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Vehicle Anti-Theft Back-Up System using RFID Implant Technology

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Abstract— Since the creation of the vehicles, they have been very well received by the world market. However, this has caused some individuals to try to obtain them illegally. Likewise, several security systems were created to avoid this type of actions such as the location of the vehicle. However, these security systems were prevented by blocking the signals emitted by these devices, which increased the rate of attacks of this type. In this sense, the present research project implements the Radio Frequency Identification (RFID) implant technology, which is already being used in several applications worldwide thanks to its adaptability and low acquisition budget. The objective of this project is the implementation of this technology as a backup means to prevent the vehicle from being mobilized while the owner is not inside the vehicle or to keep it running when it is forcibly removed from the vehicle. The purpose of this implementation is to reduce the number of people who are victims of vehicle theft in the Lima-Metropolitan district, which has seen a high rate of theft in recent years.

Keywords— Arduino; Global Positioning System (GPS); RFID implant; RFID reader.

I. INTRODUCTION

Over the years, the automobile has had a significant industrial growth due to the large number of vehicles manufactured; thus, in India the number of vehicles has risen to 100 million with a projection of 450 million by 2020 and in the United States (U.S.) the number of vehicles is greater than the number of drivers with a driver's license [1]. However, the increase in the number of vehicles has brought with it an increase in the criminal activity of vehicle theft, even those with specialized security systems have not been able to reduce the percentage of vehicle theft [2].

In fact, the rate of vehicle theft increased by 27.5% from January to June 2017 in Mexico [3]. However, the situation does not have a different picture in our country as the percentage of vehicle theft increased from 3% to 24% between the years 2017 to 2019 in the department of Lima being these official figures provided by the National Institute of Statistics and Informatics (INEI) [4]. Even, those vehicles that have anti-theft systems of vehicles with GPS location technology, since the gangs that carried out these thefts had a blocking system for GPS signals with which the theft of several units was facilitated [5].

Taking into account the problems of a system that applies GPS signals as mentioned in the previous paragraph, systems have been developed that have added RFID technologies as a means of authentication, since they provide an increase in the accuracy and efficiency of the system [2]. In this sense, RFID is a technology that is not only being applied in security systems but also in wireless applications for traceability, logistics, access control, payment, passports, car keys, etc., the versatility of its use added to a low cost in its production make it a very useful tool in the creation of new projects [6].

Likewise, this technology has been implemented in Barcelona so that those who have an RFID chip implant can make payments through them [7]. Taking into account the versatility of this technology which is not only implemented in the payment of products, but it is also used in security, tracking, identification and health issues, hence, these can provide ease when extracting information from its users [7]. Now, this versatility can be combined with the control capacity of the Arduino Mega 2560 device, which has been used in the creation of similar systems in vehicle security [8].

Therefore, considering the aforementioned information, a project was developed in which these technologies are combined in the development of an anti-theft system for vehicles which is activated by means of an RFID implant [2], [8]. It has been developed with the purpose of reducing the percentage of people who are victims of vehicle theft in the department of Lima - Peru.

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This project was developed through the use of RFID implants which have been selected according to the characteristics of frequency and distance for the proper functioning of the project [6]. In the same way the Arduino device was used thanks to its open-source libraries and its versatility in detecting the actions of the sensors [9].

II. METHODOLOGY

In this section we discuss in detail all those methodologies, tools and devices that have been used during the development of this research project, which are an important part for the fulfillment of the previously stated purpose. In this sense, we detail the following:

A. *Flow Diagram*

Before starting with the development of our research project, an analysis of the scenarios in which it should work was developed, in this sense, these have been captured in flowcharts for better understanding and comprehension of the readers.

Taking into account the above mentioned the first scenario of action of our system is when you want to start the vehicle, Figure I detail the way in which the system works detecting if the chip is inside the vehicle and then identify it, otherwise the system blocks the electric fluid which leads to the engine shutdown, this process will be detailed later in the research.

