DEVELOP SMART LOOP FOR CARDIAC PATINETS

HANA ALGHAILANI
Student

Khoula Al Harthy
Senior lecturer

Department of computing
Middle East College
Muscat, Oman

ABSTRACT

Technology has become rapidly growing as it facilitated life and increased productivity. Population growth is increasing very significantly, thus there are many and different diseases, so the health system must be effective and of high-quality working to cover the needs of the patient. This matter is expensive and not easy, but to monitor patients' health and diagnose them very accurately, the hospital must be equipped with smart technology devices that seek to reduce the mortality rate and strive for the benefit of patients. By using the Internet of Things, which connects devices with sensors that can transmit data in real time through the Internet without human intervention, and it is considered one of the most important technologies that are used and develop things to make them more intelligent in several systems such as education, health, and the environment. In this project, proposed a smart sensor loop that is implanted in the human body and using the Internet of things that diagnoses patients' condition and sends it at the same time to the hospital. Thus, smart health care will help increase the individual's productivity and lead a healthy life free from disease. The aim of this project is:

- To reduce reviewing appointments in hospitals and thus reduce congestion.
- To design a sensitive and intelligent looping system that senses and detect when clots occur and depends on the Internet of Things.
- To achieve a prototype application of the smart loop system that contains heart rate, ECG, and pressure measurement data.
- To apply an intelligent alert system that works to give notification to the patient and the hospital that there is a dangerous situation for the patient in the event that it is not possible to break up the clots, and urgent medical intervention is generate notification.

This project will follow analysis of a methodologies like waterfall, Waterfall modification, incremental, spiral**.** Method of collecting information, a plan that specifies the duration of the project, and preliminary designs for the proposed system.

Introduction:

The Internet of Things is the system that connects any device or sensors to the Internet in order to be able to transfer and exchange information without human intervention (Keyur, 2016), thus achieving and building smart systems that work on the Internet and determine the sites as well as management and monitoring. the era of digital transformation has been done. Moreover, the advantage of the Internet of things is become one of the most important technologies that are used in educational, health, human and environmental fields, and systems.

Based on the Internet of Things solutions, this project will be for the health sector especially heart patients. The health sector started relying on this technology and developing smart devices that are easy to use and more effective in contributed to reducing hart congestion, providing better services, and preserving and storing patient files and data.

Statistics indicate that the health sector owns approximately 20 billion devices connected via the Internet of Things technology, and it may reach 646 million devices by the end of 2020.

Problem:

Heart patients suffer from several problems such as clogged arteries, high blood pressure and high heart rhythms, which is one of the causes of heart attacks, which are sudden and occur quickly and without the presence of any symptoms or previous warnings and may lead to death in the absence of rapid treatment intervention for these patients.

The project aims to design loop that solve the problems facing heart patients linked to a program that is in the phone equipped with a pressure measurement, heart rate and an electrocardiogram, and is linked and connected to the patient's file number in the hospital files, and this data is sent periodically throughout the day.

Literature review:

The Environment:

The Sultanate of Oman has achieved remarkable development and achievements in the health sector, and it is the responsibility of doctors and nurses to save the lives of patients. These health systems are targeting to provide comprehensive services to all citizens and expatriates.

Regardless of health services and care for the sick and the elderly, the state guarantees to help the citizen in cases of emergency and disease to achieve solidarity in societies ***(Health Vision 2050)***. The Basic Law states that the state cares about the general health of individuals and means of preventive measures from diseases as well as epidemics.

The health sectors benefited from the digital development and smart technologies that appeared and kept pace with this fundamental transformation, and this contributed to the doctor's help in that the diagnoses became very accurate, which enabled the doctor to achieve outstanding results in treatment and improve the quality of performance and medical services provided, as these new software and smart devices became covering approximately 80% in health institutions. These programs are characterized by the fact that they facilitate remote patient monitoring and sense the medical and vital signals of the patient with more care, lower maintenance costs and reliability, and these devices are linked to health systems and their servers more smoothly and easily ***(Woo, M., Lee, J. and Park, K. 2018).***

(Mahajan& Gupta, 2020) They indicated in this article that due to population growth and the increase in diseases, devices must be developed in line with the provision of smart health care that reduce mortality and contribute to meeting the needs of patients because traditional care has become ineffective. Among the goals that have been set for smart health care that enables the individual to know Consequently, his health condition in the event of any change in the patient's vital signs that threaten the patient's life gives him alerts to go to the hospital and the Internet of things contributes to reducing costs for the patient because it enables the doctor to diagnose the case without the need to visit the patient except for periodic statements every 3-6 months.

