Journal of Engineering Technology Vol. 10(1): 189-193, 2022
ISSN 2231-8798© 2013 UniKL BMI

Autonomous Medical Robot for Home Based Monitoring

Nur Adila Mokhtar, Naszariah Mohd Noor
[1]Section of Medical Electronics Technology
Universiti Kuala Lumpur British Malaysian Institute

Corresponding email: adila.mokhtar@s.unikl.edu.my

Abstract: An aging population is defined those aged above 65 years old. In 2020, it was estimated that the share of Malaysian population 65 years and above stood at seven percent. According to statement on July 2019 by Chief Statistician of Malaysia, 15 percent threshold made would be crossed in 2030. Recent estimates suggest that 8.5% of Malaysians over the age 60 having dementia, suffering from dementia and approximately yields population of 260,345 elderly with dementia. Many people with dementia have a prolonged disease trajectory, lasting years from diagnosis to death. Besides having trouble in remembering their personal details, they are also having problem on their medication management. The first problem to be addressed is the error of the caretaker giving medicine to patient. Medication errors are one of the most common health-related mistakes that have a negative effect on patients. Majority of the elderly are unable to manage themselves. More families are finding themselves unable to look after the elderly who are unable to manage themselves. Heart diseases remained the cause of death. The current heart rate monitor needs caretaker to visit every patient's bed to make sure the heartbeat rate is normal. The results obtained from this medical robot shown on the Blynk applications. The testing was being run repeatedly to ensure that the results obtained were parallel with each other even after a bunch number of testing occur. For the results and discussion on the system of detecting spo2 and bpm, various tests has been taken in order to make comparison between each readings so that the results can be analyzed to ensure the validity of the system. The project goals has been successfully achieved. As for the future recommendation, the advance technology has already existed, but it still in need of deeper research and studies for each system that involved in this project because simplification needs change in term of component used which the new component must be able to produce the same or better result than the older one. This will lead to a small product but still maintaining the quality of the results produced.

Keywords: Alzheimer, dementia, medical robot, elderly, vital parameters, medication

1.0 INTRODUCTION

Malaysia is a unique country with its multi-ethnic and cultural diversity population. Malaysia is expected to become an older country by 2035, with the total population expected to reach 15 percent above the age of 60 [1]. During a survey conducted on aging, more than 70 percent Malaysian respondents thought it was a duty of the young to take of the elderly. This mindset has placed the burden of care on a shrinking base of young people. Moreover, it could contribute to the underdevelopment of social services for the elderly and Malaysians also seemed pessimistic about aging [17]. According to Hertzog & Dixon, 1994, memory loss is one of the most common problems occurs among the elderly [1]. Dementia and Alzheimer's disease are the most frequent disabling illnesses that related to the elderly. According to an Alzheimer Disease International report, in 2005 the prevalence of dementia in Malaysia was 0.063 percent, with a 0.020 percent yearly incidence rate [2]. The most popular type of dementia is Alzheimer's disease. The treatment for this disease is symptomatic and also involve in support and assistance.

The robot is defined as any machine that can move and do a person's wok and is usually controlled by a computer [3]. There are many people, especially the elderly, require more medical caregivers for check-up, which raises health-care spending as the existing problems such as a lack of professional caregivers, affordable care and elder-friendly housing need to be quickly addressed before the silver tsunami overwhelms the country [17] . In such cases, the use of robotic technology may assist to obtain records of the patient's vital biological parameters such as pulse rate and blood oxygen saturation level and delivering medicine without the doctor or nurse having to interact with them directly. Developing a home-based

medical robot can help to keep the old patient under constant surveillance while ensuring that their quality of life is not disrupted by frequent visits to healthcare professionals or even costly permanent admission to hospitals or nursing homes.

For this project, the main objective is to develop a line following autonomous medical robot that can perform care task. Secondly, able to deliver medicine to the patient remotely without the caretaker having contact with the patient. Thus, the caretaker can monitor the patient health parameter throughout their phones. Lastly, to develop a robotic system that works on reading of the patient heart rate as part of the vital healthcare. Hence, able to reduce the workload facing by the caretaker. Ageing of the population is a global phenomenon with farreaching implications and repercussions on many facets of human life. Ageing is more obvious in the developed countries and less evident in the developing countries [4].

According to studies from the World Health Organization, the United Nations Population Fund, and Help Age International, there have been many discussions about the ageing in place concept in recent years, especially in modern countries where the ageing process is more pervasive [5]. Based on research by Burton in 2016, the expenses of healthcare service in Malaysia have increase as a result of improved healthcare standards and also by the increasing the minimum wage rates [6]. Furthermore, the pressure imposed on Malaysia's healthcare system is rising due to an increase in the number of elderlies, while technological developments in medical science have resulted in improved methods of treatment but higher medication costs. As a result of these findings, it can be stated that, while Malaysia's healthcare system is adequate, there are still challenges with affordability and quality that are likely to increase with time [7]..

