e-Assist: A Web-Based Assistive Technology for Locating Objects and Monitoring Activities of the Elderly

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Abstract. Assistive technology uses the variety of devices used to expand, maintain, or improve the functional capabilities of persons with disorders. It helps people who have difficulty speaking, typing, writing, remembering, pointing, seeing, hearing, learning, walking, and many other things. Different disabilities require different assistive technologies. It may also be classified as a device or system that provides practical solutions to everyday life activities. They promote greater independence and safety by enabling people to perform tasks that they had difficulty with or were unable to accomplish independently. Assistive technology is one of the most used technologies worldwide. This technology helps persons with disabilities (PWDs) and elders overpower their daily struggles. This study was designed to assist the elders in finding important documents or objects that they have misplaced or borrowed from someone using a locator. It can also detect when a document was borrowed and when it will be returned. It can also remind the user of important dates and times. After a series of functional and usability testing, the developed system was able to pass all its user requirements, error-free and ready to assist the seniors.

Keywords: Mobile application; Assistive Technology, Elders, Elderly, Locator, Remind, Objects, Internet-of-Things

1. Introduction

Primary caring for an older parent is a demanding responsibility and noticing the aging parent becoming forgetful and absent-minded. Our elders tend to forget a lot of stuff, even the things that should always be with them, for example, misplacing car keys or forgetting someone's name [3]. Today caring for your aging parents is the top priority of their children. The problem is that you are not always present with them, giving them a self-guidance way that might help them cope with their problems [4].

In research about age-related cognitive decline, here are the results in which men or women's memory declines to -3.6% for those aged 45-49. And memory continued to deteriorate until at the age of 60-64, and surprisingly the elders' memory started to improve at the age of 65 in both males and females. Just knowing elders' age when they start to be forgetful, we will have the basis on our client [5].

Assistive technology does seem to interest other people to use it more to help them diminish some of their difficulties. Assistive technology improves the quality of life, increases satisfaction with activity performance, and is better accomplished overall. For elders, it means less burden for the caregiver that is taking care of them, which is beneficial to others and not the only one using it [6]. There are some similarities on the other application that has already been released, but there will always be that issue of why it doesn't work on everyone. There's an article about a medication reminder app that does it for different ages. This application is only about medication like medication-alarm and medication-info. Young people did not have any problem using the app because they have seen more complicated apps than the elderly. When it comes to the elderly, they have difficulty navigating the app [7]. It is not a reminder about taking your medication, and it will be much more, giving more freedom for the elders. They can put medical appointments, medical prescriptions, and special events like birthdays, reunions, and anniversaries. Some new features like text to speech, text to visual integration for the application, and even an object locator that will help the elders look for their belongings. The system developed will significantly help the elders satisfactorily and greatly affect them.

The study's main objective is to develop a web-based assistive system for the elderly in locating objects and reminding them of their daily activities. The system is assistive technology for the elders, wherein it will

help locate objects that the elders often misplace. Things that can be found will only be limited to what they always use. The objects with a radio frequency identification (RFID) tag can be located from one to five (1-5) centimeters within the elder's area. A radio frequency identification (RFID) reader will find an object.

The system also has a reminder that will help the elders be reminded of what they need to accomplish within the day, events that they need to attend, their appointment with their doctors, and when the elders can take their medicines. A developed process flow that can be subject to change every feature found in the menu page of the system, old reminders, and their date will be listed there as well. The elders can choose between adding, editing, or deleting a reminder and an object locator. Gathering the modules for the system, the developed process flow of E-Assist in Figure 1 shows how the system work. The elders can choose their preferences and what system function they will use before inputting the required details for the system function, they desire. After that, the data will be processed. The reminder can help the elders be reminded of what they need to do in their everyday lives. On the other hand, the object locator will help them locate the objects or essential documents. The users can input the details needed of which system function they choose and view it using a visual only as their preference. The details that the users' input will be stored in the database. They can access the application on their desktop using different Internet browsers (i.e., Google, Mozilla Firefox, Microsoft Edge) and mobile phones. Even if the details were stored in the database, both the reminder and the object locator require an Internet connection for it to work.
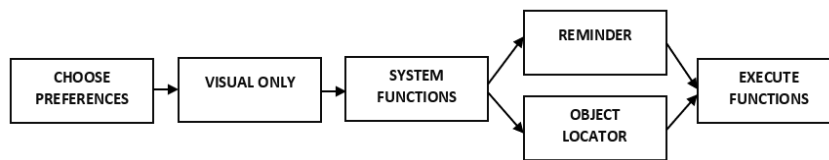

Fig. 1: Process flow of E-Assist.