As indicated by ***(Chen,2020)*** that mobile health and e-health is one of the health practices that is supported by phones and mobile devices to monitor patients using a personal digital assistant, which is used to smartly monitor and care for patients using e-health, which aims to add information and transfer data between sensors and the staff Medical.

Figure 1e-health&m-health

Internet of things in smart health:

According to a study ***(Rath,2018),*** it was discovered that the Internet of things is a combination of computing and communication that connects to the Internet, and it is one of the physical electronic models and connects to real elements such as phones and portable devices, and thus connected via wireless networks. These devices are managed using the Internet of things and these devices are distinguished by being able to access data from After data exchange, examples of these devices are remote patient monitoring, education, agriculture, situations, and others. Among the benefits of using the Internet of things are sensors, location, communications, identification, all of which relate to the patient's smart health.

The Internet of things has been widely applied to medical equipment, portable medical surveillance systems, chronic disease management, and patients and their activities are monitored daily, thus preserving the patient's health.

The Internet of things is a bridge between the doctor and the patient. The doctor can monitor the patient's health remotely and permanently, and in the event of any problems, he provides the patient with advice that reduces the expected problems.

Thus, health care results are more accurate and effective. And it is through a combination of sensors, processors, control devices and the storage cloud, and it is done using the Internet of Things.

Due to the development of Internet technologies and the large demand for them in patient care, many new technologies have been available that contribute to patient care and control in the easiest way. The Internet of things contains components used for smart health such as sensors and networks used to connect the device, the operator, and storage clouds, and these layers cover the needs of the patient.

Internet of Medical Things (IoMT):

(*Santana,2020)* He says that IoMT is an amalgamation of medical software applications and medical device data. This system combines data, processes, and people, which is done wirelessly by medical devices that are linked to the phone to improve performance and results. The Internet of medical things is one of the most important inventions used by technology in health care. It contributed to the fact that it made it possible to monitor the vital signs of patients and to show this data in the systems of health care providers, as it became very important to detect diseases early and thus try to solve the problem. Studies have indicated that by 2023, the number of elderly people may reach 1.2 billion and thus many health problems will appear. Therefore, IoMT will play an effective role in health care systems and help the elderly, therefore vital signs and heart rate will be read and reminded of medication appointments.

Cloud computing in smart healthcare:

(Slabodkin,2014) Who mentioned in his article that cloud computing is a technology that is used to provide smart healthcare. And you reduce costs so that the system is more flexible. Thus, when cooperation with cloud computing and the increase in demand for its services by health care, we have many solutions that are used for care. One of the advantages of this computerization is that it facilitates the medical staff to access patient information as well as store it at the lowest costs. Hospitals can now provide services that satisfy patients.

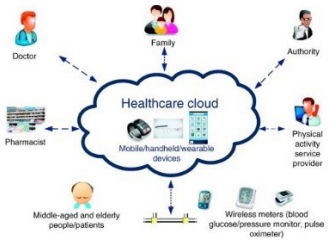

Figure 2healthcare cloud

Problems and Challenges:

It is estimated that approximately 17.5 million people die annually and worldwide from heart attacks ***(Lokshina & Lanting, 2018)***. This problem is facing heart patients in the world, and it is one of the main causes of death in the world, as it is an obstacle to work after mental illness and accidents. According to ***(Nabil Al-Shammari, 2015).***

The vast majority and the most vulnerable to heart attacks are young males in their 30s and 40s who depend on the lifestyle that individuals coexist with, such as lack of sleep, lack of exercise and fast food. Heart problems are very dangerous to the health of individuals because they happen suddenly and without any stimulation and thus lead to death.

According to ***(Al-Saadani, 2017)***, a heart attack is an interruption in the blood supply in the heart muscle and the reason for this stopping is the presence of a blood clot that prevents the passage of blood and when it occurs, the person is exposed to very serious complications and endangers his life, as such attacks occur due to atherosclerosis.

