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Neurodegenerative Disorders: Mobile and health-care support technologies for patients

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Abstract

Neurodegenerative disease is a term used to characterize a series of disorders mainly affecting the human brain neurons. Such conditions are incurable and debilitating which leads to progressive degeneration and/or death of the nerve cells. It triggers movement disorders (called ataxias), voice, intelligence or mental health problems (called dementias).In this paper, we discuss, examine and evaluate the work that has been attempted over the past ten years to develop strategies for detecting, managing and supporting neurodegenerative disorders to demonstrate existing and future developments that are hoped to assist medical practitioners and researchers in finding additional approaches to addressing these conditions.

Keywords: Neurodegenerative disorders, Alzheimer's, Dementia, Parkinson's, Mobile Applications

1. Introduction

Neurons are the nervous system's building blocks which include the brain and the spinal cord. Typically, neurons do not regenerate or kill themselves, and cannot be replaced by the body when they are damaged or die.Parkinson's disease, Alzheimer's disease, and Huntington's are examples of neurodegenerative disorders. Though therapies may help alleviate some of the neurodegenerative disease-related physical or mental symptoms, there is currently no way to delay the progression of the disease and no proven cures. The risk of developing the neurodegenerative disease increases rapidly with age.

In recent times, mobile apps have attracted much attention from patients, healthcare professionals, and researchers around the world. Mobile apps are available for several important health-care activities such as monitoring symptoms, tracking progress in diagnosis, and treating disease. Within this paper, we address the use of these smartphone apps aimed at improving health treatment within neurodegenerative disorders.

While aging is typically followed by functional and cognitive impairment, today the most widely known symptom of aging is Alzheimer's, Parkinson's, and other neurodegenerative diseases. These conditions have a detrimental effect on older people's health and quality of life. They are characterized as progressive illnesses, as the symptoms gradually worsen over several years. The memory loss of any disease is mild in its early stages but individuals with late stage lose the ability to hold a conversation and adapt to their surroundings.

Given all this, and the increasing usage of mobile applications, both academicians and researchers are developing mobile apps that can resolve the different problems about these diseases from both the patient and caregiver's perspective. Many smartphone apps have recently been introduced or have emerged on the market that provides multi-service for these patients and their caregivers. Mobile apps are analysed to assess the weaknesses and strengths of each program. This research's

main inspiration is to develop ways to enhance the applications that handle with such disorders.

2. Literature Review

In this section, we present and discuss the mobile apps chosen as a result of our survey. To explain the above approach, the section is divided into two sections: non-academic applications and academic applications.

2.1. Non Academic Applications

In this segment, we publish the facts resulting from the Apple App Store and Google Play Store search using the target keyword "Alzheimer + Mobile App," "Parkinson + Mobile App." Many applications were found, but we identified the four categories of application areas on the need for specific statistics, as described above.

i-PROGNOSIS - It is a Play Store-based smartphone application focused on a ground-breaking approach to capturing the risk of changing from stable status to Parkinson's Disease (PD). The approach focuses on the unobtrusive compilation of behavioural data derived from the users' normal interaction with their intelligent devices. This application aims to capture data that may be related to symptoms of early PD such as voice, movement, and mood. It is based on the symptoms already known. Data such as voice, hand gesture, keystrokes, distance walked, emotional content based on text messages and facial expressions are collected without interfering with the users' smartphone activities.

This App focuses on the early detection and care that could be given to the patients.

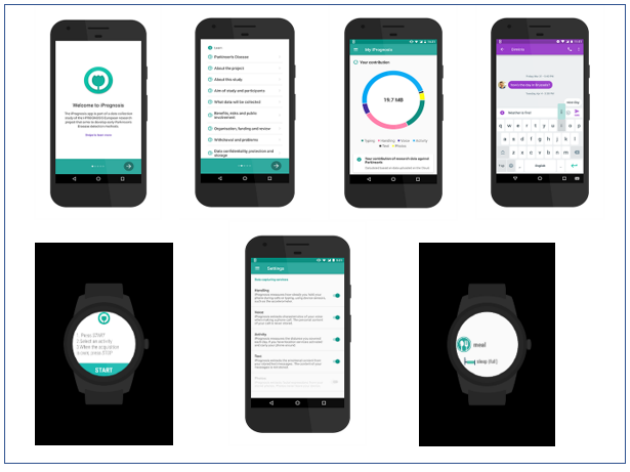

Fig:1 Screenshots of i-PROGNOSIS mobile application

ASPEN (Alzheimer's speed of processing game) - This program is a visual game processing speed intended to help delay Alzheimer's and Dementia progression. This kind of cognitive training has been shown to have beneficial benefits according to findings from the Advanced Cognitive Education for Autonomous and Vital older adults (active) study, as reported in the Washington Post and New Yorker.This application has the brain exercised through a logical game that keeps the brain involved.

