, which utilizes Liu and Hu Opinion Lexicon, can output 3 basic moods: positive, neutral, and negative.

A chatbot named "Muni" was integrated inside the web application where users can interact with her ask her for guides and help like answering screening tests (PHQ-9 and GAD-7), as well as practicing CBT and DBT approaches, in this case, Flashpoint Tools and Breathing Exercise. Different visualization of the user's mood data is also present in the Reflection Module like Cards, Pie Chart, Trend Graph, and Word Cloud. Various activities are available on the Action Module which also adapts using a Recommender System that is based on the user's current mood of the day and their selected interests.

Administrator privileges are also accounted for like, dashboards, user management, CMS, and audit trails.

With the help of the evaluation and professional insights of the researchers' project and course adviser, the following conclusion was finalized through utilizing the Functionality, Usability, Reliability, Performance, and Supportability methods to evaluate the system's effectiveness, efficiency, and equity to the users. The outcome of the system was exceptionally met, even higher than the developers' expectations as seen on the summary of weighted mean where almost all criterion is excellent except for one. The main objective of this Capstone Project is to promote the mental health of users via a website and mobile application where it is accessible, free, and in line with the guidelines of the National Center for Mental Health. Consequently, based on the statistical results and comments of behavioral specialists of NCMH and outside sources, the general aim of this project has been met.

Even with the success of the system, some limitations were present as pointed out by particular users while using the system. To future researchers/developers, below are the gathered recommendation from this Capstone Project's proponents that can improve the project and it contains five concrete recommendations.

First, the Sentiment Analysis utilized in the system is only at the entry-level. It can only understand the direct context of the English language. A plethora of words and phrases were not properly recognized either being by Negation of Words, Sarcasm, Proverbs, Jargon Words, and Emojis among others. Following this, the Chatbot present in the system is a conversational AI chatbot that uses a natural language understanding platform called Dialogflow by Google. The proponents believe that having a machine learning AI chatbot can greatly improve the user's experience. Next, visualization of moods is present in the Reflection Module. The past mood data of the users are organized and presented into charts and graphs where users can easily glance and tell their mood history. Although this is already beneficial to the user, one more way to improve this is if the system can predict the user's mood based on all the data conferred by the user. Moreover, future researchers/developers can also partner with alerts services like local authorities and hospitals to further improve the SOS system of system. At present, the only actions the system can do when it detects an emergency is to prompt the user to seek help from a friend, call emergency hotlines, and provide soothing activities. Granting that this is still valuable, the system can help more if it directly calls the user or alerts the local authorities. Lastly, activities and exercises found on the Action Module are all outside sources. Users will be redirected to the source of the activity and from there, they can try the said activity. Due to technical and time predicaments, this is the best alternative the developers can think of. If given the time and skills required, future researchers can integrate beneficial activities inside the system so users do not have to transfer applications.

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