According to ***(Nausheen &Begum,218)*,** he says in the article that one of the disadvantages of the Internet of things is:

- ✓ Internet-based devices are considered one of the technologies vulnerable to malicious software, and thus health organizations can be exposed to such attacks and access to patients' personal information, and the patient loses his privacy, so they may be exposed to many problems.
- ✓ The Internet of Things is considered one of the connected networks, and when any errors occur, the network inflicts damage to all connected devices.
- ✓ Accidental failure and compatibility defects: When an error occurs in health care systems and patient monitoring based on IoT, small errors in manufacturing lead to device failure, incompatibility, and incompatibility with device developments.
- ✓ Lack of encryption: Not all Internet of things technologies contain encryption systems that are used to protect data and prevent anyone from accessing the data.

Also, one of the challenges facing heart patients is that the person does not feel high pressure, an increased heart rate, or when a blockage occurs, so the person overlooks this matter.

After accidents that endanger people's lives, it was imperative that the medical staff search for solutions and proposals that would reduce the likelihood of individuals experiencing such strokes ***(Lokshina & Lanting, 2018).*** Consequently, regular and permanent examination is required and one of the problems patients face may be the difficulty of attending appointments permanently. The costs are high, professional commitment and no knowledge of pre-stroke symptoms.

These challenges can be solved using the Internet of Things by installing sensors that monitor the patient's health status, alert him in case of danger, and send reports to his health authority.

Similar works and applications:

There are some similar applications, watches and sensors that contain the same features that are available on the market, some of them are very expensive and contain many features and are targeted to serve and save people, thus

avoiding the occurrence of risks, and others are low-cost but do not contain many advantages, they only include a pulse rate the heart.

1) Apple Watch: It is a smart watch that contains a microprocessor and sensors that it monitors the heart rate, measures pressure, counts the number of steps per day, calculates the calories burned and displays an electrocardiogram, and can call the emergency number in the event that the patient falls when sensing that danger and send notifications Attention. But these watches have disadvantages such as: the high cost of versions of the Apple Watch, and the battery life does not last for more than two days and cannot work with Wi-Fi, it only needs a connection to the Bluetooth of the phone near it, that is, it must be paired with the phone's Bluetooth. (A Khushhal, 2017)

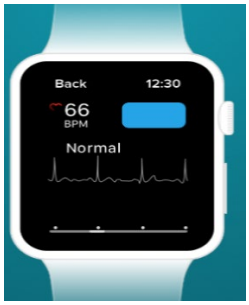

Figure 3 apple watch

2) Smart pills: It is one of the modern and advanced technologies in the world of technology and it will benefit patients and the smart pill is an electronic device with a built-in sensor feature and cameras, as well as tracking sensors, and this pill can be swallowed thus the thing is examined more accurately because the doctor follows and monitors the patient's condition in real time. Among its many advantages, but there are some factors that affect it, such as that it has a high cost and the patient's lack of knowledge of these smart technologies, so there is a lack of trust between the patient and the doctor.

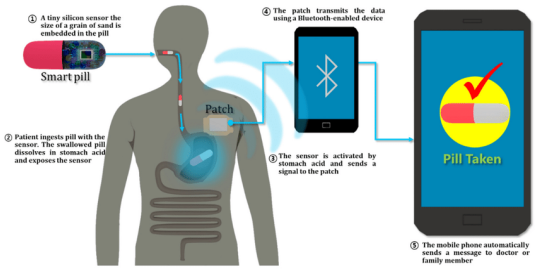

Figure 4 smart pills

3) Holter device: : It is a device that an individual can wear to track the heartbeat and electrical activity of the heart, and record it for a day or two, and it is tied as a belt on one of the shoulders. (Guillermo, 2006) It should be carried for 24-72 hours and sometimes the results are very inaccurate.

