

AlzAI: A Smartphone based application for Assisting Alzheimer Patients

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Abstract : Early diagnosis of Alzheimer's is very important in order to enhance the lifestyle of the patients. Due to recent advancements in mobile technology and software applications, various assistive toolkits are developed but a majority of them fails to handle complex data and sometimes gives inaccurate results. At present various studies are being done but a lot is yet to be discovered. This paper presents an assistive technology for Alzheimer's patients. We have developed an Android application which can be used by patients, their relatives and friends to improve the lifestyle of the patients suffering from Alzheimer's.

Index Terms – Alzheimer's; Software application; assistive toolkit; android application.

I. INTRODUCTION

Machine Learning (ML) techniques are used in various fields nowadays and one major field is computer diagnosis [1]. The percentage of population suffering from Alzheimer's disease (AD) and other dementia-related disorders is believed to escalate, and care costs are very high, making it unaffordable for a significant portion of the population [2]. AD is a major neuro-degenerative disease and it is expected that approximately 16 million people are likely to be affected by 2050 [3]. Recent advances in the healthcare sector have made a huge contribution to raising human living standards [4]. Humans' inactive lifestyle, on the other hand, has resulted in a variety of psychological disorders, such as Alzheimer's disease, which affects cognitive functions [4]. Since there is currently no standard procedure for detecting Alzheimer's disease early, diagnosis is only supported by computational diagnosis of the condition based on the Magnetic Resonance Image (MRI) scans of the brain [5]. If the number of cases of Alzheimer's disease rises every day, doctors and physicians are looking for new and effective ways to address the problem [6]. Recent research has shown that video games involving brain memory and problem solving can help patients relax their brains and reduce Dementia symptoms [6]. In a recent study, it was found that the integration of conventional treatment methodologies with computer assisted technologies, can improve the condition of the Alzheimer's patients [7]. Nowadays, new software developers are trying to develop more user friendly applications, focusing on the people belonging to the older age groups suffering from Alzheimer's which can help the doctors in offering better treatment to the patients [6]. However, despite of the advancements in mobile and software technology, challenges still persists [6-7]. This challenge indicates that there is a strong need of developing novel assistive techniques for Alzheimer's.

The paper contributes the following:

- Identification of challenges in existing software applications/assistive tools for diagnosing Alzheimer's and how the challenges are resolved through the model/application suggested in this paper.
- Development of Smartphone based application for assisting Alzheimer patients.

The rest of the article is laid out as follows: The second section provides an outline of the relevant research. Section 3 explains the significance of the work. Section 4 contains the methodology. Section 5 brings the article to a conclusion.

II. LITERATURE STUDIED

Both mortality rate and aging-related disorders such as Alzheimer's disease are on the rise worldwide, impacting patient quality of life [8]. Various trials have been conducted in order to diagnose and track Alzheimer's patients remotely. The authors of [9] proposed a multimodal and multiplexed analytical method for in-vitro and in-vivo diagnosis using indirect biomarkers imaging in the brain with different biofluids to generate characteristic signatures for discriminating between stable and Alzheimer's patients. In [10] the authors have designed a system for monitoring and recording the location, heart rate and spatial position of Alzheimer's patients. This system will help the patients in self-administration of the drugs and allowing their relatives to monitor them continuously. The authors of [11] created a smartphone application that can monitor patients' movements using GPS and include reminders about medications, food, and everyday routines, as well as a quiz to improve patients' cognitive functioning. The synthesis of peptidomimetics used for Alzheimer's drug development targeting beta-secretase inhibitors and amyloid-beta aggregation inhibitors was identified in [12]. For this, solid-phase peptide synthesis (SPPS) was used with natural amino acids and other amines.

In [13] the authors have suggested a new technique for classifying the Magnetic Resonance (MR) Images for Alzheimer's by only using the hippocampal asymmetrical attributes. The results found from this study was found consistent with other statistical assessments. In [14] the authors have examined the impact of the COVID-19 pandemic on individuals suffering from Alzheimer's. The authors have discussed and suggested the mitigation strategies for the risk of COVID 19 and its associated mortality of Alzheimer's patients. The authors of [15] used a new brain imaging method focused on 3D convolutional neural networks (CNN) to analyze brain MR images from the Alzheimer's disease neuroimaging initiative (ADNI) database for early Alzheimer's diagnosis. The authors of [16] proposed using a tightly linked CNN based focus mechanism which can learn the multi-level features of the brain MR scans for Alzheimer's detection. The authors of [17] created a layer-wise transfer learning model for classifying Alzheimer's from MR images. In [18] the authors have developed a facial recognition application capable of diagnosing Alzheimer's. Here the Bayesian Network was used to make the early prediction and diagnosis of patients before the onset of disease. A novel interactive screening method named Dementia Test, covering cognitive functioning was suggested in [19]. This approach automates and secures the use of traditional screening approaches such as 6-CIT and SCIDS [19] to improve diagnosis.

