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Navigation and Tracking Mobile Application for Mild Intellectual Disabled

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ABSTRACT
Mild Intellectual Disabled (MID) is identified as a group of people having learning difficulties, such as dyslexia, or even mental illness, such as dementia. The limitations disrupt the quality of life significantly which limit their activities. These group of individuals need assistance to navigate around and to be able to live independently as adult. Thus, in this paper a system called Navigation And TRAcking (NATRA) is proposed. NATRA is a real-time tracking system that utilizes radio frequency identification (RFID) and Global Positioning System (GPS) that tracks and navigates the location of mild intellectual disabled individual. The system is developed using the WiFi Module ESP8266,RC522 13.46MHz RFID Reader Module and designed for the Android Operatng System. The GPS and Radio Frequency Identification (RFID) is used to track the location. If the system is use as a tracking system, it displays the current location. In addition, GPS and images are incorporated for the navigation in outdoor and indoor environments. The Ionic 4 framework is used in developing the mobile apps. The mobile app is also equipped with a panic button, which is used when the MID individual is in danger or requires help from their respective guardians. Firebase and PHP databases are used to keep the data from the system. The mobile application is linked to both databases and can only be accessed by authorized personnel. Furthermore, the databases can be accessed anywhere with internet access.

Key words : real-time tracking, Global Positioning System (GPS), indoor and outdoor tracking, indoor and outdoor navigation.

1. INTRODUCTION

Mild Intellectual Disabled (MID) correspond to those of having learning disabilities. Individuals with MID are slower in all areas of conceptual development, social and daily living skills. The MID individual tends to show confusion, forgetfulness and difficulty concentrating in performing their daily chores.To enjoy a good quality of life, people with MID may choose to visit the grocery store, meet with friends or use public transportation. Thus, most of the time the MID individual needs assistance specially to navigate from one place to another which is a very critical skill for independent living. To help those with MID to get around, a navigation and tracking system is proposed as the tool that could be used by them.

Navigation system these days are mostly to be used on smartphones[1], such as Google Maps which is integrated with the Global Positioning System (GPS). GPS is a satellite-based navigation system which provides a geolocation to a GPS receiver anywhere on or near the Earth. In addition, tracking system is developed especially to track human, cars and also parcels. The human tracking systems are mostly employed for kids, aging or disabled people. The system developed by Huai-Kuei Wu [2] and S. B. Shree [3] used the GPS to track the dementia patients. However, the tracking system can only be employed when it is outdoor. Due to the limitation of GPS, thus, S. W. Soon [4] has come up with a mobile application to track elderly people using RFID system in indoor environment. In addition, there are also systems that operate using images to navigate in indoor environment. D. Croce [5] and H. Kaminoyama [6] have come up with a picture navigation system in which it is made to help the visually impaired and dementia patients. The navigation system used the phone camera to capture special path laid out on the street. The user has to turn on their phone camera while tracing the path, and if they went out of the path, then the phone will vibrate. A. Kassim et. al [7] proposed to use RFID navigation system which is embedded in a cane. The RFID has extended the coverage as compared to Bluetooth which is up to 1000 m for a single transmitter in a free space environment.

Drishti [8] is an integrated indoor and outdoor navigation system where it uses wireless connection, wearable computer and vocal communication interface to guide and help the blind to move one place to another. For outdoor environment, Differential Global Position System (DGPS) is used to locate the blind and for indoor usage, Drishti uses ultrasound positioning service which provides a high precision measurement scale and prompts the user with the indoor room layout. Ultrasonic sound based navigation and assistive system [9] is used as a tracking system for blind individual. It comprises of 3 technology modules, which are the Ultrasonic sound for obstacle detection coupled with gyroscope sensor to trigger ultrasonic wave pulse, GPS and Global system for mobile (GSM). All these components are combined with an Arduino board to create a system that can be used by the blind

to navigate around. S. B. Shree has come up with an elderly tracking system that comprises of GSM and GPS. In this paper,[10]the system focuses on elderly with Alzheimer and dementia diseases. The tracking system gives real time location of the elderly.

database. If it is a guardian profile, it will display the guardian information as well as all the account linked to the guardian. The guardian will then need to choose theMID user that needs to be tracked. The data of the tracking such as time and location of the MID user will be stored in the PHP database.