The focus is to slow down the progress on the stages in neurodegenerative disorders.

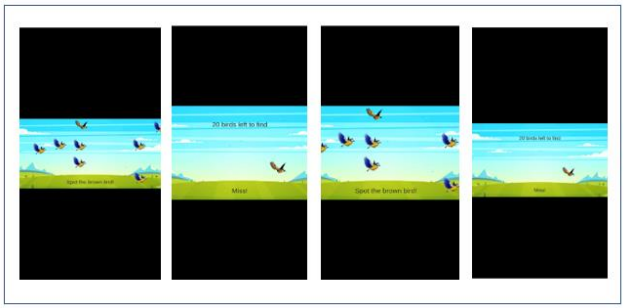

Fig:2 Screenshots of ASPEN mobile application

Greymatters (Reaching Beyond Dementia) – This technique enables animation, together with music and sports, to improve the standard of living for people suffering from dementia and their caregiver's. It is like a portable scrapbook that can include pictures, music, and games for preserving memories and reaching out to patients who are not talking. To help elicit memories, caregivers may create a customized storybook full of images accompanied by text or voice narration. The program uses reminiscence therapy and research on a life story that helps to keep the users involved and connected.

The focus lies in preserving memories and evoking lost memories.

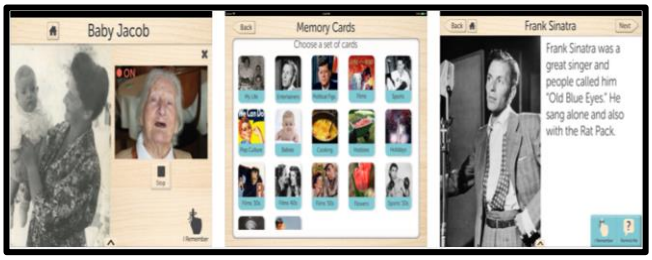

Fig:3 Screenshots of Greymatters mobile application

Dementia Emergency - Designed for carers, family members, and medical workers. Dementia Emergency provides advice on how to interact with people with dementia in emergencies. Dignity & Dementia, the referral centre that launched Dementia Emergency, is very vigilant to ensure that support is available for even the most unusual cases.

Focuses on providing immediate medical support to dementia patients.

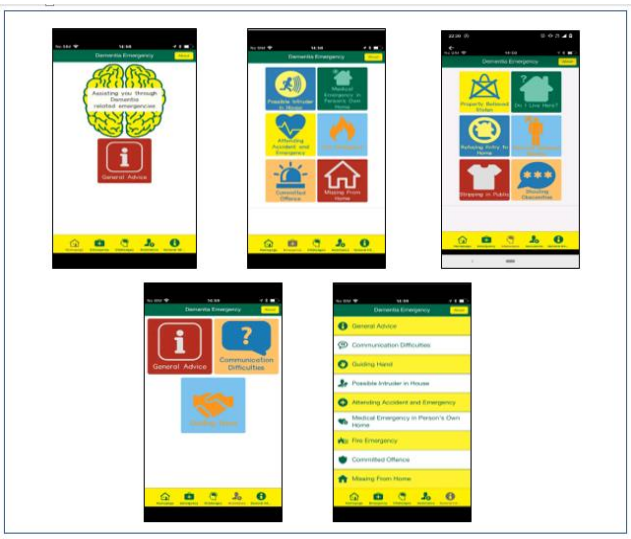

Fig:4 Screenshots of Dementia Emergency mobile application

2.2. Academic Applications

Kasliwal et Patil, in his paper "Smart Location Tracking System for Dementia Patients," suggested the need for a reliable and economic monitoring system to make life better of these people and their families. The purpose of this proposed system was to monitor dementia patients in real time to make sure their safeness when going outside their homes. A patient 's global location coordinates in the caretaker's mobile phone will be sent to the Android app. The global position of the patient can be seen on Google Maps after the latitude and longitude are obtained. The prototype of such a real-time tracking includes communicating the coordinates of a patient's location to the caretaker's smartphone or tablet.

In their paper "Help Me! MyDem Application for Early Stage Dementia Patients," KS.Savita, JJ. Do Amaral Marrima, M Muniandy, A.I.Z. Abidin and S.M.Taib, proposed addressing the dementia patient's problem of oblivion by providing a specific alert in the proposed mobile app. An augmented intelligent technique was employed in the form of a frame to discover a forgotten object. On top of this, a picture gallery of old images is used to stimulate the mind of a patient with dementia to rekindle memories. An initial test result shows that MyDem software lets dementia patients live their daily lives. In this segment, we publish the facts resulting from the Apple App Store and Google Play Store search using the target keyword "Alzheimer + Mobile App," "Parkinson + Mobile App." Many applications were found, but we identified the four categories of application areas on the need for specific statistics, as described above.