Upon analysis of the available literature, we have found that existing detection techniques dealing with pre-diagnosis of Alzheimer's are not comprehensive and don't measure various cognitive functioning domains [19]. A more realistic method is still needed to be developed that includes the cognitive functioning of Alzheimer's. In this paper new approach is suggested resolving the challenges faced by the existing studies.

III. SIGNIFICANCE OF WORK

The conventional methods used in diagnosing Alzheimer's are complex, requires high technical requirements, requires invasive diagnosis and can't be used widely in clinical practice [18]. In recent years, the emergence of assistive technologies based on mobile applications has broad prospects. To standardize the mobile health technology various guidelines are required to be followed. These are:

- User Experience is a major factor i.e the initial understanding of the software can be acquired from the feedback provided by the users before/after the opening of the software [18].
- The functionality of the system should maintain a consistency so that they can operate the system immediately and efficiently. Also the application needs to give the feedback to the users as quickly as possible in order to reduce the waiting time and lose users [18].
- The application should not only reduce the cognitive burden, but also make the visual experience of the users smooth for quickly identifying the target functions [18].

While Alzheimer's disease cannot be prevented, patients can become more independent and increase their quality of life by using assistive technologies such as mobile apps [11]. Technology should be used by patients in moderate stages by analyzing signs at different stages [11]. The goal of our work is to improve the daily routine activities of the patients suffering from Alzheimer's. The methodology suggested in this paper will not only reduce the burden on the caregivers but also act as a feedback mechanism for the researchers and doctors to track the medications given and to experiment it further in order to develop new treatment strategies to help the patients.

IV. SUGGESTED METHODOLOGY

Healthcare experts, academics, app engineers, and network service providers have also paid close attention to mobile health [20]. Mobile apps are easy to use and can be used for a variety of functions, including symptom assessment, resource utilization, and monitoring [21]. The main goal of the proposed application in this paper is to help the Alzheimer's patients to remember their daily routine tasks. The application will not only help the Alzheimer's patients but also keep a track of medical negligence such as wrong medication prescription and also help the researchers in tracking the medications for their research and bioactivity prediction for generation of novel drugs. We have followed a standard approach as described in [18] for designing the application and is explained in figure 1.

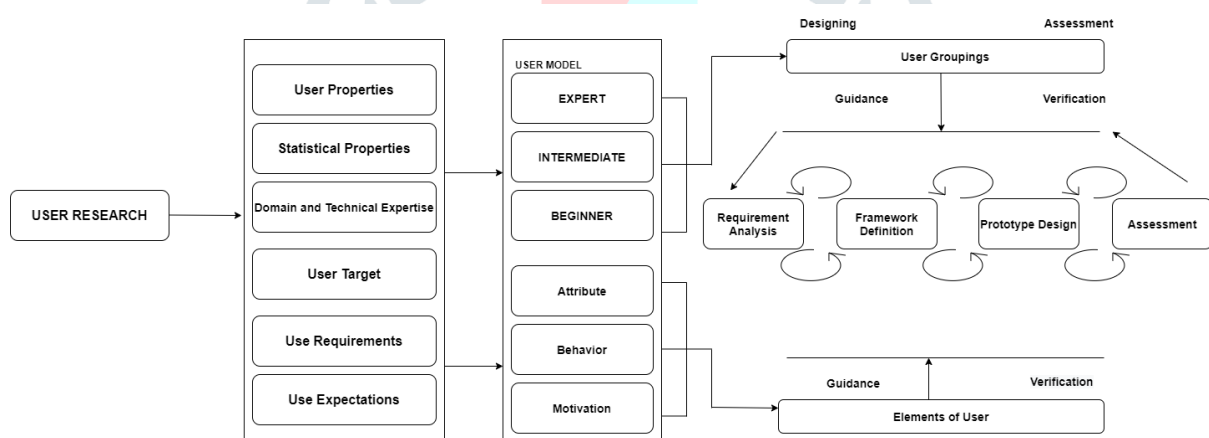
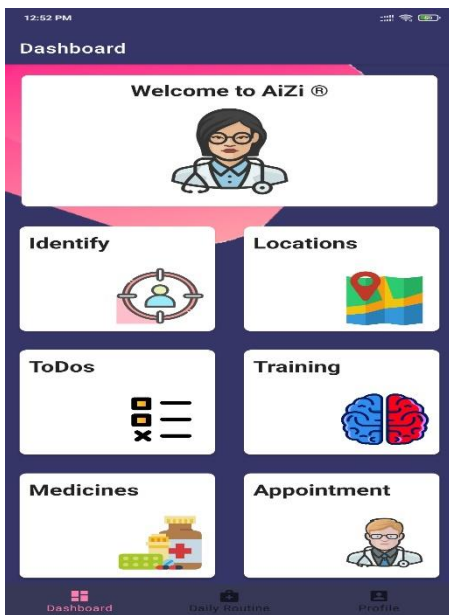