2. Literature Review

A paper entitled "SmartLohas: A Smart Assistive System for Elder People" [8] is about an application it aims to design an assistive tool for elders using modern technology. This system, SmartLohas, provides tools to assist the elders in improving their abilities. The abilities that an elder can improve are their memory, vision, and decision-making in their daily lives. Also, SmartLohas is designed to enhance the social connectedness of older people. The system also includes schedule reminders, living utility, and object recognition.

Another research paper entitled "Asset tracking and management system for the library using active radio frequency identification (RFID)" is a system wherein it uses RFID for tracking and management. Radio frequency identification (RFID) is one of the most popular ways of tracking and tracing, whether it's a person or an object that can be identified using a Radio Frequency transmission using a sensor. Radio frequency identification (RFID) is already being used to identify books, tools, equipment, and any other assets you may have. Also, the physical location of a particular book will be easily identifiable using radio frequency identification (RFID). The process of tracking an object can be identified by using tags and barcode labels attached to the object [9].

3. Methodology

3.1. Data Gathering

The first step for developing the system is the gathering of data. The researchers have gathered documents needed and data related to the system settings. The documents and data gathered helped the researchers gain knowledge on how to implement the system and what things were needed. Also, the documents and data gathered were used for the development of the system.

3.2. Analysis and Design

The system architecture shown in Figure 2 presents how radio frequency identification (RFID) works. A user will input the details needed for the reminder and object locator. The data gathered will be stored in the

database. The conceptual framework of the system is shown in Figure 3, where an elder will be assisted by a home agent, who will input the details of the elders to be stored on the database. Support will handle what is inside the cloud services and maintain the website. After that, the elders can use the reminder and the object locator using their desktop or mobile phones.
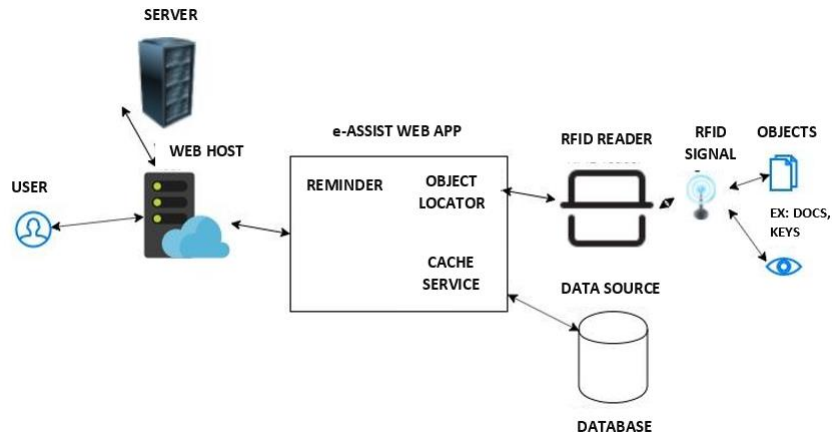

Fig. 2: System architecture.

