Health Monitoring of Elderly, Children, and Alzheimer's Patients through Medication Reminder Apps and Wearable Sensors

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Abstract

Introduction: Numerous healthcare apps, medical trackers, and wearable sensors are the furthermost significant progression in medical technology for self-care, especially in children, older people, and Alzheimer's patients.

Objective: The study aims to discover opportunities by medication apps and wearable self-monitoring sensors for older adults, children, and Alzheimer's patients.

Method: We investigated that how the advancement in modern technology can help in preventing health issues in individuals. Various applications in smartphone and wearable devices utilize these technologies, make them more user-friendly with only one tap and successfully prevent serious health conditions.

Results: The deep investigation revealed three primary themes: 'Device Functionality', 'Reasons for Use,' and 'Utilization Strategies.'

Conclusion: In summarized manner we can say that critical health and lifestyle aspects of individuals can handle by SW-SHMS or medical tracker devices, especially in older people, children and those individuals who are suffering from chronic diseases and neuro disorders such as Alzheimer's.

Keywords: Activity trackers, medicine, alarms, elderly, adults, Alzheimer's patient, healthcare.

List of abbreviations:

SW-SHMS- Wearable Sensors for Smart Healthcare Monitoring -

BMR-Basic medication reminder

PMR- Progressive medication reminder

MAA - Medication administrative apps

ECG -Electrocardiography

AI - Artificial intelligence

ML - Machine learning

IoT - Internet of things

Wi-Fi- Wireless Fidelity

5G- Fifth generation of cellular network

Introduction

As the population of older people and patients of chronic diseases such as diabetes, blood pressure, and forgetting diseases like Alzheimer's are rapidly increasing, it is creating a significant impact on the health care system worldwide. As per the 2015 report of the United Nations [1], by 2030, number of elderly people in the world is supposed to grow by 56% i.e. from 901 million to more than 1.4 billion. Hence, there is an urgent need to create awareness about tracking of vital health parameters. So, this report makes it clear that the aging process and burden of chronic diseases are rapidly increasing worldwide [2]. The report of the United States also states that in the developing world, the number of patients with chronic diseases like diabetes will rise up to 228 million by 2025. According to reference Engel et al., medical trackers such as wearable electronic devices and various healthcare apps are one of the most significant advancement in technology for self-care of individuals especially in older people and forgetting disease-related Alzheimer's patients [3]. The individual and independent documentation of monitoring of various health indicators like blood sugar, blood pressure, sleep pattern, body temperature, and oxygen level [4] is a growing area of research and they are achieved by self-monitoring [5]. Self-monitoring systems inform people of their vital health parameters and facilitate the substantial and more active relationship between the doctor and the patient [6]. Fitness trackers enabled in smartphones, smart wearable devices, and wearable sensors further promote the performance, development and adoption of this trend [7].

During the last few years, the primary investigation in microelectromechanical systems has had a more significant impact on people's health. Micro sensors used via different mediums such as smartphones, wearable devices, and wearable sensors help individuals and their caregivers to track the health accurately [8].

➤ The aim of the study to discover opportunities by medication trackers and wearable self-monitoring sensors for older adults, children, and Alzheimer's patients.

➤ Making healthier life-style of individual by tracking significant health parameters and raise alarm for daily medicines uptake by use of medical tracker.

Method and research design

Wearable Sensors for Smart Healthcare Monitoring (SW-SHMS) such as wearable sensors and smartphones are used to properly monitor children, elderly people, and Alzheimer's patients. SW-SHMS performs to monitor the physiological data collected from the wearable device of the patients. It uses data recorded and facilitates data access to authorized health care departments such as doctors and patients' relatives (family members) at anytime and anywhere.

In SW-SHMS system, two factors are responsible for the latency, namely, the latency experienced due to hardware components in the network, which are responsible for the bridge between gateway and Bluetooth device and secondly speed of network for delivery of data from gateway to cloud.

Technically system goal is achieved by the three-layered system collaborated work.

Every layer is significant in its techniques and composition. The primary layer in the system is stated below, and the structure is explained in the research design section **Figure 1**.