Figure 1. Designing Process of the Application [18]

The application has been designed by considering the challenges faced by the Alzheimer's patients [22]. Major features of the application are as follows:

- Dashboard Screen: The dashboard is the start up page consists of tabs such as identify, for identification of person, Locations, for identification of location or for tracking by the family members. It also consists of a To-do list which



includes the major tasks/daily routine tasks of the patients. It also contains a feature of medicines and appointment which is to be used for medical purposes. The major benefit of the application is that it can be simultaneously used by the family members, patients and doctors for continuous tracking and evaluation of the health of patient. The dashboard is shown in figure 2.

Figure 2. Dashboard Screen



Figure 3. Add Task Feature

- Daily Routine and Other tasks: This feature enables the patients to make a list of their important tasks and daily routines which would be helpful in reminding them in case they forget everything. Major functionality includes addition of tasks, addition of daily routine and list of all previously saved tasks. The same is shown by figure 3,4 and 5 respectively.
- Identification of People and Important Locations: This feature includes the addition of people such as relatives and friends of the patient suffering from Alzheimer’s with important locations such as patient’s home, nearby shops etc. For our convenience, we have used dummy peoples for identification tasks. This has been shown by figure 6 and 7 respectively.

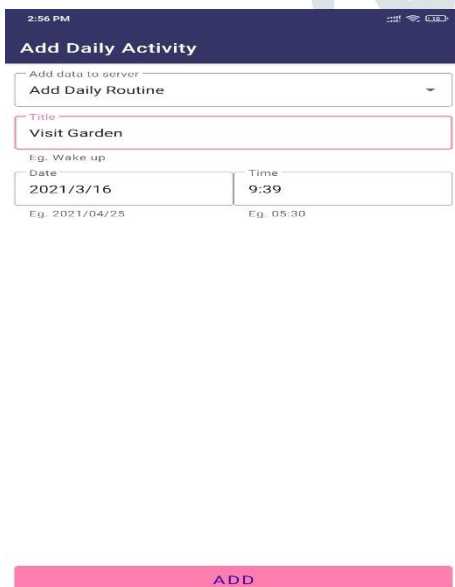


Figure 4. Add Daily Routine

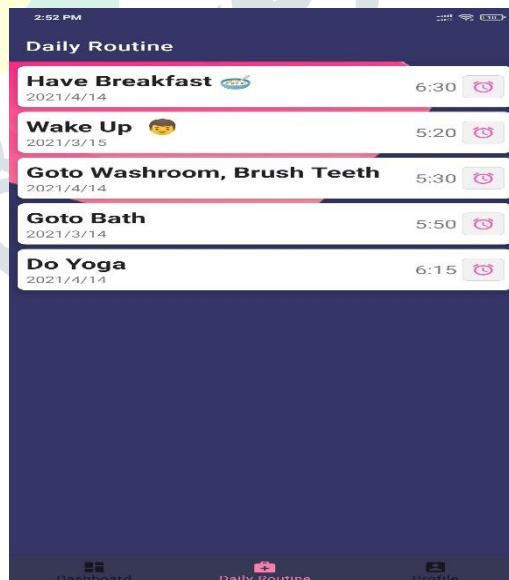


Figure 5. Daily Tasks List (To-do List)