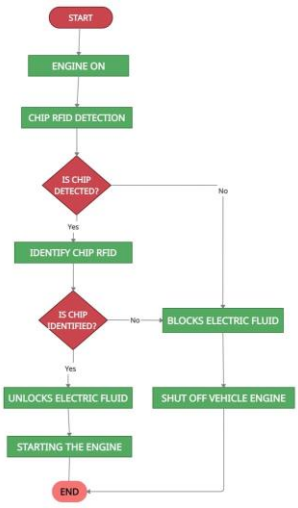

Figure I Engine ignition

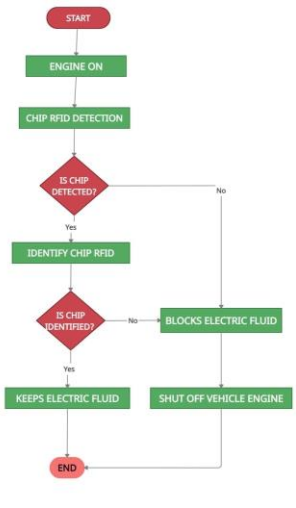

Figure II Engine shutdown.

The second scenario in which the system works is when the vehicle is already with the engine running in Figure II the Chip detection system is triggered immediately after making contact with the vehicle key. Then, the identification of this RFID Chip is performed in order to unblock the fluid that allows the engine to start.

B. *Hardware implementation*

In this section we address the physical part of our research project (hardware) identifying the components that will allow the correct operation of the project and briefly detailing the technologies addressed.

1) *Physical diagram*

In this section it is shown how the different electronic devices were implemented in Figure III you can see the vehicle ignition key which activates the Arduino device, then it performs through the RFID reader the detection and identification of the RFID implant, then proceeds to unlock the passage of electric fluid for the ignition of the vehicle engine.

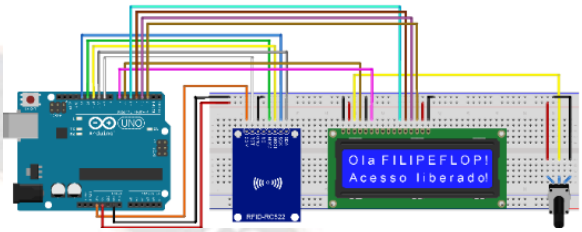

Figura III Vehicle anti-theft system with RFID reader.

2) *Arduino*

This device has been used for its ability to receive information from the various sensors and devices that are connected to it, in addition, it is responsible for processing this information to perform the activation or deactivation of these devices according to the commands that have been previously programmed [8].

3) *RFID reader*

The RFID reader consists of a high frequency module that covers two functions: transmitting and receiving information, a control unit and a coupling section [7]. Figure IV shows a circuit in which this device is used in conjunction with an Arduino.

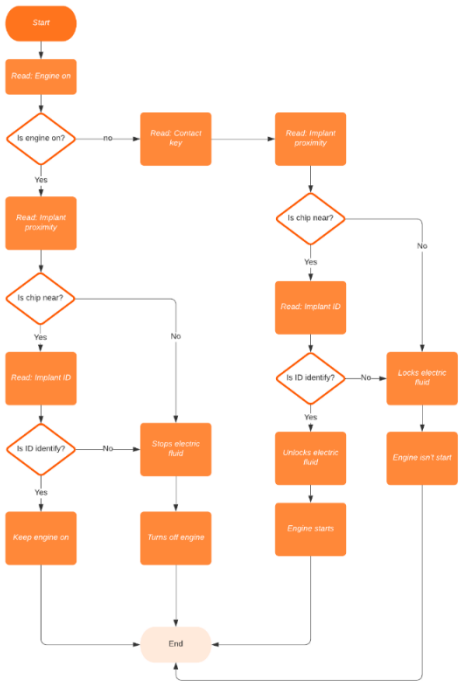

Figura VIII Pseudocode flowchart.

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The RFID chip technology was used because they are already part of hospital and industrial systems due to the fact that they have the particularity of being able to contain a variety of information about the user in a device the size of a grain of rice in order to allow actions such as activation of circuits or electronic devices [7].