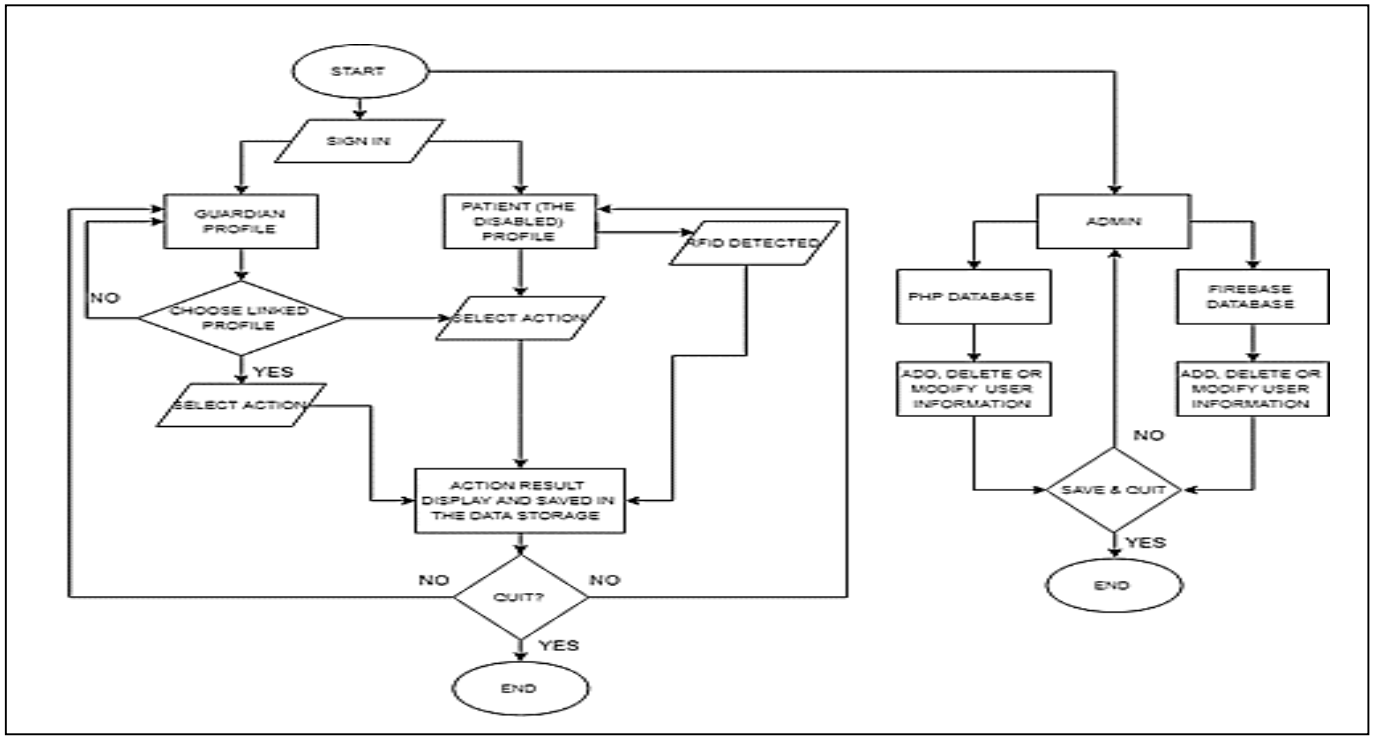

Figure 1: Flow Chart of the NATRA system

In this paper, a navigation and tracking system for Mild Intellectual Disabled (MID) community was developed which is called NATRA. To the best of author's knowledge, most of the proposed navigation and tracking system in the literature is only to be used either in outdoor or indoor environments. The Navigation And TRAcking system, which is called NATRA is applicable in both environments which is using the RFID for indoor and GPS for the outdoor.

This paper is organized as follows, the methodology of developing the system is summarized in section 2. Results are discussed in section 3. Finally, section 4 concludes and proposed the future works to be implemented.

2. METHODOLOGY

2.1 Flow Chart

Figure 1 shows the flow chart of the NATRA system. After starting the application (app), user will be prompted to sign in or sign up into the NATRA system. If the user chooses to sign up, they have to decide on which account to create, either the guardian or the MID user. On the other hand, if the user chooses to sign in into the system, the system will request for email and password to be set up in order to proceed. Then, the system will compare the input with the existing data in the

For the MID user account, the system will open up the profile page. There are two interfaces that can be used by the MID user, which is either to navigate or to send SOS to the guardians. If the MID user chooses the navigation feature, a list of images for indoor navigation and search bar for outdoor navigation will show up. The tracking data of the MID user will be stored in the PHP database. As shown in figure 1, RFID input to this system is the indoor tracking features of NATRA. If the RFID is detected by the reader, it will automatically load the data containing the time when the reader detects the RFID tag, the location and the RFID tag number into the PHP database.

The MID user will need to provide a code in order to sign out from the app. This is one of the way to prevent the MID user from accidentally signing out. The admin feature can be used to add, delete or modify the information in the database.

