Methodology for the development of technological solutions, based on heterogeneous communication protocols: IOT + RFID

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Abstract

Currently with the development of technology, we can find a number of devices with different communication and connectivity technologies, which can be used for different applications. We can find devices that can be connected through wireless networks using protocols such as WIFI, Bluetooth, RF, among others, that allow information to be sent and received. We also find devices that are used to store relevant and important information and that is always available such as RFID. In an analysis to evaluate the strategy in solving problems, we can find different ways to use these devices working individually, the complexity of the solution grows increasing the level of complexity, if you decide to integrate different communication protocols with the intention to have a more robust solution that allows the integration of different technologies. In this paper we present a methodology to be able to propose solutions based on the use of different communication technologies, in order to find a sequence of steps necessary for choosing the right hardware as well as its final integration. The results are presented through a sequence of steps for the implementation of the methodology with the use of IOT and RFID technologies, as well as the description of the frame for sending packets between the different devices, the methodology is easy to implement as well as be scalable.

Keywords 1

IOT, Serial communication, RFID, Protocol, connection, data.

1. Introduction

Making a review of the literature, we found works related to determining the advantages in the use of RFID technology in helping robots to navigate for use in hospitals, with the intention of automating certain processes in the location and identification of patients to provide the services [1]. RFID technology is commonly used in many industrial processes, as a mechanism for identifying equipment and products among others, in order to automate processes, it is important to indicate that these automated systems require truthful and accurate information, RFID technology provides us with these characteristics, used in the pharmaceutical industry for the storage and storage of drugs [2]. Due to the effects of the pandemic caused by COVID-19, there are problems related to the decrease in physical contact between health personnel and patients, as a communication mechanism the IOT technology is presented in order to identify people as well how to analyze the data that is generated [3]. The name that is currently being used is the IoMT, which is constituted in the use of IOT technology applied to health issues [4]. Many applications dedicated to exploiting the data generated by COVID-19, are stored for later exploitation, these variables such as temperature, oxygen saturation, heart rate, blood pressure, among others, can be captured and stored thanks to the IOT technology [5] [6]. The pandemic is causing many of the processes related to the medical sector to be in the process of digitization, in order to have less and less face-to-face relationship between the various sections of a

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hospital center with patients, for this reason many related solutions arise to patients, diseases, medications among others [7]. In the process of knowing in what state the patients are in relation to the state of contagion by COVID-19, solutions are presented based on identifying the patients according to their level of contagion and the process that is, through the use of RFID technology analyzing data through the use of artificial intelligence techniques [8]. Know how technology is being coupled more frequently in most actions and processes, thanks to IOT technology this integration can be achieved, we find applications where it integrates IOT, Virtual Reality, Blockchain among others with the aim of enhancing the use of data that are available and can be exploited [9]. The use of technology is causing influence among the different professionals, we also find works related to being able to identify how these technologies are causing an impact in different areas, asking about the level of knowledge of the technology, the ability to interact and future applications [10]. In the present work we find a methodology how we can integrate IOT technologies with RFID so that it can be replicated in the solution of problems where the identification and availability of information is required.

2. Materials and Methods

The proposed methodology allows establishing a direct relationship between the problem that can be found and the solution that is being applied, based on the use of a technology that is available. In figure 1, the procedures to be carried out are presented based on the analysis of the technical details that we can indicate about some of the IOT RFID devices that we can have available, then a method is presented to analyze how these two technologies can be integrated, as well as the presentation of how to transfer the data of each one and finally in the third procedure it is proposed how to integrate both technologies in a final application, then each of the aforementioned procedures is developed:

Figure 1: Block diagram of the proposed methodology.

2.1. Study of available technologies and their protocol of use

In the analysis to be able to solve problems in the area of technology, the first thing that we must consider, depending on the problem, are the future electronic components to be used, in this sense the choice of the appropriate device differentiates the success of the solution, the methodology that is proposed is characterized by evaluating each of the components and analyzing their technical characteristics, in figure 2 the flow diagram for choosing the appropriate device to solve the problem is presented.