The network diagram is shown in Figure 4, where the program can be accessed through a personal computer or a mobile phone in which Internet access is needed to download. The object locator must always be connected to the Internet to identify where that object is accurately. The unregistered object is trying to contact the webserver but seems not to be answered by the web server because it's still not yet registered to be identified. Registered objects will be processed in the web server, and the details will be stored in the database. Both the reminder and the object locator always need an internet connection to function.
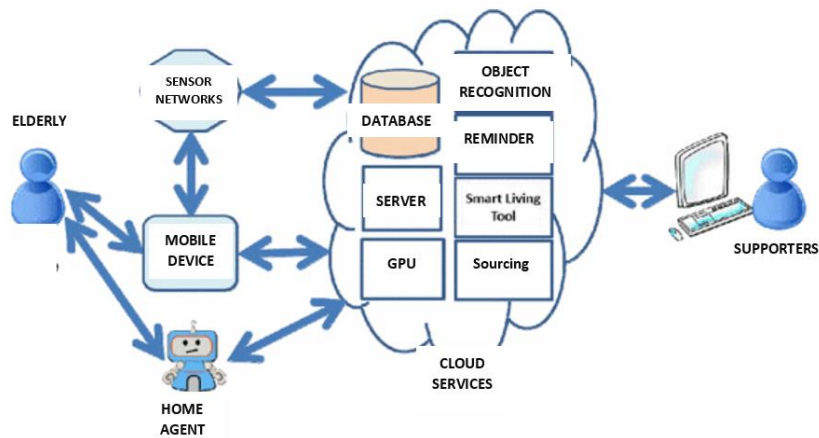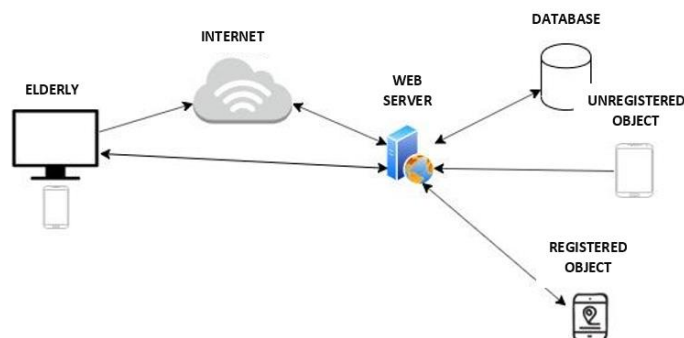

Fig. 3: Conceptual framework of the study.

Fig. 4: Network diagram of the study.

3.3.   System Design

The developed system has the following modules: reminder and object locator. *Reminder Module* - this module is for users to be reminded of the activities they need to accomplish within the day.

Object Locator - This module is an object locator that can locate objects within a specific range.

The user interface design for the elderly has minimal icons and buttons for easy navigation. The web application mainly has two parts: the reminder icon for activities notifications and the tracking function for locating objects within a specific range like keys, reading glasses, purses, umbrellas, etc.

3.4.   Development

The web application was developed using PHP as the primary scripting language and MySQL for the database. The web interface design of the object locator is shown in Figure 5, has four quadrants with its unique design that provides the location assignment of an object. Item or object data represents a table format containing identification (ID) and Item name of a radio frequency identification (RFID) tag. Highlighted quadrant in the web interface represents that the RFID tag has been detected and the information has relied on the web server. Tag is classified as registered or unregistered. If the information is present, it will show the data, and if it's not, it will show unregistered. There will be a small graphical effect and small text to pinpoint which quadrant, as shown in Figure 6. It shows the quadrant used for the object locator and the original plan of using four (4) RFID readers, one of each quadrant, to mark an item on which quadrant it was located.
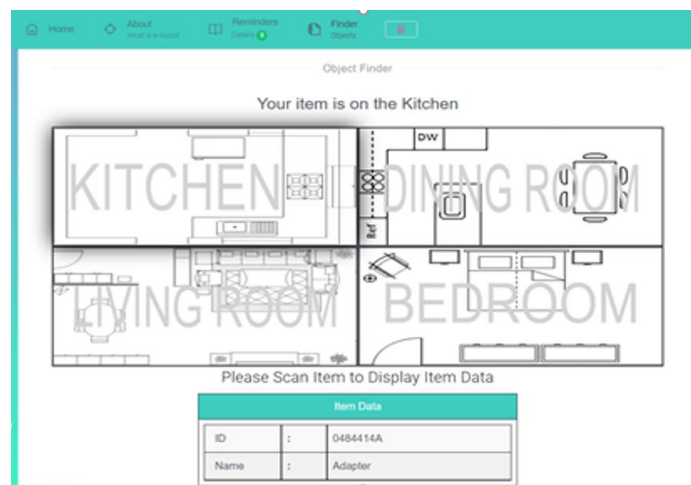

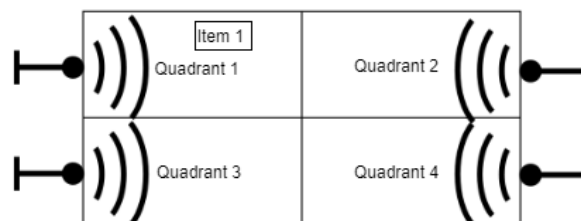Fig. 5: Web application design of E-Assist.

Fig. 6: Quadrants with 4 RFID reader design.

