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Original Article

Design of an IoT Prototype for the Prevention of Robberies in the Young Areas of Lima

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Abstract *- Latin America is affected by citizen insecurity; street robberies are frequent. In Peru, this scenario is alarming; according to studies and reports presented by the authorities, it is estimated that a monthly average of 1,5348 robberies are reported every month. Lima, being the main capital, is exposed to a greater number of assaults, especially in young areas; because of this, in this research work, an IoT design was presented, which consists of a system of alarms implemented in specific areas where the complaint rate is higher. This alarm will be activated through a mobile application installed on the user's smartphone, This way; the user can turn on the alarm in case they witnesses or is the victim of a robbery; the application will send an alert message to the nearest authorities to take action on the scare. The Scrum Methodology was used as a methodology because its framework is adapted to the needs of this research.*

Keywords *- Prototype, Alarm, Scrum, IoT, Robberies.*

1. Introduction

Peru is one of the countries most affected by citizen insecurity due to the great amount of violence, assaults and robberies in the streets. This fact is supported by the studies carried out so far. For example, according to a report published by the Peruvian National Police (PNP), an average of approximately 15,348 complaints per month are reported [1]. These include sexual harassment on the street and in public transportation. For this reason, it is estimated that around 30% of women in Lima have been involved in sexual harassment at some point in their lives [2].

For this reason, this research work presents a solution to the problem of citizen insecurity in Lima. For this purpose, using IoT technology, a prototype was created to prevent theft. The design consists of an alarm system activated through a mobile application. The aim is to help reduce the high rate of robberies in Lima and, in this way, contribute to our society by improving safety in the streets.

The research aims to design an IoT prototype to reduce robberies in Lima, with the help of the alarm system and the mobile application to alert the authorities of the reality that is lived in the streets every day.

This research work is as follows: Section II presents the Review of the Literature. Section III defines the methodology to be applied to the project and defines each stage in a theoretical manner. Section IV describes the case study, and Section V describes and shows the results and discussions obtained. Finally, Section VI defines the conclusions and future work.

2. Literature Review

This section deals with the research on the application of IOT to reduce robberies, to show how this technology has been applied and what the results have been.

The Internet of Things is primarily used for human-to-human and human-to-machine information sharing [3]. The following research seeks to link those homes with IOT capabilities to reduce accidents, from fires to improved security, alerting you to a possible break-in. With the help of a microcontroller, they can send this information from house to house, alerting neighbors and the nearest authorities [4]. It also links this information with your social networks. It allows the user to check the status of sensors and IoT devices, enhancing public safety against crime.

On the other hand, as is well known, new technologies are currently being developed to manage cities and their populations better; thanks to IoT, we transfer valuable information and knowledge that helps improve people's quality of life. That is why in the following research, the author conducted an analysis of the myriad of cloud-based IoT applications and what their role is in smart cities. Therefore, I conclude that using IoT devices can reduce costs and improve the efficiency of everyday processes, such as garbage collection, and reduce accidents or crime [21].

Similarly, the following research addressed the transportation system due to the current deficiency in accident prevention systems. In addition, there is no adequate mechanism for accident detection [6]. Therefore, using IOT, the author proposes the Smart Vehicle Monitoring System (SVMS) application, whose purpose is to monitor the vehicle continuously and also to have the ability to control the vehicle [7] remotely. The IoT device used by the vehicles is the Raspberry Pi (RPi) because it links to the sensors quickly. It allows the system to inform the authorities about the magnitude of the accident. This application also uses GPS, which allows vehicle tracking during the trip.

The system known as IoT is advancing day by day, and its application is infinite since it adapts to different situations. For example, The following research is applied in a residential city to detect fires or robberies and thus create a prosperous and safe city [8]. For this purpose, they use two tools for IoT applications; the first is several smoke sensors to detect fires, and the second is PIR sensors and ultrasonic sensors to detect theft [9]. The user himself uses the monitoring system through the web. In this way, he keeps control of what happens at home in his absence or while he is at home.

Similarly, the following research applied IoT to increase security by preventing theft using security cameras. These cameras were designed to improve efficiency and reduce costs. The use of a traditional surveillance camera requires round-the-clock activation and monitoring requires a computer, in addition to staff in charge of monitoring each event, however for this case, using image processing, a camera was created with the ability to detect an exact area of occurrence of movement, in this way the system captures images to be viewed by the user remotely using the internet, thus providing an innovative idea for theft detection using IoT [10].