A. Devices for wearing prospect (layer related with a patient)

Patient wearable sensor devices and smartphone sensors will be linked together and accumulate the physiological data. Various sensors related to healthcare are used today which are used in the examination of meaningful signs such as the heart rate, blood sugar, blood pressure, ECG, the body temperature, the oxygen level in the blood, etc. [9-13]. All these parameters play a vital role in the patient's body and well-being [12,13]. Regular tracking of all these parameters is imperative. Uncontrolled body parameters may lead to serious illnesses e.g. abnormal blood pressure for a long time can lead to kidney diseases, oxygen level drop in the body may cause sleep apnoea, etc. All these kinds of sensory data are communicated to the smartphone of patient with the help of a Bluetooth. Furthermore, sensors automatically send all the measured data to the cloud database in automated form (i.e., through IoT and various communication techniques such as 5G). All these key features augment the quality of experience of users and make them safer health wise. With the advancement in the technology, lot of complex devices such as Ultrasound machines and ECG machines are also available now in compact form that can be carried by the patients and the reports can be sent to the doctors via internet immediately. One such example is Vscan from GE Healthcare. Please refer to **Figure 1**, user environment block for process details.

B. Cloud (Layer of data)

Cloud is the place where data are kept and managed. With the help of the internet, the patient's smartphone data is transferred to the cloud where the doctor's team does their inspections and analysis. A doctor can track the patient's disorder and abnormal changes in the patient's body. All the information or collected data can be sent to family members as well in any emergency circumstances. Cloud helps in sharing of knowledge and enable teamwork via its structure and allows the medical team to diagnose and information of the host. Cloud provides real-time updates as well as fast speed of prescription. Please refer to **Figure 1**, cloud datacenter block for overview of the process.

C. A platform for monitoring (Hospital layer)

This layer helps doctors in the monitoring of patients' health records as well as sensory data and taking action against it. Synchronization of information in a real-time manner by using data pulling from the cloud helps doctors take immediate action in the case of emergency and prevent hospitalization. Also, the patients can get treatment from specialized doctors and the doctors of their choice from any location. These advancements remove the barrier of physical proximity for diagnosis. Please refer to **Figure 1,** monitoring platform for hospitals block for process details.
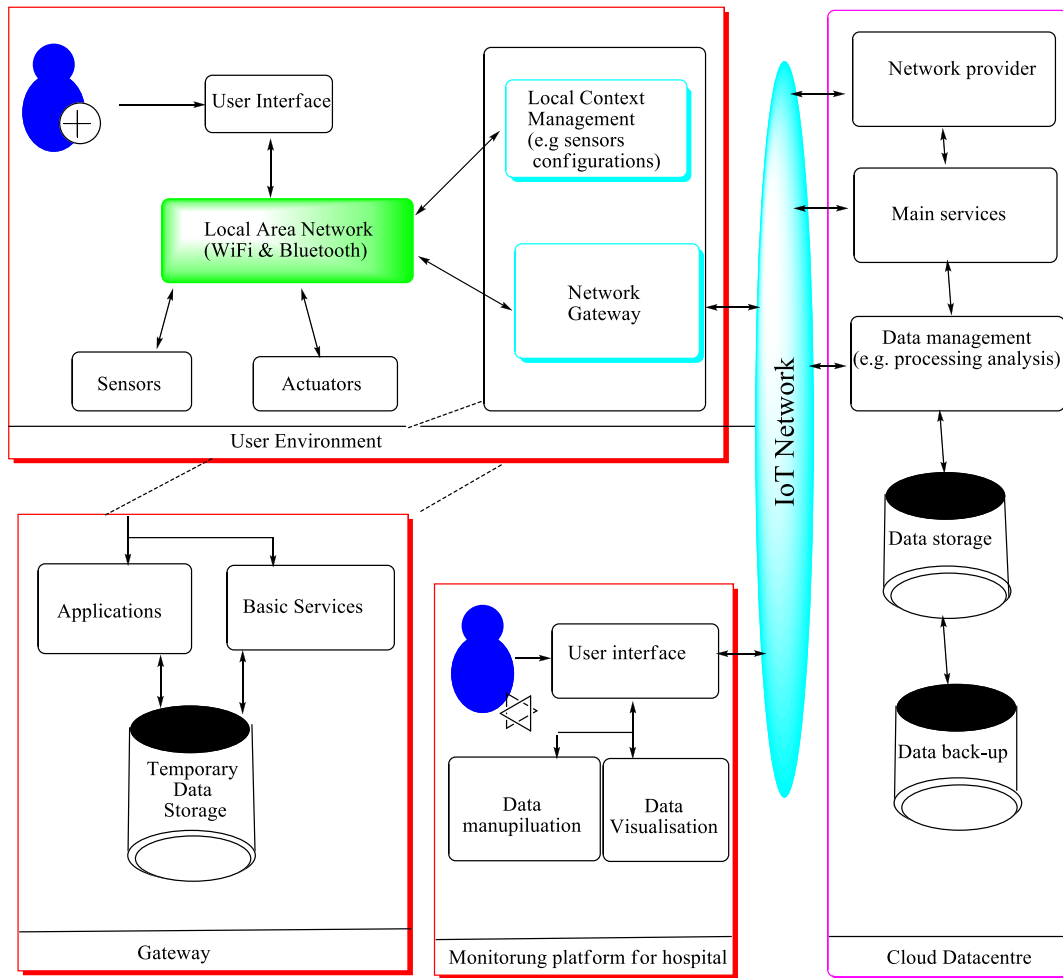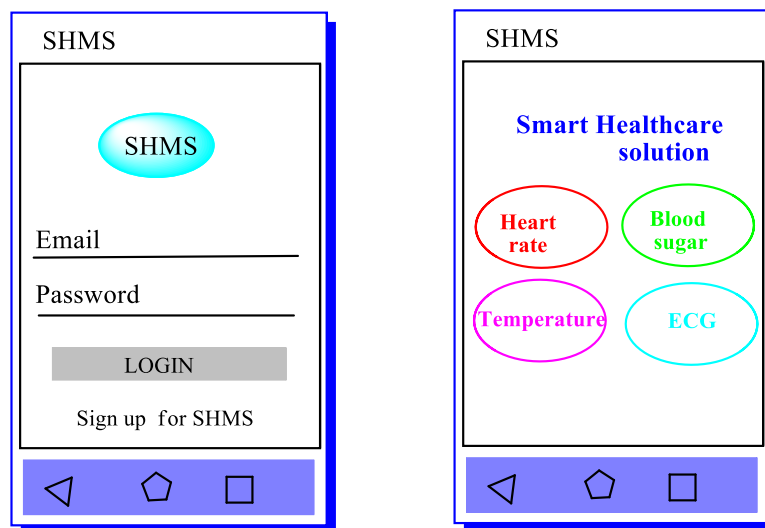
Figure 1 System network model for WS-SHMS