2.0 MATERIALS AND METHODS

Figure 2.1 shows a block diagram of the remote healthmonitoring. The block diagram consists of three main parts which is an input, process and an output. All the mentioned components above are put on prototype. In this project, ESP 32 Wifi module is used as a microcontroller. The function is to perform an overall activities of this project. In addition, ESP 32 Wifi also connected to all other peripherals used such as for delivering medication and measuring patient's parameter.

As for the input, the use of three sensors, which line tracker sensor is to detect the black line to ensure the robot is following the destination path, the magnetic switch is to detect the opening and closing of the medicine box and MAX30100 is to measure the pulse oximetry reading. After obtaining the input data, then ESP 32 transmits to the output according to therequirement such as DC motor driver for locomotion of the robot, buzzer for the indicator to the robot when it reaches the right destination and LCD is used for the output to display message for the patient to take medication and all set parameters such as heart rate and oxygen saturation. Both status of medicine delivered and the reading of heart rate and oxygen saturation can be also seen in Blynk application.

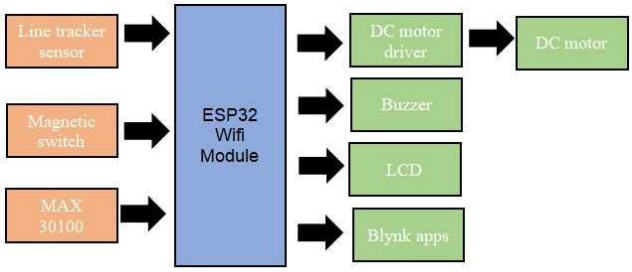

Figure 2.1. Remote of Health Monitoring

ii. Flowchart

This project's method and decision making have been incorporated in Figure 2.2 to track the workflow. robot has to follow. Therefore, the caretaker needs to set the destination of the patient, either in Room 1, Room2 or Room3 on the smartphone. After the Room setting has been made, the robot starts moving to the desire destination by following the line. The line following robot follows a line with the help of IR sensor and sent a signal to ESP 32. When it reaches the destination, the buzzer trigger and generates sound. With that, LCD displays a message to the patient to take their medicine. Therefore, the patient needs to take their medicine from the box provided. Once, the patient closed the box, a massage then send to the caretaker phone and the buzzer will deactivated.LCDs

In this case, measuring heart rate is used as of the patient's vital monitoring because elderly usually diagnosed by a disease such as asthmatic [18]. For this purpose, MAX30100 sensor module is used as its functions are to monitor and measure the pulse rate and oxygen saturation. Initially, LCD displays an instruction message to the patient to place their finger on the sensor. The reading of heart rate will display at the LCD when the heart rate electrical signal is been detected. The caretaker able to obtain the reading of patient's heart rate via Blynk Apps in their smartphone.