In addition, using the far field this device has the ability to be used up to distances of 25 meters by using UHF or microwave antennas for detection [6].

C. Software implementation

In this section we address the software technologies that have been implemented during the development of our research project.

1) Arduino IDE

This is a technological tool through which we can develop the code that will be entered into our Arduino device, in this sense, this tool is used to capture the pseudocode that allows the different actions between the sensors and the Arduino [10].

2) C++ Lenguage

For the Arduino device to know what actions to perform, it must have a set of instructions that tell it to do so, hence, a simplified C++ language is used to easily capture the structure of the pseudocode [10].

3) Pseudocode

This is the structure of code instructions that is introduced in the Arduino to perform various actions according to the information provided by the sensors that have connector [1]. In this sense, Figure V shows the flowchart that was developed for the management of each of the situations in which the system must make a decision and perform a process.

III. RESULTS

In this section of the research, we present all the results that have been obtained through the development of the research. Next, the results of the cases in which the system is activated will be explained in detail.

A. Forced starting of the vehicle

As for the forced ignition of the vehicle, it was taken into account that the vehicle's engine is turned off. Then, the person who tries to start the vehicle without the RFID implant will activate the vehicle's power supply by means of the key, which starts the RFID detection system.

When the RFID detection system is activated, it starts detecting the implant as shown in Figure VI within a certain radius of 25 meters maximum. If the implant is not found within this distance, the system blocks the electric fluid that allows the ignition of the vehicle, thus preventing the ignition of the vehicle.

B. Vehicle Lockout

As soon as the vehicle is already started the system maintains a constant state of monitoring the proximity of the owner. As soon as the owner is forced to leave the vehicle, the system will continue with the detection of the owner's implant, in this sense, while the vehicle starts its journey, the implant will leave the reading range and the system will stop detecting it and proceed to block the electric fluid that allows the operation of the engine.

Figure VII shows that the driver of the vehicle has been left behind the vehicle while it has traveled a certain distance. Once the limit was reached at which the RFID reader can detect the implant, the system proceeded to block the electric fluid of the engine and the vehicle proceeded to stop. This prevents the vehicle from being started by anyone other than the owner and holder of the implant, thus avoiding the criminal act of stealing the vehicle.

C. Survey analysis

After completing the development of this research project, a survey was conducted among 73 people in order to obtain information about the criminal situation faced by the public, their opinion about the current vehicle security systems, and the level of information available on the subject of RFID technology.

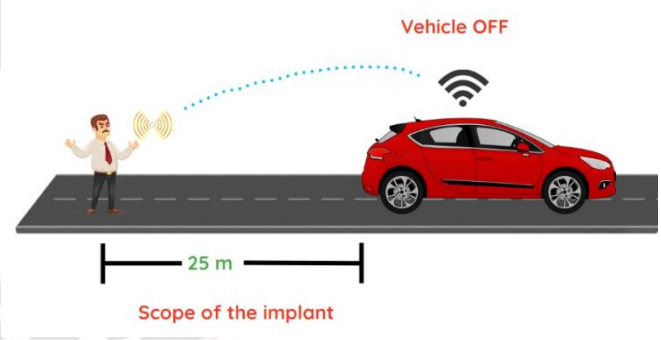

Figure IVII Locking of the vehicle.

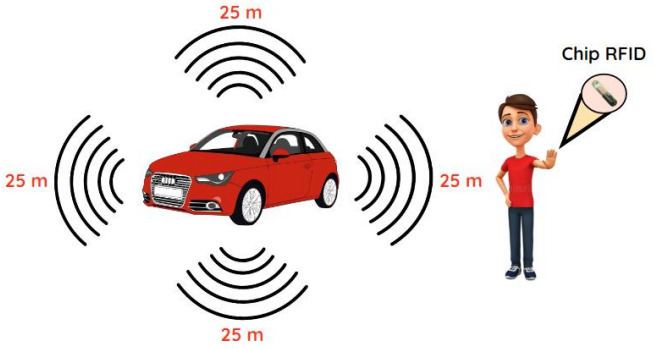

Figure VIV RFID detection range.