A. Login Page   B. Home Screen

Figure 2– Patient's platform

As explained in Figure 1, the sensors fitted on the user's body send the vital health parameters such as BP, heartrate, body temperature etc. to both the smartphone of the user on the app as well as to the cloud data centre using the communication bridges of IoT network (Bluetooth and 4G/5G). The user can login to the app and access the data. The health parameters are received on the cloud data centre through the IoT network. The data is cleaned and processed at this stage as well along with adding security to the same. This data is then shared with the hospitals and doctors. The data is shared from the cloud to the monitoring platforms in the hospitals and clinics. It can be software that can process and display this data through internet.

Types of Reminder Apps

Application related to medication reminders has been divided into three parts based on their complexity function. Some examples of such apps are shown in **Figure 2**.

I.Basic medication reminder (BMR)

BMR applications offer memory-related essential supportive functions e.g. alert or alarms, flexible scheduling, and customizable alert types.

II.Progressive medication reminder (PMR)

PMR applications offer memory-related with forthcoming and retrospective memory functions. For example, protection from an overdose, support in different time zones, tracking in the late dose, smart silencing, user notes, medication log, etc.

III. Medication administrative apps (MAA)

MAA also help in the management of medication and health routines. Some of these apps help in many user accounts and are further split into family-based medication administrative and personal medication apps. Information stored in these types of apps are doctor's contact details, appointment reminders, patient's health information, etc. [14]

Result

The main results are categorized into three parts

1. Reason for use - First of all, using these trackers helps to adapt more active and healthier lifestyle. Internet of Things (IoT) facilitates all these usages smoothly and efficiently. So, these technologies benefit elderly people, children, and Alzheimer's disease patients to maintain their wellbeing and provide lot of support to family members and caretakers as well.

2. Utilization Strategies

Depending on the personal interest, utilization approach varies from person to person. Few participants use it to monitor vital health parameters such as BP, Sugar level; oxygen level, heart rate etc., and other participants use it as their medicine reminder or their medicine stock reminder with the help of alarm or snooze. In general, individuals take the help of these assistants to make their lifestyle better. Some of the examples are explained in the **Figure 3.** Also, the safety of the patient and the battery life of this equipment are also very important to take care.

3. Device Functionality

Technology has given lot of advantages to individuals for their health and self-fitness tracking. There is various health apps provided on the Apple store and Google Play app store platform for the users that give a significant goal to the user. Some of the best apps are listed below.

1. Medisafe Pill Minder – It is available on Android and iOS, and features doctor visit management and appointment alert. Health measure tracker, measurement tools, and notification sounds are also available.

2. Medical ID – It is a free android app, and there is premium option available. It can create multiple medical profiles, contact medical staff in an emergency, and share GPS location with emergency contacts even when the app is closed.