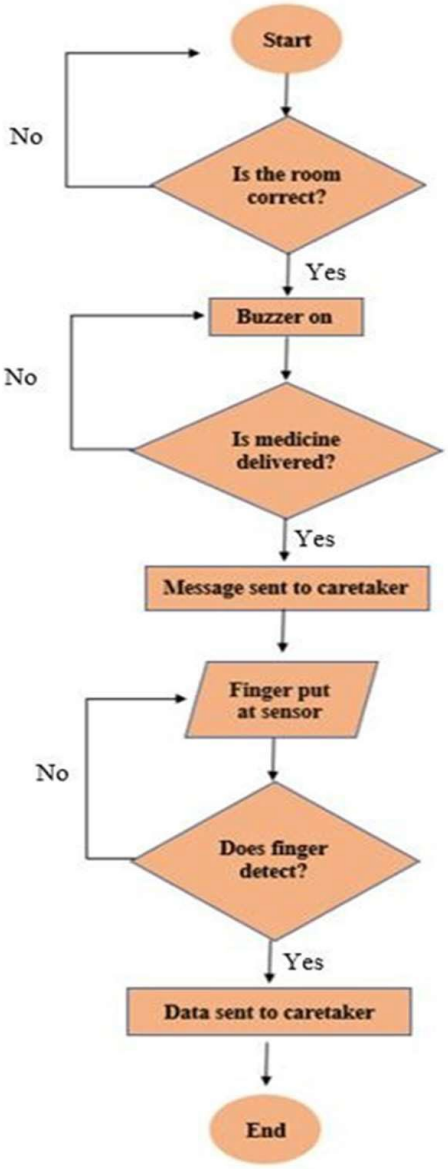

Figure 2.2 Flowchart of remote health monitoring

3.0 RESULTS

This project is designed to monitor the patient's, which include their heart rate, SpO2 and also delivering medicine to patient remotely through online application. The reading of the patient's heart rate and SpO2 also will display on LCD. Caretaker can monitor the patient reading and medication through Blynk application. The Max30100 is put to the patient's finger to get the reading of heart rate and SpO2. The LCD displays the health parameter and a message for the patient to take their medicine.As illustrated in Figure 3.1 and Figure 3.2, the LCD is displaying the necessary messages to the patient such as reminding them to take their mediation and also their vital signs reading on heart rate and oxygen saturation level. It is generated by the sensor that istalled in the medicine box and to the patient.

Figure 3.1: Reminder for medication

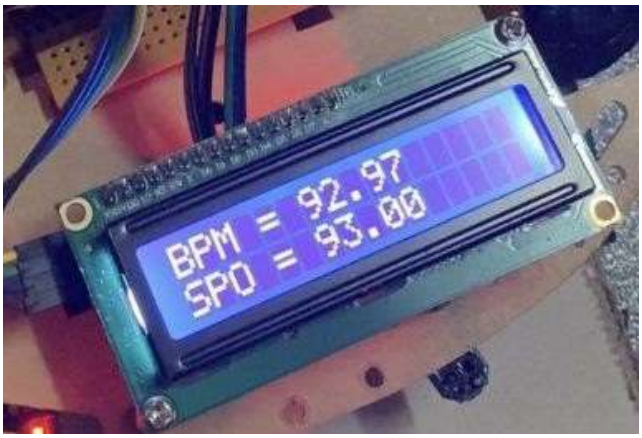

Figure 3.2: Health parameter messages

Once the robot has arrived at the place that the caretaker has set using Blynk apps, these messages are then shown. The patient must place their finger at the sensor for readings of their heart rate and oxygen saturation after the medication has successfully reached its intended location. The output of the patient's health data from Blynk apps is shown in Figure 3.3. The caretaker's phone will continually update with patient's health metric. Using the Blynk apps, the user can continue to maintain track on the patient's health.

Figure 3.3: Heart rate and oxygen saturation test results parameters

Figure 3.4, it demonstrates the alert notification informing the patient in room 2 that the medication has already been taken. The caregiver can determine whether the patient has taken their medication thanks to the alert notification. The graphic depicts a successful outcome because it can notify the caregiver.

Figure 3.4: Blynk apps alert notification

4.0 DISCUSSION

This patient's heart rate and oxygen saturation levels are measured as part is this project. The data collection is testing on 10 individuals. Table 4-1 contains the results of data tabulation. The average percentage error between the prototype and calibrated device is determined to be 4%. The measurements between heart rate and oxygen saturation obtained from 10 patients concurrently are at the 4 percent error, as shown in Figure 4.1.

It is conceivable to draw the conclusion that the measurement for heart rate and oxygen saturation level from the prototype device is appropriate based on the health parameters discovered during the investigation on 10 different individuals.The heart rate range that is considered to be a typical reading is 69 to 94. The oxygen saturation level is also within the typical range of 95% to 96%. The prototype can be used by the user fearlessly, preventing a false warning.

Table 4-1: Comparison health parameter between MAX30100 and Philips Suresign VM6.

Heart rate reading from MAX30100 (Bpm)	SpO2 reading from MAX30100 (%)	Reading of heart rate from Philips Suresign VM6	Reading of Spo2 from Philips Suresign VM6	Percentage accuracy of heart rate between MAX30100 and Philips Suresign VM6 (%)	Percentage error of SpO2 between MAX30100 and Philips Suresign VM6 (%)
76	96	79	100	96	96
92	95	95	96	97	100
93	96	98	95	95	99
69	96	67	95	97	99
78	95	79	100	99	95
75	95	78	96	96	99
94	95	97	100	97	95
73	95	75	100	97	95
70	96	68	95	97	99
62	95	67	95	92	100

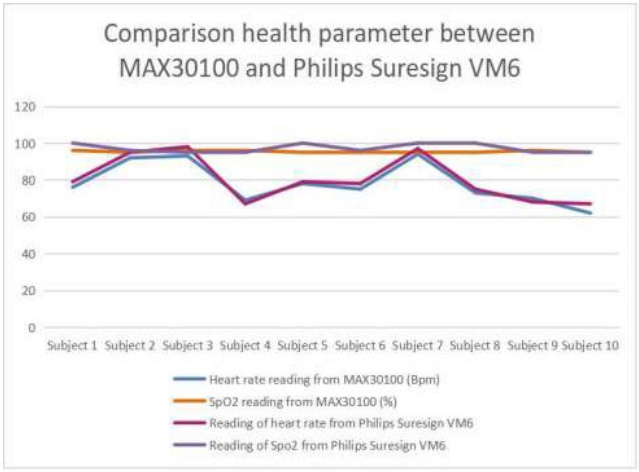

Figure 4.1: Graph comparison health parameter between MAX30100 and Philips Suresign VM6

