Low-cost system for the management of hospital services, applied to hospitalized patients through the use of IoT technology

Wilver Auccahuasi[a], Christian Ovalle[b], Zoila Ayvar[c], Justiniano Aybar[d], Rubén Quispe[e], Amaury Farfan[f], Angel Tongo[g], Luis Romero[h], Edwin Felix[i] and Denny Lovera[j]

[abcdefghij] *Universidad Continental, Huancayo, Perú*

Abstract

IoT technology is making a strong foray into all work areas, the health sector is not the exception, for this reason many applications are presented more frequently giving solutions to complex problems, thanks to technology a lot of sensitive information is being created that previous years did not It was thought that it could occur, one of them is the creation of databases of medical information, with which applications can be developed based on the exploitation of these data, another type of application is related to the location of certain devices with The intention of locating them in real time, based on this application in this work a methodology is developed to be able to monitor in real time patients admitted to health centers, knowing if they are in their room, also knowing if the patient needs any help with which the nurse on duty can approach to provide assistance. The methodology presents the use of low-cost devices that allow the implementation of IoT solutions, being able to connect 3 rooms through an application developed in LabView that allows knowing the current status of patients, their location and if you need any help, the application can be adaptable to different needs and scalable according to new requirements, it is necessary to indicate that you must have a Wi-Fi connection so that all IoT devices can share the same connection and web services.

Keywords 1
IoT, healthcare facility, patient, web service, application.

1. Introduction

Hospital services are essentially important in a health center, one of the most important areas is the hospitalization service, which allows monitoring patients who are hospitalized, through the use of IoT technology, making a review of the literature We found work related to the treatment of related inpatients in hospital centers where they carry out medical and nursing practices, where they supervise hospitalized patients based on frequent visits, both for medical indications and for the supply of medicine through the nurses [1].

We also find jobs related to monitoring patients at home based on IoT technology, cloud computing, the proposal proposes to remotely monitor, through a mobile application where the patient's vital signs are displayed and create the medical report, the system It also has a mobile phone to monitor the environmental status of the ward and its state of health and to be able to provide provisions to the nurse about care, patients and relatives along with an application for relatives that allows them to know how the hospitalization process is going, the environment Hospitalization must be adequate, however, for home hospitalization, certain limits must be in place to minimize the risk

for the patient and can even be fatal, for which it is necessary to monitor the environment such as temperature and humidity detection, leak detection gas, and smoke detection, both of which connect to the unit for vital sign detection through the hardware MySignals HW V2 Platform which is a development platform for ehealth applications [2].

The use of health technologies is of utmost importance and its application depends on how the perception of how much it helps in the treatment of patients is used, it is demonstrated with the skills for its exploitation by health personnel, for This is why studies are carried out regarding the perception of its use and as an aid in the treatment of patients, there are studies on knowing and understanding this perception, in this area we find works where a self-reported questionnaire was carried out on the use of IoT technology by of nurses, a survey has been chosen, which has been created by a multidisciplinary team composed of nurses, computer scientists, for which a prior review of the IOT literature was made, from which 15 elements on patient safety were obtained, work efficiency and hospital environment [3].

The use of information and communication technologies is greatly influencing hardware development. For this reason, we find many solutions in the market, which depend on the application and uses, we find jobs where a matrix of various sensors is used, which are connected on a WIFI communication board for the transmission of data to an internet server, The solution allows integrating many technologies thanks to the different communication ports provided by the embedded cards, the use of these cards allows the design of low-cost solutions, one of the fundamental characteristics of the solution is the integration of a real-time system to have direct access to the devices, allowing the solution to be portable, the solution allows subsequent data analysis by exporting in csv format, which can be analyzed with tools such as Matlab, Octave or Python, among others [4].

With the information that can be obtained through the use of IoT technology, many applications can be implemented in data processing, such as the analysis of cardiac signals related to classifying acute myocardial infarction, which will be carried out with the data obtained. which is divided into two groups, the first for training and the second for tests, many of the data that are needed to carry out these applications are obtained thanks to the IoT systems that are collecting data at all times, many of these applications are related to the health area, where the influence of artificial intelligence is gaining importance and is constantly growing [5].

In the present work, he proposes a methodology for the use of low-cost devices, to be able to monitor patients admitted to hospitalization services, who require attention from nurses and nurses also need to know the presence of their patients.

2. Materials and Methods

In the approach to the methodology for monitoring the energy and consumption of servers in a data center, it is necessary to implement certain steps to be able to implement an IoT-based solution, the detail is described below:

Figure 1: Block diagram of the proposed methodology.