3. Dminder- It is a free app in Google and Apple store and comes with a premium upgrade option. It suggests history of vitamin D intake, calculates the best time to get sunlight for vitamin D, as per your location, and sends an alert when to go outside to get the sunlight.

4. My FitnessPal, - It is available on Google and Apple stores, and the desktop version is also available. It is all in one activity tracker to enhance calmness, track the gap between food intake, track sleep quality, etc. Weight and activity goal can also be set along with meal plans. The App can be synced with wearable medi-sensors like watches and other devices. The premium features are also available on payment.

5. Diabetes: M- It is available in Android and iOS stores. It helps in tracking glucose levels. It helps in taking medicine on time as well as sends insulin reminders. Data storage is also available, which can be shared with doctors during visits. In the premium version, an additional profile can be added and connected to a Bluetooth-enabled monitoring device.

6. Apple health – It is available on all Apple devices. It helps to monitor sleep, activity, food intake, symptoms, heart rate, etc. This app also participates with health institutions for keeping lab results and reports for medical usage by the user. Medical donors also take part in this app and designate themselves.

7. Eyecare Live- As the name suggests, this app is available for eye health care by connecting to various doctors virtually within an hour. This app is free for Android and iOS users. Even premium option is also available to get access to more enhanced features.

8. Drugs.com- This is a medication guide provides dose guidelines and tracking feature with particular pills.

9. mySymptoms- Food diary and symptom tracker, tracks eating and bowel movements. Virtual doctor selection is also available in this app.
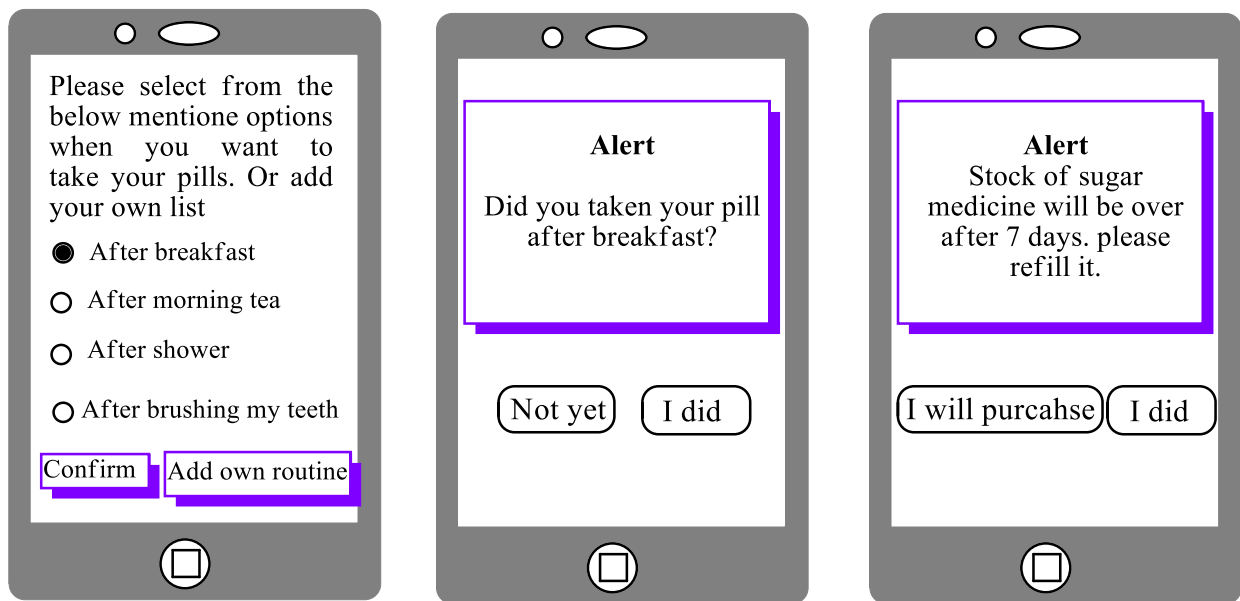
Figure 3. Graphical presentation of a hypothetical application. (A) New routine setup (B) Example of back up notification (C) Example of medicine purchase reminder

Further, we understand that the advancement in communication technologies and data processing help for accurate, reliable and quicker data transfer among different stakeholders involved here such as the user, its doctor and the care takers/relatives of the user. New versions of Bluetooth and Wi-Fi along 5G and AI/ML techniques are contributing significantly to these developments.