3.5.   Testing

Program errors within the development of the system were all addressed and fixed accordingly for unit testing done. User feedback was gathered after the initial testing as the basis for improvement done in the application. After the application had been modified, another testing was made. Aside from unit testing (test case list, sample output, data printouts, and defect information used as proof that the testing has been fulfilled and to make sure that every module has passed the testing), user acceptance testing (UAT) followed.

4. Results and Discussion

The survey was gathered from twenty-one (21) respondents, ages 60 and up. The survey results were based on the respondents' experience using the application. The survey was analyzed using a Five-Point Likert scale and computed for the weighted mean as shown in Table 1.

The result of the respondents' evaluation of appearance and design is shown in Table 2. The respondents evaluated the appearance and design of E-Assist as very acceptable as it garnered a weighted mean of 3.94. Specific categories gathered a mean of 4.28 for both appearance of homepage and colors and design of the homepage, 3.71 for the appearance of the registration form page, 3.81 for the appearance of the user data page, 3.86 for the presentation of quadrants, 3.95 for the appearance of reminder page, and lastly, 3.67 for the appearance of about us page.

Table 1: Five Likert scale rating

Rating	Numerical Scale	Descriptive Rating
1	1.00-1.80	Not Acceptable
2	1.81-2.60	Fairly Acceptable
3	2.61-3.40	Acceptable
4	3.41-4.20	Very Acceptable
5	4.21-5.00	Highly Acceptable

Table 2: Appearance and design evaluation results.

Appearance and Design	Weighted Mean	Verbal Interpretation
Homepage Appearance	4.28	Highly Acceptable
Homepage Colors and Design	4.28	Highly Acceptable
Registration Form Appearance	3.71	Very Acceptable
User Data Page Appearance	3.81	Very Acceptable
Presentation of Quadrants	3.86	Very Acceptable
Reminder Page Appearance	3.67	Very Acceptable
About Us Page Appearance	3.94	Very Acceptable

The result of the respondents' evaluation of accessibility is shown in Table 3. The respondents evaluated the accessibility of E-Assist as highly acceptable as it garnered a weighted mean of 4.38. Specific categories gathered a mean of 4.43 for ease of registering an item, 4.33 for ease of creating a "to-do" list, 4.19 for easiness of locating the "to-do" list made, and 4.57 for creating the " to-do " list ease of use on using the locator. While the result of the respondents' evaluation on usefulness and user-Experience showed acceptable remarks, as shown in Table 4. The simulation for the object locator gave these results that quantify the idea and requirement for the object locator to work correctly and accurately. The number and the power of the radio frequency identification (RFID) reader are needed to be considered to likely give a proper output and functionality that will need to have adequate funding to pull it off and make the Object locator better. Weaker radio frequency identification (RFID) readers or low frequency tend not to work on specific situations like further range and penetrability. The study also found that you cannot pinpoint the exact location of an item by having a premade location for the RFID reader.

Table 3: Accessibility evaluation results.

Accessibility	Weighted Mean	Verbal Interpretation
Ease of Registering an Item	4.43	Highly Acceptable
Ease of Creating a "To-Do List"	4.33	Highly Acceptable
Ease to Locate "To-Do List" created	4.19	Very Acceptable
Ease of Use of Locator	4.57	Highly Acceptable
Overall Mean	4.38	Highly Acceptable

Table 4: Accessibility usefulness and user-experience evaluation results.

Usefulness and User-Experience	Weighted Mean	Verbal Interpretation
Good experience in using the system	4.05	Highly Acceptable
The system is responsive	4.19	Very Acceptable
Overall experience in suing the Object Locator	4.76	Highly Acceptable
Object Locator is useful	4.76	Highly Acceptable
Overall Mean	4.44	Highly Acceptable

5. Conclusion

The study aimed to develop a web-based assistive system for the elderly in locating objects and reminding them of their everyday activities. Based on the objectives, the study created a locator that can find any documents or objects with a radio frequency identification (RFID) sticker tag attached. Items with an RFID sticker tag can be located inside a quadrant representing an area's location using an RFID reader. The study was also able to create a reminder that can assist the elders in managing their daily activities, medicines, appointments, or events that they need to attend. These functions were made in just one system that would suit the elders' needs and preferences.