In conclusion, in the research mentioned earlier, the application of IoT in the area of citizen security has already been raised. In all cases, we could say that its application positively impacts society because it increases safety in their homes by monitoring accidents. In this way, they feel more protected and safeguarded at home. However, a point to improve is its approach because the IoT system is usually intended for the public sector. It is recommended to apply it individually so that each user can quickly alert the authorities to an incident or theft. The present research presented the structure for the IoT application to improve each user's experience.

3. Methodology

An agile methodology was used to resolve this research project and, in turn, software and hardware development tools. That is why the Scrum methodology was chosen, thus taking its structure to present the information. On the other hand, mention is also made of the technological tools that allowed unifying a system for a set of devices.

3.1. Scrum

For the development of the research project, the Scrum methodology was used since it involves a work team, assigning roles and activities to be carried out in the project, which is why this methodology was chosen [11]; in addition, its structure significantly involves the work team, which allows us to improve teamwork and optimize the organization of the project [12]. In addition, considering that its information framework is adaptable, which favors the project's development. The Scrum process is shown in Fig. 1, evidencing the methodology's roles and process [13].

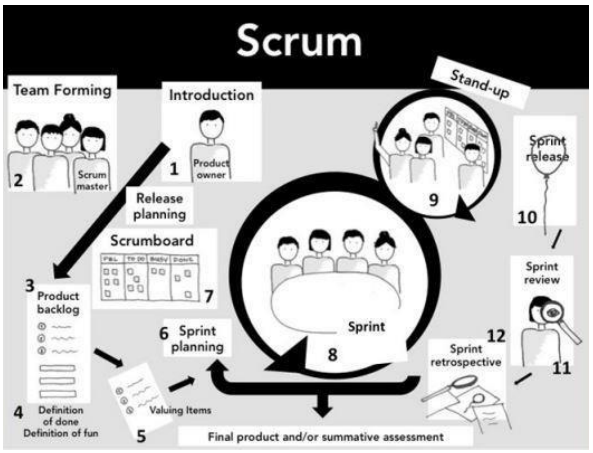

Fig. 1 The Scrum Methodology Process

3.1.1. Third-Order He

To carry out the Scrum methodology, there are roles. The main ones are the following: Product Owner, Scrum Master and the Development Team [14].

3.1.2. Planning

At this stage, the project is planned, and the team must define the technical tasks to be performed, the resources needed, and the work schedule [22]. To do this, several meetings are held involving most or all of the team to determine the list of tasks, the number of Sprints, and what will be developed. Sprint is deliverable, with a time shorter than the final project [14].

3.1.3. Development

Also called the implementation stage, its purpose is to develop the Sprint previously determined, fulfilling its priority level, all of which is agreed upon in the previous stage. It is important to highlight that each Sprint is developed in the time established by the team. Therefore, it must be respected, and the delivery must be completed according to the deadline [16].

3.1.4. Review and Retrospective

In this stage, meetings are held between the work team at the end of each Sprint to discuss the Sprint carried out, thus determining the contribution of each member, the difficulties encountered, and the points to be improved [16].

3.2. Software Tools

To develop the application, the following is a recommendation of the tools to create the project satisfactorily.

3.2.1. Kotlin

Kotlin is a programming language mainly focused on developing Android mobile applications. This language began to be developed in 2010 as open source, and its first version was released in 2016 [17].

3.2.2. Firebase

Firebase is an application that allows you to create web and mobile applications without programming; it is a web server capable of storing data, implementing access rules and verifying users [18]. The Firebase operation diagram is shown in Fig. 2

Fig. 2 Diagram of Firebase Operation

3.2.3. Balsamiq

Balsamiq is a popular tool for designing or prototyping various web, software or mobile platforms. It is an application capable of transmitting the designer's ideas quickly and efficiently [19].

4. Case Study

4.1. The Scrum Process

To start the project, a meeting was held to determine the role of each project member, and depending on this, the activities to be carried out will be assigned. This decision depends on the capabilities of each member. Table 1 below shows the role of each team member.