2.2 System Architecture

Figure 2 shows the system architecture. It is divided into 3 stages which are the input, data storage and the output. The input to the system is the email address of the guardian or the MID user. Then, for verification, the system will check the input from the app with Firebase database, which keeps the data of the guardian and PHP database which holds the information of the MID user. After the verification process,

user can access and start to use the app. The guardian will utilize on the tracking system while the MID will use the navigation system. Both are considered as the output of the system. The navigation system of this app is able to navigate the MID user from one place to another and direct the guardian to the MID user when they need help.

Pictures of indoor images are also added to the navigation system so that the MID user can move from one place to another in indoor environment. The image needs to be uploaded into the database beforehand by the guardian into the system. Wi-Fi and GPS is used in the tracking system of this app. This feature helps the guardian to track the location of the MID user. Wi-Fi is used to track the MID user in an indoor environment, while GPS tracks the MID user in an outdoor environment. All the data from this system will then be stored in the Firebase.

2.3 Software Implementation

A. Microsoft Visual Studio Code 2019

The software used as the code editor in developing the mobile app.

B. Android

Android is the operating system for the mobile application.

C. Firebase

The cloud platform for the system's database storage, and mobile service hosting and file storage

2.4 Hardware Implementation

A. Android Phone

The mobile device that is used to track the user using GPS and data exchange between the user and cloud service.

B. RFID Card

RFID Card that is equipped with unique code that will be carried by the MID user.

C. RC522 13.46MHz RFID Reader Module and ESP8266 WiFi Module

These modules will read the RFID Card and communicate with the network devices.

2.5 The Framework

A. Ionic 4

Ionic 4 is the framework for the user interface toolkit for mobile app development.

3. RESULTS AND DISCUSSION

3.1 NATRA System

The devices that are equipped with NATRA app interacts using Firebase cloud storage. The NATRA mobile app exchanges the data of GPS location, GPS navigation and RFID input (location, time and ID) to the database. The mobile app is developed in order to help the MID users to move around independently with minimal risk of getting lost. The GPS of the smartphone is used for outdoor tracking and navigation. When the MID user turns on the GPS, they are able to use the navigation system while the guardian can locate their position. Image is used for indoor navigation system. The images are uploaded into the Firebase before it is being used. MID user needs to click the next button on the image when arrived at the location. If the images are not uploaded by the guardian

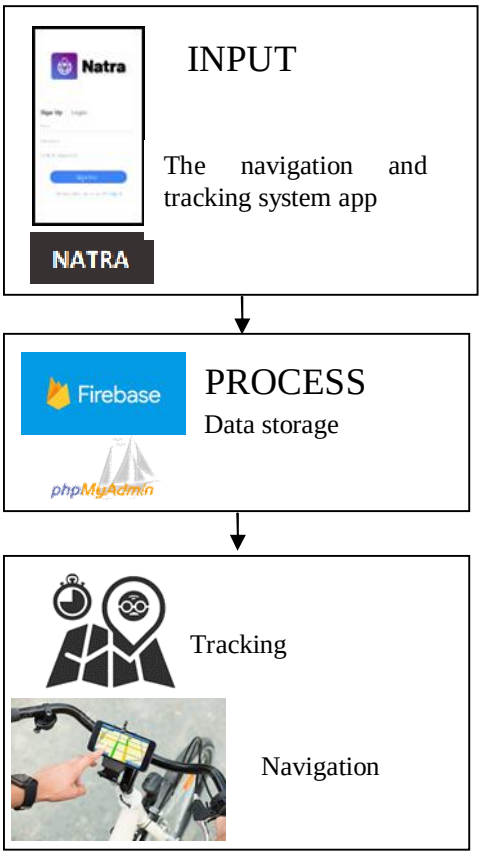

Figure 2: System Architecture

beforehand, the MID user may not be able to use the indoor navigation feature in this app. Another feature that is provided by NATRA is indoor tracking using RFID. RFID readers are placed at some points for indoor tracking. When the MID user tap the card on the RFID reader, the time and location of the reader and ID will be stored in the data storage and displayed on the mobile app.

3.2 User of the system

There are two users in this system, and the NATRA app provides different services to the users as listed below:

A. The guardian is able to track the MID user's location through GPS and RFID and navigate to the current location of the MID user.

B. The MID users is able to navigate using GPS and image, being monitored and send SOS alert to the guardian.

3.3 Modules of the System

A. Sign Up & User Authentication

This is one of the most important modules because only registered users are able to sign in and access the system as shown in Figure 3. This mobile app forbids the MID user from leaving the system by using code in order to log out which is illustrated in Figure 4. In this module, the system used a custom-made authentication for login and registration using Firebase.