Bernardini, Silvia et al introduced an App in their paper, "A Mobile App for Remote Monitoring and Assistance of Parkinson's Disease Patients and their Caregivers," which aims to enhance interactions between the patient/caregiver and the clinicians, factors and practices of both the symptoms of the disease and the care process. The presented software is designed to gather patient symptoms and input from their caregivers. The collection of this data is stored in a global database and monitored by a neurologist, psychologist, and nurse. After experimenting with the app for a year they found the monitoring system to be effective in identifying the patient's hazardous conditions and useful in implementing reactive health management strategies.

In the paper, "An Android application for dementia patients," Frank Sposaro et al outlines a tool that would make life better for dementia patients. iWander technology allows carers to cost-effectively track their patients. The application features audio to prompt users, a navigation system to support the patient's residence and announce the patient's location to the caregiver. The app also mines info and uses Bayesian network analysis to obtain the wandering person's likelihood.

In "Designing and evaluating a mobile application to monitor Alzheimer's disease patients: A day-centre case study," Alma Chávez et al presents a mobile application called Alzheed that monitors Alzheimer's disease patients. The program gathers behavioural data, clinical and health-related data, performance activity data, cognitive and physical therapy response data, perceived emotion data, hygiene data, dietary patterns, and administrative data. After experimenting with day-care centres, it was found that the application was useful and usable.

3. Discussions/Summary

The four above applications are the focus areas that have been brought to the researchers' attention. For the diagnosis and treatment of neurodegenerative patients and their caretakers, tools like these are much important.

The above apps have several features that help diagnose, delay progression, control the disease, and support patients in emergencies, but the need for the hour is an application that performs all the above features. The I technology helps diagnose Parkinson's disease at an early stage, but it cannot be used with other neurodegenerative disorders and therefore does not include any way to better treat PD. ASPEN is a game-based program that uses a game to help activate the Alzheimer's patient's brain. However, it does not aid in emergency detection or support for the caregivers. The Greymatters initiative focuses on the support that can be provided to patients and their families to improve the standard of living for memory loss patient. Dementia Emergency is an application based primarily on people suffering from memory loss and delivering care in emergencies. It cannot be used for other neurodegenerative disorders and has no mechanism for the diagnosis or treatment of the condition.

The software mentioned must be improved in the future in such a way as to track, evaluate, and regulate patient's activities. It will include features such as having to plan the patient's regular activities that will be supervised by their caregivers and physicians. Facilities can be given to warn the patient or caregiver that there is a pending or lacking operation, appointment, or medication. Caregivers will be able to track the vitalities of the patient on a regular basis, which physicians may refer to during emergency periods.One framework is needed that can be used for all neurodegenerative diseases, rather than a specific disease.

In the papers presented above, different approaches have been considered to develop mobile applications. The welfare of the patients while they are outside their homes is the most critical in such situations. Such patients seem to get lost in the crowd and neglect their homes. Although Kasliwal and Patil's research in their paper to track patients from their current location, we would recommend a device that could alert caregivers when patients move out of reach or a specified house diameter. Help me! MyDem Early Stage Dementia Patients Application is another work that suggests support for patients to keep their memory loss less progressive through a daily exercise to recollect their loved ones. In Bernardini, Silvia et al concept of an application, aspects of both detection and management of PD have been discussed. Though their app has proved to have helped patients and their caregivers, it has to be made available to a larger population, so the data collected is useful in building accurate predictive models. The application is focused on PD and can be developed to further accommodate other neurodegenerative diseases as the symptoms and management is similar. The iWander application by Frank Sposaro et al is focused on a guidance system for dementia patients. Integrating this system with other applications will be more useful as there is no provision for detection, management or support for the patients. Although the concept of the application is useful, it needs more features to help users as a stand-alone application. Alzheed mobile application focuses on patients with Alzheimer's and helps monitor the patients. This application can be further developed to include machine learning techniques to help the medical professional determine the accurate course of treatment. The application now mainly focused on Alzheimer's can be used for other neurodegenerative diseases like PD. Also, a web application especially for the medical professionals can be developed to support the administrative data entry which would be difficult on a mobile application.

4. Conclusion

In conclusion, after reviewing the various applications, both available and proposed, it should be noted that an application which provides a complete set of features is needed. The targeted audience must be the patient's caregivers because it is difficult to train the patients to use these applications after a certain stage, and caregivers are the ones who follow them closely. Mobile applications need to be developed to alert them about movement, medication, activity monitoring, and progressive symptoms. The medical practitioners may have trouble tracking multiple procedures for a single patient.Therefore, we propose that an application that incorporates the different features described above should be created in a common application that manages all the patient-related activities that also include a guidance and fall detection system, connects patients with medical and emergency staff and provides administrative data entry means.

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