Table 1. Team Roles

Roles	Responsible
Scrum Master	Enrique Lee Huamaní
Product Owner	Enrique Lee Huamani
Development Team	Ricardo Leon Ayala
Development Team	Brian Meneses-Claudio
Development Team	Alexi Delgado

4.2. Planning

The Sprint to be developed to complete the project was determined in an upcoming team meeting.

4.2.1. Sprint 1

In this Sprint, we develop the Login and the User Registration, implement the Global System for Mobile (GSM), and request the permissions the application needs for its optimal operation. The user stories to be developed for Sprint 1 are shown in Table 2 below.

Table 2. Sprint 1 User Stories

User Stories
As an administrator, I want the application to allow me to log in to access the functionalities.
As the administrator, I want the application to allow me to register my data so that this information can be saved.
As the administrator, I want the application to implement the GSM system to keep my device connected.
I, as the administrator, want the alarm system to use a stable wireless connection to avoid delays when activating the alarm.

4.2.2. Sprint 2

In this Sprint, we developed the application's home. Also, we implemented the alarm system to track the user using Radio Frequency identification (RFID) and connected it to Google maps. The user stories to be developed for Sprint 2 are shown in Table 3.

Table 3. Sprint 2 User Stories

User Stories
As an administrator, I want the application to have a module that allows me to access the main options.
That allows me to access the main options.
As an administrator, I want the application to allow me to send an alert in a simple and fast way.
As the administrator, I want the application to send the alert

with all the necessary information for prompt attention orintervention.
As an administrator, I want the application to notify me when I pass through a dangerous place to be more alert to this situation.

4.2.3. Sprint 3

In this Sprint, we developed the interface of the alarm emitted from the cell phone and the options the user can access during the alarm system. The user stories to be developed for Sprint 3 are shown in Table 4 below.

Table 4. Sprint 3 User Stories

Roles	Responsible
Scrum Master	Enrique Lee Huamaní
Product Owner	Enrique Lee Huamani
Development Team	Ricardo Leon Ayala
Development Team	Brian Meneses-Claudio
Development Team	Alexi Delgado

4.3. Development

4.3.1. Development of Sprint 1

In Sprint 1, the development was based on the user history of Table 2, which is why the development started by creating the wireless alarm system, which is shown in Fig. 3; that is to say, it allows the entry of the flow of electrical energy, from this tool releases two wires, also known as Phase 1 and Phase 2, these wires are connected to the intelligent electronic switch because this component will be responsible for connecting with the mobile application to activate or deactivate the output voltage to turn on the alarm. Finally, this device is connected to a siren to emit the sound of the alarm.

On the other hand, the initial interface of the application was designed, the user can log in by entering their username and password or use a Google or Facebook account to enter, as shown in Fig. 4; otherwise, you must register by providing your email and password as shown in Fig. 5. Finally in Fig. 6, you can see the permissions required by the application to use the features, for example, the user must give access to the camera, GPS, special vibrations, audio and activation of gestures for quick access.