5.0 CONCLUSION

As for the project's conclusion, it can be employed by senior people who are suffering from dementia and Alzheimer's. This prototype can make the caregiver's job easier by helping them keep track of the patient's medication and overall health. The Alzheimer patient can forget to take their medication without this robot. The patient must always be under the caretaker's watchful eye. By putting this system in place, we may also notify the caregiver if the patient's heart rate falls.

To enhance this project's usefulness and increase its

dependability for industrial use, a few improvements should be done. The first suggestion or improvement is to simplify the circuit design in order to incorporate more monitoring system into a smaller device. The robot's camera should then be attached so the doctor can see and warn the patient via the webcam. This could let the caregiver keep an eye on the patient in real time to see if they are indeed taking their medication or not. This project can also be enhanced with a sound sensor to enable the production of voice commands. The voice command will increase the alertness of the elderly because some of them may not be able to see the LCD display clearly. To decrease medication errors, the robot should have a realtime clock so that it can monitor when the medication is given.

REFERENCES

[1] Hertzog, C. & Dixon, R.A. (1994).Metacognitive development in adulthood and old age. In J. Metcalfe & A. Shimamura (eds), Metacognition:Knowing about Knowing (pp. 227-251).Cambridge, MA: MIT Press.

[2] Economics A. Dementia in the Asia-Pacific Region: the Epidemic is Here. Melbourne: Access Economics for Asia Pacific Members of Alzheimer's Disease International 2006, 21 September 2021.

[3] Pearson Education Limited, Longman dictionary of contemporary English. (2015).

[4] Tobi, S. U. M., Fathi, M. S., & Amaratunga, D. (2017, October 3). Ageing in place, an overview for the elderly in Malaysia. AIP Publishing. Retrieved October 14 2021, from https://aip.scitation.org/doi/abs/10.1063/1. 500543 4

[5] Hagen, S. A. (2013). Rising demand for long-term services and supports for elderly people. Congress of the United States, Congressional Budget Office.

[6] Burton, C. (2016). Livability for All: The 2016 AARP Age-friendly Community Survey of Tallahassee, Florida AARP Members and Residents Age 50-Plus.American Association of Retired Persons. [Accessed Sept 18, 2021].

[7] Guerin, B., Hoorens, S., Khodyakov, D. and Yaqub, O., 2015. A growing and ageing population. Global societal trends to, 2030.

[8] Mat Nuri, T., Hong, Y., Ming, L., Mohd Joffry, S., Othman, M. and Neoh, C., 2022. Knowledge on Alzheimer's disease among Public Hospitals and Health Clinics Pharmacists in the State of Selangor, Malaysia.

[9] Alzheimer's disease International (2015). "World Alzheimer Report 2015," in The Global Impact of Dementia: An Analysis of Prevalence, Incidence, Cost and Trends. Available online at:https://www.alz.co.uk/research/worldreport-2015 Accessed Sept 18, 2021).

[10] Stafford, A. (2015). The pharmacist's role in supporting people living with dementia in the community. Aust. Pharm. 2015, 34, 38

[11] Alotaibi, M., 2019. Role of robots in healthcare management.[Accessed; 9 September 2021]

[12] R. Horton, "Robots are Coming", Deloitte, London, 2015. Available:https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/finance/deloitte-uk-finance-robotsare-coming.pdf. [Accessed: 24- Oct- 2021].

[13] Suryawan, S., Musamwar, S., & Kolhe, S. (2019). Line Follower & Obstacle Avoider Robot. 07(12). (Accessed Sept 18, 2021).

[14] Varghese, A., Sunil, Mrs. S. M., & Sajeev, A. M. (2021). Medicine Delivering and Patient Parameter Monitoring Robot -MedRobo. IARJSET, 8(6), 449–457.

[15] A. Abutaleb, J. Alsabhani, S. Alkinani, S. Alkaydi, S. Alghamdi, and A. Bensenouci, ''Design and implementation of a nurse robot,'' in Proc. Int. Conf. Ind. Eng. Oper. Manage, 2020.

[16] M. Niemela and H. Melkas, "Robots as social and physical assistants in elderly care," in Human-Centered Digitalization Services, Vol 19, pp 177-197, 2019.