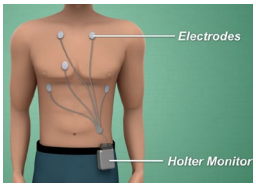

Figure 5Holter device

Use of the Internet of things for health care:

- ✓ **Monitor the patient remotely or in real time:** Many people suffer from chronic diseases that make them frequent appointments. As it is real-time monitoring, it is one of the systems that benefit heart and diabetic patients, and the patient must carry these devices or wear them, which alert them in the event of any malfunction. ***(Darshan& Anandakumar,2015)***
- ✓ **Wearable devices:** They are devices that patients wear daily, which are like bracelets and bands, which are used to calculate heart rate and blood pressure. These tools are used to monitor the patient's condition, especially for the elderly, and calculate calories. These devices notify family members in the event of any developments or change in the patient's condition.
- ✓ **Hospital administration:** by using the Internet of things, the quality of performance is improved, and costs and equipment that are lost and stolen are reduced, leading to wasted money. Therefore, there are solutions by tracking the location of the sensors and by Bluetooth and RFID. ***(Darshan& Anandakumar,2015)***

Advantages of using the Internet of things in health care:

- **Less expenses:** By using smart tools that can monitor and track the patient's condition, it has become easier for the doctor to follow the true condition of patients remotely and in real time, thus reducing patients 'visits to the hospital and reducing the cost. ***(Nausheen& Begum,2018)***

- ✓ **Effective results, the treatment:** using smart technologies, cloud computing, and connecting devices between the patient and the doctor. Therefore, using health systems based on the Internet of things, medical analysis and intervention are done in a timely manner, thus making smart care and better results.
- **Detection and control of disease**: When using smart technologies and due to periodic updates of data, the doctor can discover any diseases and thus seek to find appropriate solutions quickly. ***(Nausheen& Begum,2018)***
- ✓ **The patient's trust in the doctor:** the more communication between the doctor and the patient becomes, the more mutual trust between them becomes.

Figure 6 advantage of smart healthcare

literature summary:

After delving into and carefully searching for information and problems that occur in the medical field and internationally, I found some solutions that had been previously proposed and compared it with the solution that I suggested from Gantt, the advantages, prices, and its function. Because these literary reviews helped me that the idea became clear, and I have many evidences. I learned about the sensors that serve the category of heart patients, as well as targeted Internet systems of things, how they can serve the community and how they work.

Methodology:

The methodology is one of the most essential tasks in any project and aims to help the stakeholders and managers to achieve the goals with high quality and less risks. The methodology is a set of techniques, processes and phases that are used to complete the tasks of the project. Thus, it reduces time and effort and works on managing and distributing tasks among employees. Therefore, the project manager is the person responsible for choosing the

methodologies, and it must be a strong, effective, and appropriate methodology for the type of project

Waterfall modification methodology:

This methodology has been used to correct the flaws facing the Waterfall methodology, and this modified version provides the possibility of overlapping these steps in an effective and flexible manner in the process.

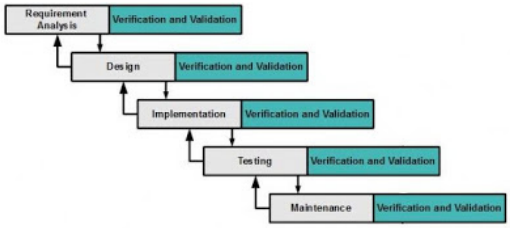

Figure 7 waterfall modification

Advantages of Waterfall modification methodology:

1. It is considered elastic from the pure waterfall model.

2. Documentation may be reduced.

3. Easy to implement and reduces potential issues.

Disadvantages of Waterfall modification methodology:

1. It is more mysterious than the pure waterfall.

2. Assumptions that are wrong due to misunderstanding that may occur because people are working at the same time in different steps.

The appropriate methodology for developing smart loop for heart patients is: The modified waterfall methodology because it is characterized by the pure waterfall methodology with flexibility and gives developers the possibility to overlap tasks when needed and thus it is possible to change the sequence to finish the tasks. The overlap required in this project based developments which based on human body reaction to the smart system .Therefore, when there is a possibility of overlapping tasks, it gives individuals the ability to modify tasks in the project and work on several tasks at the same time without facing problems, and this makes us skip this project without facing problems due to the flexibility of the modified waterfall methodology, and the project can integrate a number of stages with different times.