Figure 6. Identification of People

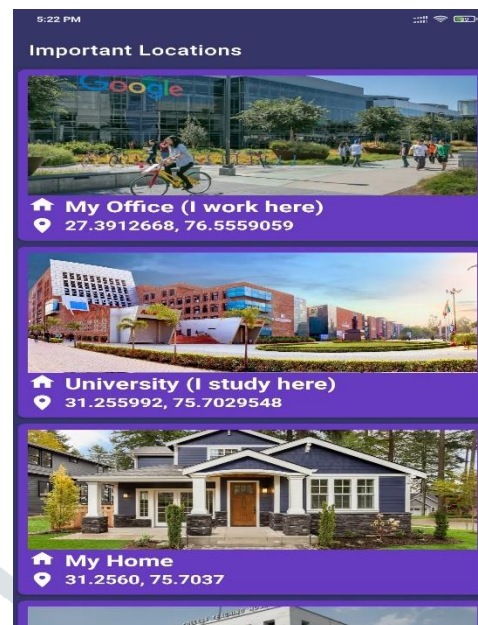


Figure 7. Important Locations

Other features such as medications and doctor appointments are also included. Alzheimer patients requires continuous evaluations in order to slow down the growth of Alzheimer's [22]. This feature will deal with the proper management of the appointments in the form of reminders [22]. The full source code of the project with functionality can be found on the public GitHub repository : (<https://github.com/iamkishansharma/AiZi/tree/main>). Upon performing both Black-Box Testing and White-Box Testing, we concluded that the application performed well and is ready to be released on the google play store.

V. CONCLUSION

Alzheimer's is one of the major concerns for old age people. By adopting healthy and active lifestyle, a person can improve his cognitive abilities thereby reducing the risk of Alzheimer's. Till now there is no cure for Alzheimer's. However we can improve the quality of life by providing appropriate assistive applications to the patients suffering from Alzheimer's. This paper suggests an unique android based smartphone application which is easy to use and highly interactive. The application is tested by various testing techniques helped us to assure the reliability of the application. The future work will be based on developing an integrated approach along with this application capable of computational drug design.

REFERENCES

- [1] T. Jonsson and I. Tapper, 'Evaluation of two CNN models, VGGNet-16 & VGGNet-19, for classification of Alzheimer's disease in brain MRI scans', Dissertation, 2020.
- [2] M. Andersson and L. von Sydow Yllenius, 'Detecting Cognitive Impairment with Eye Tracking Data during Picture Description', Dissertation, 2020.
- [3] Tian, J., Smith, G., Guo, H., Liu, B., Pan, Z., Wang, Z., ... & Fang, R. (2021). Modular machine learning for Alzheimer's disease classification from retinal vasculature. *Scientific Reports*, 11(1), 1-11.
- [4] Afreen Khan, Swaleha Zubair, An Improved Multi-Modal based Machine Learning Approach for the Prognosis of Alzheimer's disease, *Journal of King Saud University - Computer and Information Sciences*, 2020, ,ISSN 1319-1578, <https://doi.org/10.1016/j.jksuci.2020.04.004>. (<https://www.sciencedirect.com/science/article/pii/S1319157820303396>)
- [5] Tran Anh Tuan, The Bao Pham, Jin Young Kim & João Manuel R. S. Tavares (2020) Alzheimer's diagnosis using deep learning in segmenting and classifying 3D brain MR images, *International Journal of Neuroscience*, DOI: 10.1080/00207454.2020.1835900
- [6] Gupta, G., Gupta, A., Jaiswal, V., & Ansari, M. D. (2018, December). A review and analysis of mobile health applications for Alzheimer patients and caregivers. In 2018 Fifth International Conference on Parallel, Distributed and Grid Computing (PDGC) (pp. 171-175). IEEE.
- [7] Olalla Tárrega, M.Á. and M.Á. Rodríguez, Energy and interspecific body size patterns of amphibian faunas in Europe and North America: anurans follow Bergmann's rule, urodeles its converse. *Global Ecology and Biogeography*, 2007. 16(5): p. 606-617.
- [8] Costanzo, M. C., Arcidiacono, C., Rodolico, A., Panebianco, M., Aguglia, E., & Signorelli, M. S. (2020). Diagnostic and interventional implications of telemedicine in Alzheimer's disease and mild cognitive impairment: a literature review. *International journal of geriatric psychiatry*, 35(1), 12-28.
- [9] Arora, H., Ramesh, M., Rajasekhar, K., & Govindaraju, T. (2020). Molecular tools to detect alloforms of A β and tau: Implications for multiplexing and multimodal diagnosis of Alzheimer's disease. *Bulletin of the Chemical Society of Japan*, 93(4), 507-546.