In Figure 1, the steps that were used to develop the methodology are presented, these steps consist of the definition of the problem, going through a choice of hardware that can solve the problem and finally closes with the design of a visualization mechanism of the values to be able to monitor.

2.1. Review of Requirements

To demonstrate the methodology, we resort to a hospital center, where we identify their needs, where a decrease in direct contact with patients is required, due to the effect of the COVID-19 pandemic, in this sense it is necessary to know if the patient is In their room and even more so in their room, it is also necessary that patients present some need, they can communicate to the nurses' station so that they can assist them, as a requirement of this analysis, the proposal proposes to monitor 3 patient rooms.

Figure 2: Hospitalization room.

In image 2, you can see a room of the hospital center, it is necessary to know the physical location of the patient, as well as if the patient requires attention, he can call the nurses station, in the room the IoT device will be placed, with direct access to the patient for direct manipulation.

A second very important requirement is the nursing station, one of the main areas is to attend to patients who are admitted to their respective services, in a normal situation the nurses carry out rounds with established frequencies, to verify the location of your patients, as well as identifying patients when they need some help.
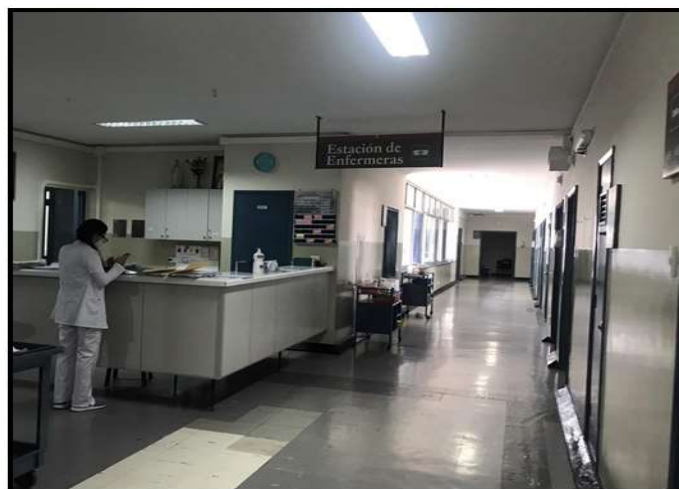
Figure 3: Nurse Station.

In figure 3, the nurses' station is presented, in the image we can identify the use of personal protection masks, due to the care with COVID-19, in this sense a maximum control with the patients is required, with the maximum protection for the health of health personnel, in this sense IoT technology, allows meeting these two requirements and satisfying both needs.

3. Choice of Hardware

For the choice of hardware, a low-cost device is used that has the functionality of being able to connect to a wireless network, where the physical location of the device can be known, the hardware also has an emergency button to send an alarm with these hardware characteristics, the final application solution is dimensioned. The characteristics of the chosen hardware are presented below.

- Conexión Wifi.
- Botón de emergencia.
- Integración IoT.
- Bajo costo.

Figure 4: IOT device.

In figure 3, the chosen hardware is presented, it can be seen that it is shaped like a keychain, it is small, practical, easy to use, cleaning and disinfection, appropriate for these moments of pandemic caused by COVID-19.

4. Display panel design

In the development of the methodology, the last component is dedicated to the visualization of the data, the IoT technology allows the connectivity between different devices and to be able to store the data for future exploitation, in this concept the methodology proposes the development of an application dedicated to solving the problem by viewing the required data. In the development, an application was designed in LabView that exploits the connection data of the IoT device, in such a way that the application connects to the same Wi-Fi network, in such a way that it can connect with the device. The requirement is to be able to monitor 3 patients installed in their rooms, in such a way that the nurses who are located in their station can monitor their patients, in figure 5, the developed application is presented.
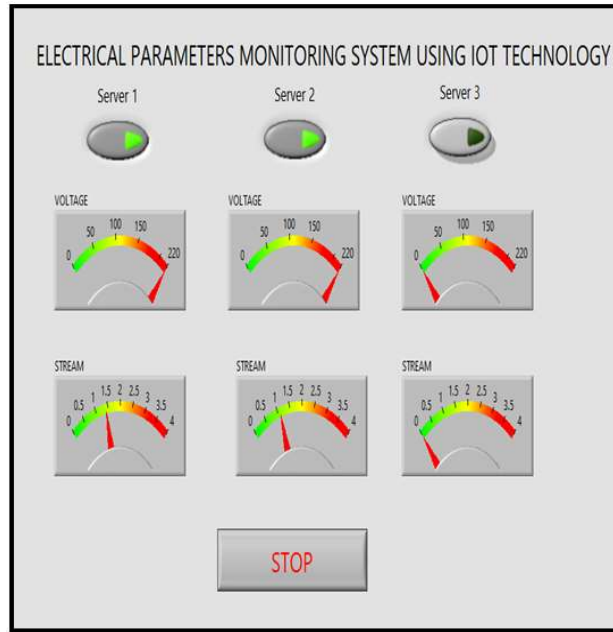
Figure 5: Display panel APP.