Discussion

Medical tracker helps individuals to strictly follow their daily routine activities, such as taking pills, insulins, etc. on time. It also helps to raise the alarm for medicine shortage in storage so that one can purchase it before it gets over in the stock. The tracker helps in keeping medical reports and medical prescriptions at one place in the application so that it is easier for both the patient and the doctors to refer them. It facilitates the doctor-patient relationship even stronger. Wearable sensors help to monitor vital health parameters continuously, which can be shared with the doctors and the family members and allow to get in touch with medical staff and family members in case of any emergency. Wearable sensors directly interface with the patient's health, so the latency and scalability requirements must be closely examined for their high performance in dealing with the subject.

Conclusion

These results help conclude that individuals can handle critical aspects of their health and lifestyle when SW-SHMS or medical tracker devices are used by them, especially those individuals who are suffering from chronic diseases and neuro disorders such as Alzheimer's.

There are various reasons to use these medical trackers and they vary depending upon the need and the condition of the individual. Further, utilization strategies also vary depending upon the individuals. There are many apps are available in the

market some of which are described along with their key features.

With the advancement in Artificial Intelligence (AI) and Machine Learning (ML) techniques, cloud database provides a vast amount of data for the system to learn and analyse the parameters and eventually help the doctors to predict the diseases before their onset. Such predictive capabilities prove to be life-saving for many people. More and more new-age companies such as Amazon, Google, and Meta are investing in high capacity and intelligent data centres that facilitate the run of such high-tech software. The advancement in communication e.g., 5G, also enhances the speed and quality of communication. The rapid adoption of the Internet in a country like India is makes it possible for people in remote villages also to utilize these features, if provided on affordable rates.

It is proving a promising path for disease prevention and healthy lifestyle not only in older people but in younger people as well.

References

1. DESA, U., 2017. World urbanization prospects: the 2014 revision. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, New York.
2. Smith-Spangler, C., Gienger, A.L., Lin, N., Lewis, R., Stave, C.D. and Olkin, I., 2007. Using pedometers to increase physical activity: a systematic review. *JAMA*, *298*, pp.2296-2304.
3. Engel, S.E., Kiely, D.K. and Mitchell, S.L., 2006. Satisfaction with end-of-life care for nursing home residents with advanced dementia. *Journal of the American Geriatrics Society*, *54*(10), pp.1567-1572.
4. Wu, Q., Sum, K. and Nathan-Roberts, D., 2016, September. How fitness trackers facilitate health behavior change. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 60, No. 1, pp. 1068-1072). Sage CA: Los Angeles, CA: SAGE Publications.
5. Simpson, T.L., Kivlahan, D.R., Bush, K.R. and McFall, M.E., 2005. Telephone self-monitoring among alcohol use disorder patients in early recovery: A randomized study of feasibility and measurement reactivity. *Drug and alcohol dependence*, *79*(2), pp.241-250.
6. Connolly, E.S., Bruyère, O., Reginster, J.Y., Slomian, J., D'Amico, R., Zacharia, B.E., Dumont, E.L., Bruce, S.S., Abraham, M.E., Camacho, E. and Appelboom, G., 2014. Smart wearable body sensors for patient self-assessment and monitoring.
7. Dobkin, B.H., 2013. Wearable motion sensors to continuously measure real-world physical activities. *Current opinion in neurology*, *26*(6), p.602.
8. Czaja, S.J., Charness, N., Fisk, A.D., Hertzog, C., Nair, S.N., Rogers, W.A. and Sharit, J., 2006. Factors predicting the use of technology: findings from the Center for Research and Education on Aging and Technology Enhancement

(CREATE). *Psychology and aging*, *21*(2), p.333.

9. Chauhan, J. and Bojewar, S., 2016, August. Sensor networks-based healthcare monitoring system. In *2016 International conference on inventive computation technologies (ICICT)* (Vol. 2, pp. 1-6). IEEE.

10. Nienhold, D., Dornberger, R. and Korkut, S., 2016, October. Sensor-based tracking and big data processing of patient activities in ambient assisted living. In *2016 IEEE international conference on healthcare informatics (ICHI)* (pp. 473-482). IEEE.

11. Pantelopoulos, A. and Bourbakis, N.G., 2009. A survey on wearable sensor-based systems for health monitoring and prognosis. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, *40*(1), pp.1-12.

12. Patel, S., Park, H., Bonato, P., Chan, L. and Rodgers, M., 2012. A review of wearable sensors and systems with application in rehabilitation. *Journal of neuroengineering and rehabilitation*, *9*(1), pp.1-17.

13. Shnayder, V., Chen, B.R., Lorincz, K., Fulford-Jones, T.R. and Welsh, M., 2005. Sensor networks for medical care.

14. Stawarz, K., Cox, A.L. and Blandford, A., 2014, April. Don't forget your pill! Designing effective medication reminder apps that support users' daily routines. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2269-2278).