Figure 3: Sign Up Page

Figure 4: Disabled user Log Out Page

B. Track List

The track list module enables the guardian to track the MID user. For instance, if user B is on the user A track list, therefore, user B can be tracked by user A. To be able to track the MID user, a request from the guardian should be sent to the MID user. If the request is accepted, then only the guardian is able to track the MID user. Figure 5 shows the track list interface of the system.

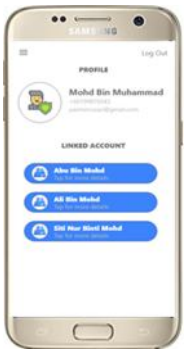

Figure 5: Track list

C. Indoor navigation using image

Images are the main component of this module. Image of specific routes are first uploaded into the Firebase. The MID user is able to navigate to the specific location by using the image uploaded into the database. Figure 6 is the interface of the indoor navigation.

Figure 6: Indoor navigation

D. Outdoor navigation using GPS

A system using GPS API is setup for this module. The MID user needs to key in the location and GPS will guide the MID user to the destination. Figure 7 shows the interface of the outdoor navigation and Figure 8 is the PHP database which keeps the tracking and navigation information.

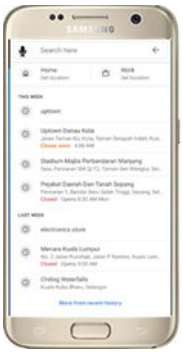

Figure 7: Outdoor Navigation

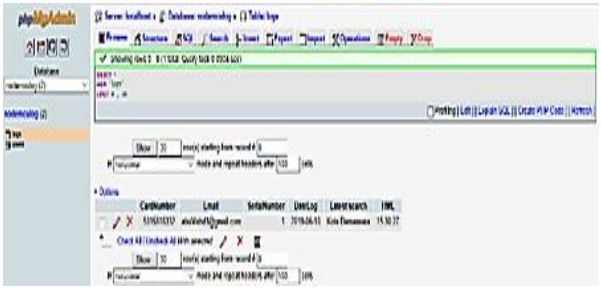

Figure 8:PHP Database for Outdoor Navigation

E. Indoor tracking using RFID

This module enables the interaction between the RFID reader and the system. The RFID card holds unique ID for each user. This indoor tracking use RC522 and ESP8266 as in figure 9. When the RFID detects the tag carried by the MID user, the red LED will light up and the input will be updated in the PHP database, as shown in figure 10.

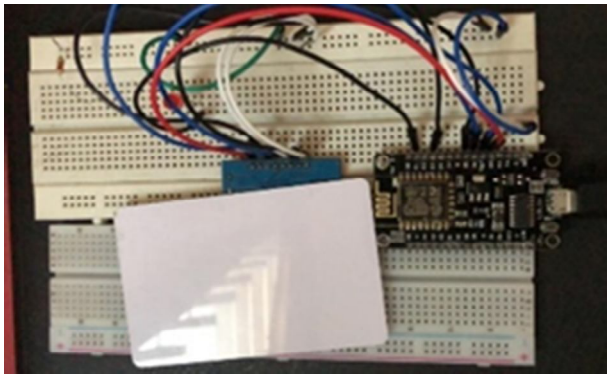

Figure 9: Hardware of NATRA system

Figure 10:PHPDatabase for Indoor Tracking

F. Outdoor tracking using GPS

Geolocation API is used in this module in order to locate the MID user. The guardian is able to track the MID user by using the mobile app as in figure 11. GPS will provide the current location of the MID user.

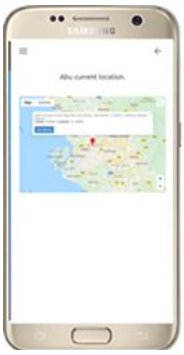

Figure 11: Outdoor Tracking

G. SOS alert

This module can be activated by the MID user and will send alert to the guardian with the current location. GPS will be used to navigate the guardian to the MID user. Figure 12 shows the interface for SOS alert.

Figure 12:SOS Alert

From the results shown, it can be concluded that the system can benefit both the guardian and the MID user. Even though NATRA provides help to the users, but there are still some limitations to the system. Firstly, the system needs internet connection at all time for data transfer, GPS and also RFID reader. Secondly, the RFID reader needs to be placed at numerous location for indoor navigation. Lastly, the disabled user will have the tendency of not using the SOS button apps. However, the system provides RFID and GPS tracking that allow the guardian to track the MID users.

4. CONCLUSION & FUTURE WORKS

It is possible to let the MID individual to navigate independently with the help of NATRA system. The system is developed to run on Android OS. The MID user could utilize this system in outdoor as well as indoor environment. In contrast, the guardian is able to track them by using the mobile app. To conclude, the system helps in reducing the resources and time in tracking and monitoring the MID individual. For future development, an indoor navigation system using augmented reality is proposed.

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