Based on the weighted mean that was computed, most results of the user acceptance testing (UAT) that the study well, with results of very acceptable and highly acceptable. In terms of the appearance and design, the evaluation results were able to get a 3.94 overall mean, which means the appearance and design of the system were very acceptable. For the accessibility of the system, it was 4.38 overall mean which means it was highly satisfactory. Also, the evaluation results gained were able to get a 4.44 overall for the usefulness and user experience, which means it was highly acceptable. The overall weighted mean of all the three (3) UAT evaluations is 4.25, which means the whole system is highly satisfactory. When the numerical scale is between 4.21-5.00, its descriptive rating is highly acceptable.

Current object locator simulation is successful and provides information about the potential of RFID. Still, it shows its limits in terms of the scalability for the actual scenario because of the study's hardware limitation is that the RFID reader has a very short detection range.

The following recommendations on future researchers that can help utilize the maximum potential of the system: 1) Use an RFID reader that has better capability in terms of performance and would identify the object further, better, more accurately, and much more flexible in specific scenarios and will yield better results. 2) Implementing an alarm or notification on the application and giving real-time updates for the users.

6. References

[1]   KO. Ojo, and E.C. Odunze, "Design and Construction of a Wireless Based Electrical Appliance Control System," Journal Applied Sciences and Environmental Management,22(9), pp.1439-1442, 2018.

[2]   H. Stojanoski, D.C. Bogatinoska, A.B.M Salem, and V. Srebrenkoska, "Practical, cheap Smart Home implementation with general-purpose embedded hardware Raspberry Pi," Proc. 2017 IEEE 8th International Conference on Intelligent Computing and Information Systems (ICICIS) (pp. 335-341), 2017.

[3]   S. Tanwar, P. Patel, K. Patel, S. Tyagi, N. Kumar, and M. S. Obaidat, "An advanced Internet of Things based security alert system for smart home," Proc. 2017 IEEE International Conference on Computer, Information and Telecommunication Systems (CITS), pp. 25-29, 2017.

[4]   J. Bugeja, A. Jacobsson, and P. Davidsson, "On privacy and security challenges in smart connected homes," Proc. 2016 IEEE European Intelligence and Security Informatics Conference (EISIC) (pp. 172-175), 2016.

[5]   J. Bugeja, A. Jacobsson, and P. Davidsson, "On privacy and security challenges in smart connected homes," Proc. IEEE European Intelligence and Security Informatics Conference (EISIC) (pp. 172-175), 2016.

[6]   M. Alaa, A.A. Zaidan, B.B. Zaidan, M. Talal, and M.L.M. Kiah, "A review of smart home applications based on Internet of Things", Joural of Network and Computer Applications, 97, pp.48-65. 2017.

[7]   P. Ramanatha, U.R Nelakuditi, S. Ravishankar, and V. Ranganathan, "UAV based smoke plume detection system controlled via the short message service through the GSM network", Proc. International Conference on Inventive Computation Technologies,Vol.2, pp.1-4, 2016.

[8] S. Moorat, H. Pervaiz, F. Soomro, and M.M. Mughal, "Development of an Arduino Based Device for Early Detection of Gas Leakage in Hospitals & Industries", University of Sindh Journal of Information and Communication Technology, 2(1), pp.68-72. 2018.

[9] V. Adat, and B.B. Gupta, "Security in Internet of Things: issues, challenges, taxonomy, and architecture", Telecommunication Systems, 67(3), pp.423-441, 2018.

[10] Y. Chahid, M. Benabdellah, and A. Azizi, "Internet of things security," Proc. 2017 IEEE International Conference on Wireless Technologies, Embedded and Intelligent Systems, (pp.1-6). 2017.

[11] E. Leloglu, "A review of security concerns in Internet of Things. Journal of Computer and Communications, 5(1), pp.121-136. 2016.

[12] A. Triantafyllou, P. Sarigiannidis, P. and T.D. Lagkas, "Network protocols, schemes, and mechanisms for Internet of things (IoT): Features, open challenges, and trends," Wireless communications and mobile computing. 2018..

[13] MINAH, F. AND MOBI, Y. 2017. A Medication Reminder Mobile App: Does it Work for Different Age Ranges. Randell, Cornet, McCowan, R, Informatics for Health: Connected Citizen-Led Wellness and Population Health, 68-72.

[14] TSAI, Y.T., FAN, C., LO, L., HUANG, S.H. 2017. A Smart Assistive System for Elderly People. SmartLohas. https://ieeexplore.ieee.org/document/8121798

[15] MUTHUSELVI, R. 2016. Asset tracking and management system for library using active radio frequency identification (RFID).