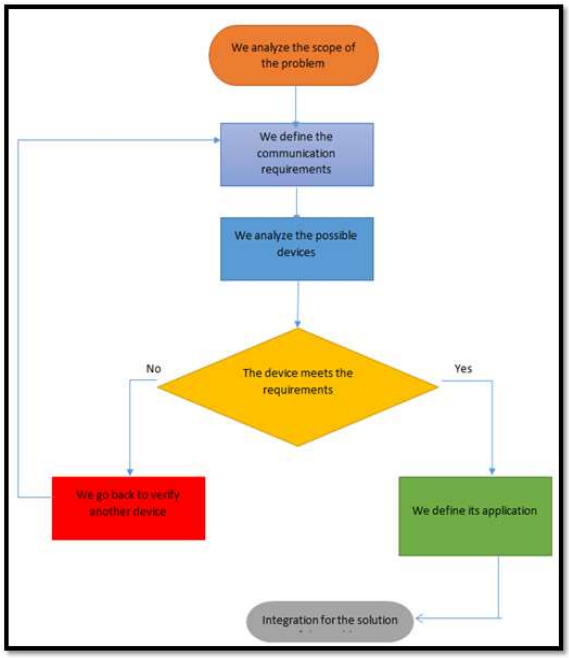

Figure 2: Flow chart for choosing the right device.

Below we describe the pseudo-code of the flow diagram, for the choice of the appropriate device:

- Analysis of the problem, indicating the physical phenomenon to be used.
- Having identified the way in which we will record the physical phenomenon, we proceed to describe what electronic components we can use, with emphasis on the communication protocol that it has in order to be able to export the data.
- We ask if the selected device acquires the signal and can be exported, using a protocol that we can handle.
- If the answer is positive, we proceed to the selection of the device and analyze how to integrate the final application.
- If the answer is negative, we proceed to discard the device and analyze the next device on the list.

2.2. Analysis for the integration of technologies

Having the selected devices, we carry out the analysis of each one of them in order to know their technical details and how to make an integration between all the selected components, a consideration that we can indicate, that up to this point, only the devices were selected, in this step we will analyze if it can be compatible between them, the final selection of the devices depends on the analysis of the technical characteristics of each device. Next, we present the detail of the devices that we can use, explaining the technical details of each one.

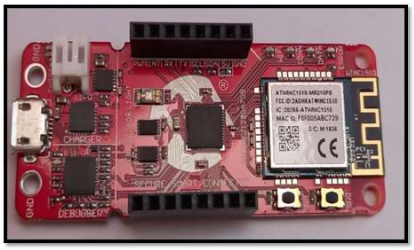

Figure 3: Image of IOT device.

In figure 3, we present the module dedicated to IOT communication where we can register different types of signals and we can upload them to a web server for later exploitation, its technical details are:

- **WIFI communication**
- Direct communication with Google
- Encryption Capability
- Sensor reading per analog channel
- Applicable MQTT protocol

A second electronic device is the one presented in figure 4, which is used for identification by geolocation, so that it can be used to its maximum capacity it must be connected to a wireless network.

Figure 4: Image of an IOT-based location device.

- **WIFI communication**
- It has the geolocation functionality
- It has a low consumption battery

A third device that we can find, is related to being able to control the power supply, by interrupting the power supply, these devices are known as an intelligent switch, in figure 5, it can be seen.

- **WIFI communication**
- Has the fast switching functionality
- 3 amp current limit

Figure 5: Image of the device known as an IOT-based smart switch.

A fourth device is related to RFID technology, where information can be stored and retrieved, it requires a reading and recording device, it has the particularity of having a unique identification number, which makes it ideal for applications where it is required. have order, location and identification.

Figure 6: Image of the device known as an RFID reader card.

- **WIFI communication (adapter)**
- It has the functionality of storing information
- It has a unique identifier

2.3. Methodology solution proposal

After having evaluated each of the components, we present a connectivity architecture, where all the aforementioned devices can be used, in order to be able to share resources and characteristics in order to be used in different applications.