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In this sense, the surveyed public was asked if they or any person in their environment has been a victim of vehicle theft in the last three (03) years, which as shown in Figure VIII, the rate of vehicle theft situations is 47.9%, which shows that vehicle theft is a problem that affects a large part of the population.

The question was then asked whether the public surveyed had knowledge of vehicle security systems that use GPS technology. Figure IX shows that a large part of the public (69.9%) is aware of this type of technology in the fight against crime in the area of vehicle security.

Thus, taking into account that the majority of respondents have knowledge about security systems with GPS technology, the question of whether they are satisfied with the performance of these systems was asked. Figure X shows that the public is not satisfied with the fulfillment of the anti-theft security function that this type of system should provide, since 60.3% of those surveyed are dissatisfied.

Taking into account that RFID technology is already being used and implemented in other countries, it was decided to find out if the people surveyed have knowledge of this type of technology. Thus, as shown in Figure XI, the number of people who have knowledge of this type of technology does not exceed 33%, which leaves a field in which research and innovations such as this project can be carried out.

Therefore, we proceeded with the presentation of the main function that was implemented through RFID technology, which allows the vehicle to be stopped by the system once the driver who has the RFID chip implant is removed from the vehicle and is out of detection range. In this sense, as shown in Figure XII, once the public has learned about the functionality that has been implemented through this RFID technology, it shows a level of acceptance and interest which exceeds 80% of the people who have been surveyed.

Finally, the main characteristics of this project were presented to the public, such as the low cost required for its implementation, the fact that the RFID implant goes unnoticed to the naked eye, and that the system automatically stops the vehicle. Figure XIII shows that once the characteristics of this project were presented, the acceptance and recommendation rate was 95.9%.

IV. DISCUSSIONS

The implementation of RFID technology is still a new topic in our environment. However, this technology has features both in its operation, cost of implementation and the security it provides at the time of identification, which have made it a good alternative when developing systems that need this type of technology for medical activities, monitoring and even payments [6]. In this sense, in our project we have implemented the characteristic of identification by means of the use of the working range of the RFID implant reading sensors.

Similarly, the research by [7] provides more details on RFID implant technology and its applications in security, proposing the monitoring of criminals in custody, which greatly facilitates the work of the authorities in controlling such situations. By means of the security provided by this type of technology with respect to the identification and tracking of a person, it was possible to implement this feature as part of the main operation of this project.

Likewise, in the work of [2] we found a project that not only has the identification of RFID devices, but also adds the location by means of GPS technology and sending signals through GSM technology. For our project we took into account the flowchart which was adapted to our needs of identification and detection of the RFID implant in a given range.

In the same way, as shown in the project of [9] where the information received from the devices is transmitted to the owner of the vehicle by means of text messages and in the same way actions can be performed by sending commands by this means. This type of implementation is visually productive for the user to be aware of what is happening in his vehicle, although the fact that the owner has to enter the commands for the system to perform a particular action can be counterproductive at times when the user is emotionally upset or otherwise forget the exact words for the development of the action in mind. That is why this research project provides the user with the automation of its main function, which allows not to depend on the actions of a specific person, but the system will act automatically when the driver is out of the detection range of the implant.

V. CONCLUSIONS

In conclusion, the development of the research allows through the implementation of RFID chip implant technology to have a means of support to the anti-theft security systems of vehicles, through which it is estimated a great reduction in the existing rate of vehicle theft, since the action of this research project is automatic.

In future research work it is proposed to implement other technologies such as global positioning systems to know the location of the vehicle after being stopped by the developed system, the global mobile communications system through which you can establish remote communication system and finally the implementation of the internet of things (IoT) which allows the implementation of systems that can perform actions remotely through these technologies can expand user actions against situations of theft and information needs to help counteract them.

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