5. Results

The results of the research are presented related to the implementation diagram, where the different components described above can be seen, for their implementation and scaling, in general it can be indicated that the methodology is easy to install and low cost, with applications that cause great impact and use by health personnel, taking care of COVID-19 infections, therefore one of the requirements is to be able to minimize interaction with patients, in this sense IoT technology allows the minimum interaction of the patient with health personnel.
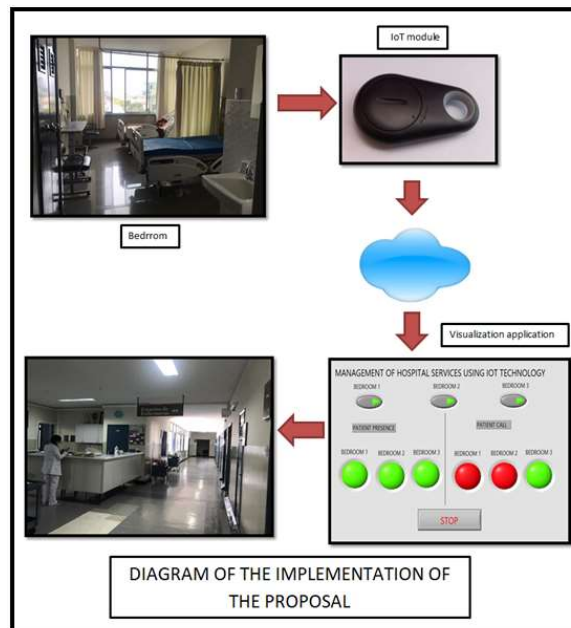

Figure 6: Diagram of the implementation.

6. Conclusions

Information and communication technologies are being used in most areas, the health sector is one of the areas where technology is focused on being able to solve problems that previous years were almost impossible to solve, one of them is connectivity and real-time monitoring of patients, where they are at all times, if they need any help, but without the need to go to their rooms. IoT technology is allowing to obtain a lot of clinical information, thanks to the use of electronic devices that have the ability to capture signals and upload them to web services, through a Wi-Fi connection, it also presents many computational tools capable of exploiting the information captured and stored in web services, developing application to view information in real time, statistical analysis of the information, among others. The use of the LabView software allows the personalized development of the application, as well as the possibility of being able to scale, it is recommended for future applications to first consider the needs or requirements, then analyze between the different hardware options that can satisfy the needs and finally the design. of an application that can be interpreted by users. In health care caused by COVID-19, minimal patient-doctor interaction is important and thanks to IoT technology this goal is achieved with low-cost hardware.

7. References

[1] Bodur, G., Gumus, S., & Gursoy, N. G. (2019). Perceptions of Turkish health professional students toward the effects of the internet of things (IOT) technology in the future. Nurse Education Today, 79, 98–104. https://doi.org/10.1016/j.nedt.2019.05.007

[2] Ben Hassen, H., Ayari, N., & Hamdi, B. (2020). A home hospitalization system based on the Internet of things, Fog computing and cloud computing. Informatics in Medicine Unlocked, 20. https://doi.org/10.1016/j.imu.2020.100368

[3] Kang, S., Baek, H., Jung, E., Hwang, H., & Yoo, S. (2019). Survey on the demand for adoption of Internet of Things (IoT)-based services in hospitals: Investigation of nurses' perception in a tertiary university hospital. Applied Nursing Research, 47, 18–23. https://doi.org/10.1016/j.apnr.2019.03.005

[4] Li, B., Dong, Q., Downen, R. S., Tran, N., Jackson, J. H., Pillai, D., … Li, Z. (2019). A wearable IoT aldehyde sensor for pediatric asthma research and management. Sensors and Actuators, B: Chemical, 287, 584–594. https://doi.org/10.1016/j.snb.2019.02.077

[5] Zhao, Y., & Zhu, X. (2020). Design of Hospital IoT System and Drug Intervention in Patients with Acute Myocardial Infarction. Microprocessors and Microsystems, 103662. https://doi.org/10.1016/j.micpro.2020.103662