- [10] C. Luca, R. Fuior, M. Datcu, D. Andrițoi, C. Corciovă and R. Ciorap, "Innovative Assistive System for Monitoring People with Alzheimer," 2020 International Conference and Exposition on Electrical And Power Engineering (EPE), Iasi, Romania, 2020, pp. 550-553, doi: 10.1109/EPE50722.2020.9305553.
- [11] Pirani, E. Z., Bulakiwala, F., Kagalwala, M., Kalolwala, M., & Raina, S. (2016). Android based assistive toolkit for alzheimer. *Procedia Computer Science*, 79, 143-151.
- [12] Hamada Y., Ziora Z.M. (2020) Peptidomimetic Synthesis: Drug Discovery for Alzheimer's Disease. In: Hussein W., Skwarczynski M., Toth I. (eds) Peptide Synthesis. *Methods in Molecular Biology*, vol 2103. Humana, New York, NY. https://doi.org/10.1007/978-1-0716-0227-0_14
- [13] Poloni, K. M., de Oliveira, I. A. D., Tam, R., Ferrari, R. J., & Alzheimer's Disease Neuroimaging Initiative. (2021). Brain MR image classification for Alzheimer's disease diagnosis using structural hippocampal asymmetrical attributes from directional 3-D log-Gabor filter responses. *Neurocomputing*, 419, 126-135.
- [14] Brown, E. E., Kumar, S., Rajji, T. K., Pollock, B. G., & Mulsant, B. H. (2020). Anticipating and mitigating the impact of the COVID-19 pandemic on Alzheimer's disease and related dementias. *The American Journal of Geriatric Psychiatry*, 28(7), 712-721.
- [15] Feng, W., Halm-Lutterodt, N. V., Tang, H., Mecum, A., Mesregah, M. K., Ma, Y., ... & Guo, X. (2020). Automated MRI-Based Deep Learning Model for Detection of Alzheimer's Disease Process. *International Journal of Neural Systems*, 30(06), 2050032.
- [16] Zhang, J., Zheng, B., Gao, A., Feng, X., Liang, D., & Long, X. (2021). A 3D densely connected convolution neural network with connection-wise attention mechanism for Alzheimer's disease classification. *Magnetic Resonance Imaging*, 78, 119-126.
- [17] Mehmood, A., Yang, S., Feng, Z., Wang, M., Ahmad, A. S., Khan, R., ... & Yaqub, M. (2021). A transfer learning approach for early diagnosis of alzheimer's disease on MRI images. *Neuroscience*, 460, 43-52.
- [18] He, T., Zhang, X., & Zhu, L. (2020). Early Diagnosis of Alzheimer's Disease Based on Face Recognition Using M-Health Technology. *International Journal of Engineering Intelligent Systems*, 28(2).
- [19] Thabtah, F., Mampusti, E., Peebles, D., & Herradura, R. (2020). A mobile-based screening system for data analyses of early dementia traits detection. *Journal of medical systems*, 44(1), 1-14.
- [20] Alharbi, S., Altamimi, A., Al-Qahtani, F., Aljofi, B., Alsmadi, M., Alshabanah, M., ... & Almarashdeh, I. (2019). Analyzing and Implementing a Mobile Reminder System for Alzheimer's Patients. ALHARBI, S., ALTAMIMI, A., AL-QAHTANI, F., ALJOFI, B., ALSMADI, MK, ALSHABANAH, M., ALRAJHI, D. & ALMARASHDEH, I, 444-454.
- [21] Habash, Z. A., Hussain, W., Ishak, W., & Omar, M. H. (2013, August). Android-based application to assist doctor with Alzheimer's patient. In *International Conference on Computing and Informatics (Vol. 28, pp. 511-516)*.
- [22] Gaurav, G. Development of Android Assistive toolkit for Alzheimer Patients and Prediction of Alzheimer Associated Protein Using Machine Learning. (<http://hdl.handle.net/10603/294438>)