1) Easy to handle and implement

2) No experience required

3) Suitable implementation prices for initial projects

4) More freedom and flexibility to move between project tasks

Proposed solution:

People lose their lives due to sudden attacks, and these heart attacks occur when there is a blockage in the arteries, and thus there is a blockage in the movement of blood to the heart. A suggested solution for detecting heart attacks was to design a loop that would be attached to an artery leaving the heart so that it senses the presence of a blood clot and alerts the patient. There will be sensors to measure pressure and monitor heart rate, so the use of the Internet of Things is one of the mechanisms for sharing patient information with hospital systems.

This proposed system will serve patients and detect if any seizures are occurring, and thus avoid them with the help of heart rate sensors, which depend on the Internet. This method uses the Arduino board as well as the Wi-Fi modules, so after setting this system up, the pulse sensor will start reading the heart rate, as well as measuring blood pressure, and when you notice a drop in the heart rate so that we feel the presence of a heart attack, and by using the Wi-Fi module , The data will be transferred over the Internet and appear in a main panel through which the patient's condition can be monitored and her medical condition can be compared to this installed ring. It is also part of this project that I implement an app in the device that aims to monitor blood pressure measurement, ECG, and heart rate tracking.

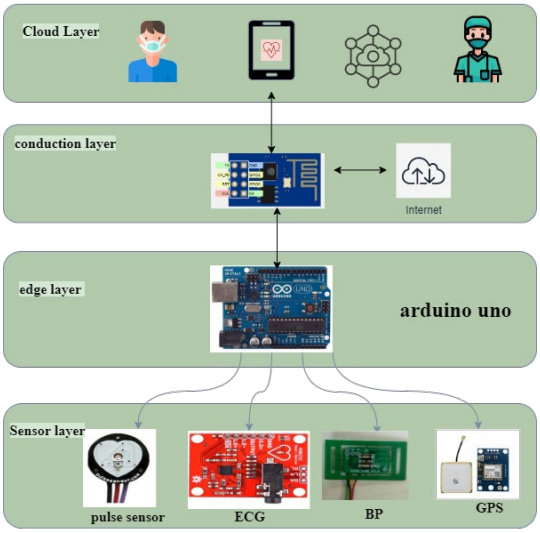

Figure 8 logical design of propused system

Discussion

This project is effective for heart patients because it is dedicated not only to stroke emergencies, and it is one of the smart ranges that includes several functions at the same time. It is possible for this device to gain acceptance from heart patients because with the help of this device it is possible to overcome the problems that occur suddenly and without warning and thus save the souls of the patients. Likewise, this project will be more effective and efficient because it will be linked to the health sector directly, so that the health status of patients will be monitored, as well as there will be site determination if the patient does not respond to treatment, then rapid intervention will take place.

Results

By reading and looking at research, I concluded that health care has evolved as it was a wearable sensor, but now it also supports a sensor implant system to monitor patients more accurately and thus predict something before it happens. These sensor techniques have contributed to preserving the health of patients who suffer from Chronic diseases and sustainable health care.

Heart patients suffer from several problems such as clogged arteries, high blood pressure and high heart rate, which is one of the causes of heart attacks, which are sudden and occur quickly without the presence of any symptoms or previous warnings and may lead to death in the absence of rapid treatment intervention for these patients.

The project aims to design episodes that solve the problems facing heart patients linked to a program that is in the phone equipped with a pressure measurement, heart rate and also an electrocardiogram, and is linked connected to the patient's file number in the hospital files, and this data is sent periodically throughout the day.

Conclusion

At the end of this research, the idea of developing a smart ring that benefits heart patients, which will contribute to the development of health care based on the Internet, is proposed, and aims at the work of a group of counselors that remotely monitor the patient and ensure his health. As this technology has become important and can be worn easily and works to measure vital signs and in the event that symptoms of a heart attack appear, a notification will be sent to the doctor through the application, thus intervening quickly and maintaining the safety of the patient and thus life will be healthy and productive.

Limitations

The project will face some challenges, such as bringing accurate and very sensitive sensors dedicated to heart patients, and they are provided upon pre-order from the countries that manufacture them and are delayed due to shipping operations and sometimes they arrive damaged due to bad shipping. Also, the programs that are used in some sensors, such as Arduino, need knowledge of the coding language. The size of the sensor must be very accurate and suitable to be installed in the arteries, which is very difficult, and the other ring must be accurate, but with a space to store the medicine.

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