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Fig. 3 Alarm system

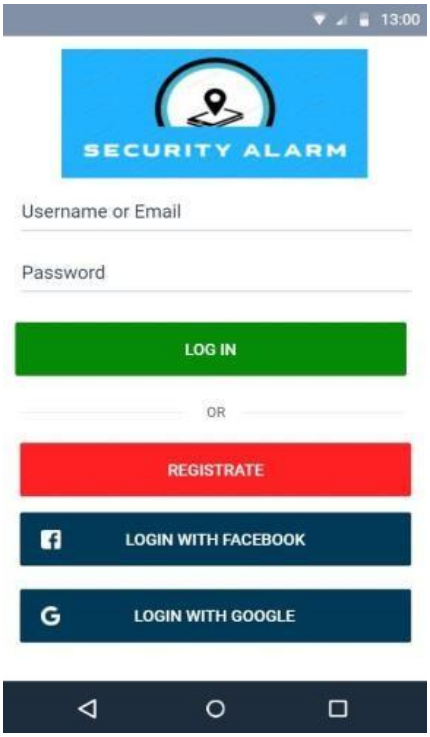

Fig. 4 Login

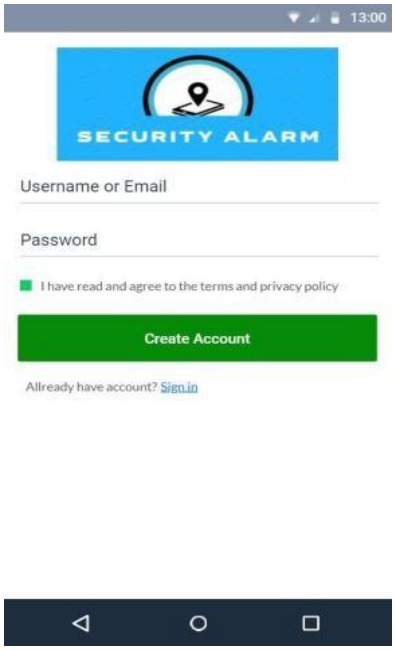

Fig. 5 Registration

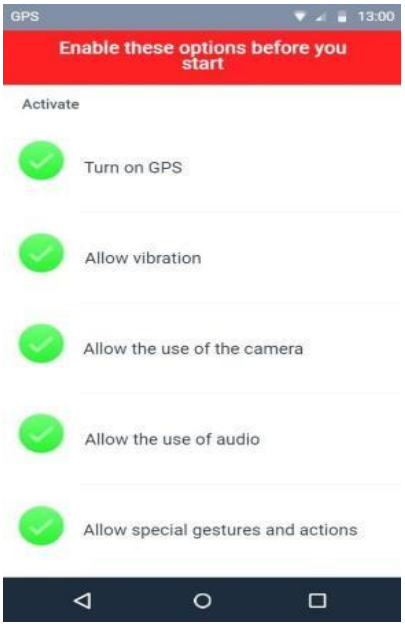

Fig. 6 System permissions

4.3.2. Development of Sprint 2

Sprint 2 was developed based on the user stories in Table 3, which is why we started designing the application's main interface, as shown in Fig. 7, adding the functionalities required by the users. In total, there are 3 main functions and 2 complementary ones. In" Track history", a record of the routes traveled in the last days or months is kept to provide the user with information about the places or the safest routes to travel.

Fig. 7 Application functionalities

The next one is the "map of tracking" developed in Fig. 8 shows that we have worked with Google maps to improve the user experience because the user is already familiar with its interface, in addition to indicating whether a route is safe or not using clear symbologists for the user, in addition to activating the alarm icon to show on the map the distance in which the device is located with the alarm.

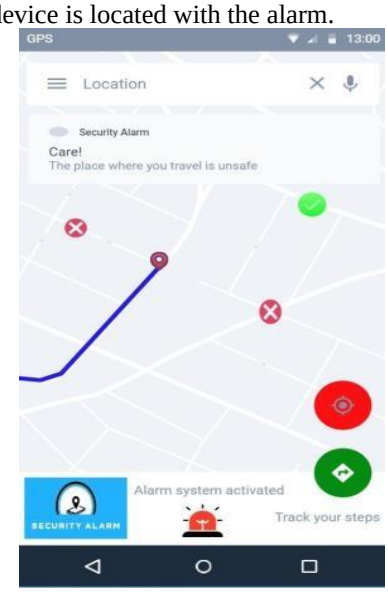

Fig. 8 Tracking map

The" Activate Alarm" icon allows the user to perform a test simulation, in which the alarm will recognize and send the information if it is operational, thus ensuring that users can corroborate the status of each alarm. Finally, we included the function to access the camera if necessary and the configuration of gestures to access the functions differently, in addition to allowing the alarm to be activated manually.

4.3.3. Development of Sprint 3

Sprint 3 was developed based on the user stories in Table 4. The alarm system interface was designed when it is active, as shown in Fig. 9. When the alarm sounds, the information is sent to the nearest authorities so that they come as soon as possible to the scene of the incident. During this process, the user can make an emergency call in case of an accident or theft of third parties, in addition to the activation of the camera as shown in Fig. 10. The application invites you to capture the facts, followed by sending the image to the authorities to take action in the matter depending on the case.