In figure 7, we can see the connections of the 4 devices, each one has an application that differentiates them from each one, with the IOT location device we can identify multiple objects in real time, these can be static or dynamic, with the device Known as smart swich we can control different equipment, with the RFID unit we can store information and that it is available, all data can be stored on a web server and with this we can access the information at any time and from anywhere, this functionality is achieved thanks to Microchip's IoT module. The 4 devices described above can be integrated into a single application thanks to the fact that the 4 have a common characteristic that is the WIFI connection, with which the 4 devices are connected to the same network and with this we manage to share their resources for a specific application.

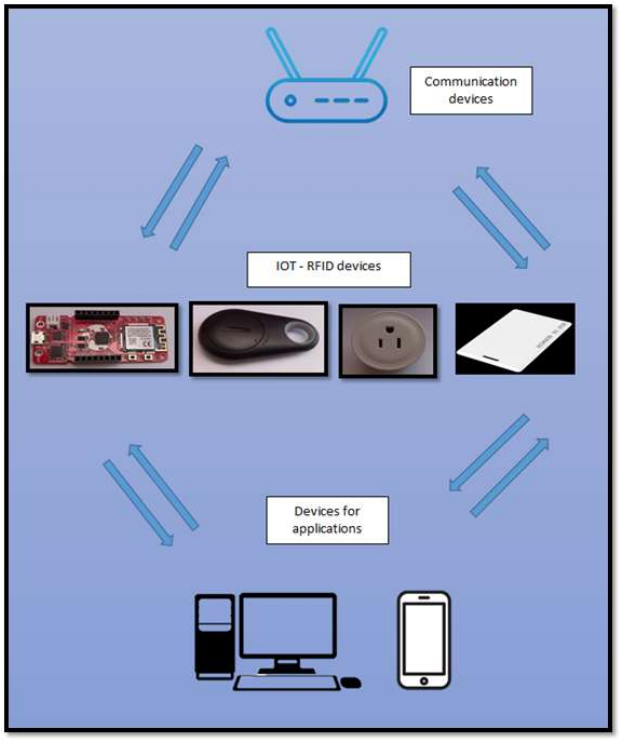

Figure 7: Image of the connectivity proposal with the available devices.

3. Results

The results that we present are related to being able to identify the technical characteristics of the different devices that we find in the market, mainly those that can connect with wireless networks for the transfer of information, to share resources and to be stored, with which we can solve two specific problems:

- First we solve a technology compatibility problem, managing to connect different devices through a common feature that is connectivity via WIFI.
- We present a methodology where it can be replicated and scalable to be able to solve different problems related to connectivity and interoperability between devices.

The results help to strengthen the technical knowledge on connectivity and to be able to use modern techniques such as IOT and RFID and the way how these can coexist in an application where it can be integrated by multiple additional sensors, which can be installed in the IOT module, so that the information of the different sensors that can be added to the solution and can be stored in a web server, we can design a data package that can be integrated into the IOT module so that it can be sent through the MQTT protocol, this data package is conditioned by the serial communication protocol that supports the IOT module.

4. Conclusions

The conclusions that we can indicate at the end of the tests and functionalities, is that as technology advances, new communication protocols emerge with increasingly better performance, it is important to indicate that in the face of this problem, it is difficult to be able to change all the devices that are counted as installed capacity, when you have a new technology, in this sense in many applications we must see the possibilities that many devices of different technologies can coexist in a single application, therefore the methodology also allows the ability to balance the workload, where each component develops its own work for which it was designed.

Finally, we can conclude that in the analysis of the program, looking for a solution, not always the sensor with the highest cost, the brand, can solve it, we can find economic devices that can be used in complex solutions, everything will depend on the technical characteristics of the devices, for our particular case, where we describe the characteristics of the IOT components such as RFID, we can indicate that they are economical and can be applied to solve real world problems.

The conclusions reached at the end of the research, where we can indicate that in terms of industrial automation, connectivity is very important and modular in the integration of systems and with it the possibility of scaling, reviewing the activities carried out.

In the process of verification of the methodology, we can define and conclude that an important factor, which is connectivity to a wireless network, this can be in the same network or in another network, this requirement is very important, when identifying the proper devices connectivity is very important.

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