Fig. 9 Alarm System

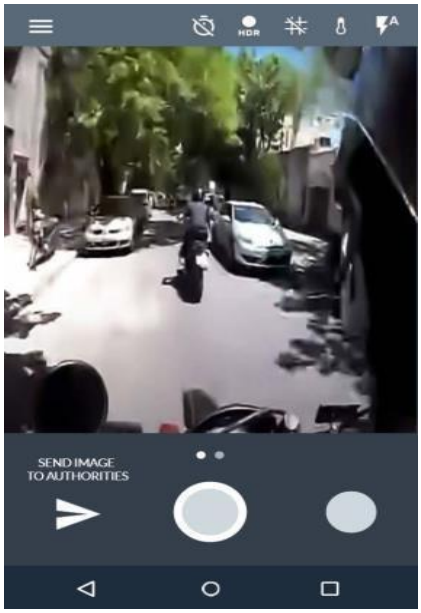

Fig. 10 Evidence camera

4.4. GSM operation in the application

The use of GSM technology allowed the application to expand its coverage and to communicate with the previous ones, which pick up its signal; this connection travels to its destination, which is the server [20], With this, we achieve the interconnection to the internet, and finally, this signal is received by the application, in this way the user achieves the wireless connection, this technology will be used to emit the signal and activate the alarm system from the application. All this is shown in Fig. 11.

Fig. 11 Structure of those involved

4.5. Analysis of crimes recorded in police stations in the district of Lima

Fig. 12 shows a graph created on the official website of the National Institute of Statistics and Informatics (INEI). With the help of the integrated crime statistics system and citizen security, the information shown was filtered specifically for crimes reported in police stations throughout northern Lima. As seen on both the X and Y axis, the number of crimes recorded is shown; this information is segmented by year, ranging from 2011 to 2021.

With the help of the graph, we can conclude that, although crimes have indeed been reduced in the last year compared to previous years, the figure is still quite high and alarming because insecurity in the streets is still a recurring problem. That is why we are looking for this project to be implemented or tested in some areas of Lima to evaluate its effectiveness and thus curb this wave of insecurity that afflicts us every day.

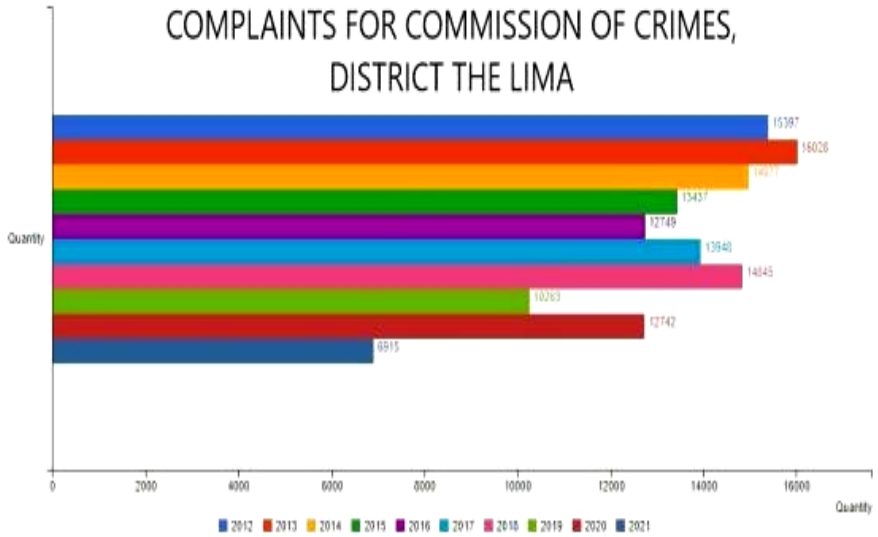

Fig. 12 Complaints for the commission of crimes district the Lima

5. Conclusion

In conclusion, the IOT prototype was designed to prevent robberies in young areas of North Lima. With the help of tools such as Marvel App and Balsamiq, each application interface and module was successfully designed to show its operation and application during a robbery. On the other hand, the main functionalities were implemented following the guidelines of the user stories.

In addition, thanks to the Scrum methodology, it was possible to structure the information in a way understandable to all readers. In the same way, following the methodology, an order in the development of the project activities is achieved, assigning a role to each team member, thus strengthening the harmonious development of the activities.

Future work

In the future, it is expected that some entity related to the development of applications or researchers will contribute to the project by developing the mobile application. The project's development and implementation will benefit all citizens because it is expected to help reduce robberies in northern Lima. In addition, it is expected that this research will encourage more researchers to present solutions to the problem of citizen insecurity.

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