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Article

Design of an alarm system for the inclusion of people with disabilities in the educational environment

Diseño de un sistema de alarmas para la inclusión de personas con discapacidad en el entorno educativo

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Abstract

Currently the participation of students in earthquake drills is very important, even in places where there are no records of large-scale earthquakes, however, when a review of it is done, it is noted that the means of warning are usually sound instruments, which leaves people with hearing problems or hearing impairment with little possibility of immediate response. This is the raison of this work, the idea is to be able to attend to people with hearing impairment in an immediate response.

Earthquake, Alarm system, Inclusion

Resumen

Actualmente es muy importante la participación de los estudiantes en simulacros de sismo, aún en lugares donde no se cuenta con registros de sismos en gran escala, sin embargo, cuando se hace una revisión del mismo, se nota que los medios de aviso regularmente son instrumentos sonoros lo que deja con poca posibilidad de respuesta inmediata a las personas con problemas auditivos o con discapacidad auditiva. Esta es la razón de ser del presente trabajo, la idea es poder atender a las personas con discapacidad auditiva en una respuesta inmediata.

Temblor, Sistema de alarmas, Inclusión

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1. Introduction

Nowadays it is very common to see earthquake drills being carried out having to evacuate people in a certain time (ideally 3 minutes). However, we rarely worry about attending to students with visual or hearing impairment problems, which generate a key point in the evacuation time.

The nature and scope of this work is precisely with the support in the immediate response of people with hearing disabilities in earthquake simulation processes and in the evacuation processes of buildings of educational institutions.

It is worth mentioning that the work carried out shows data belonging to the Faculty of Mechanical and Electrical Engineering of the University of Veracruz, Poza Rica – Tuxpan Region, however, the idea is to be able to work on a general alarm system for educational institutions in general.

design of the alarm system mainly covers people with hearing disabilities, thus increasing the effectiveness of security measures in various environments. It is expected that this device will meet the sensory and cognitive needs of people with disabilities, reducing the time it takes to evacuate buildings by 10%, improving their ability to detect and respond to any emergency situation.

2. Statistics of people with hearing impairments

According to the Ministry of Health, hearing impairment refers to the lack, decrease or loss of the ability to hear somewhere in the hearing system, Now, in Mexico, approximately 2.3 million people suffer from hearing impairment, [1] of which more than 50 percent are over 60 years of age; just over 34 percent are between 30 and 59 years old and about 2 percent are children, this represents approximately 46,000 children in the country with hearing disabilities, however, secondary and high school students are not included in this statistic because as of 2018 [2] the number of people under 17 years of age with a disability was 580,289.

In addition, according to inegi data, the rate of people with disabilities in general has increased from 6.3 to 6.8 from 2018 to 2023 [3].

Although hearing impairment is the fourth disability presented in the statistics, it is considerably high the number of people who have this problem, this is reflected in Table 1.

Box 1

Table 1

Types of disability in the Mexican population.

Type of disability	Index	Number of people (millions)
Motor	69.7%	6.203
Visual	*45.4%*	*4.04*
Memory or emotional	28.7%	2.55
Auditory	19.4%	1.72
Speaking	9.6%	0.85

[3]

The table clearly shows that 1.72 million people in Mexico have hearing problems [3], therefore, this project generates a significant impact on the inclusion of people in society.

Although currently there are inclusion programs and support from the health secretariat, it is considered a great opportunity for the engineering area to insidir in society through projects related to inclusion issues and thus achieve close a little the gap of people with hearing impairment with society and make them more autonomous.

It is also worth mentioning that this condition can be congenital, that is, a condition with which one is born, or acquired, because it occurs at any stage of life through the passage of time and exposure to loud sounds or loud music, systemic arterial hypertension or diabetes mellitus.

3. Background

In the research entitled “Design and implementation of a home automation system using a Raspberry Pi card and controlled with an Android application for people with physical disabilities to perform basic household tasks”.

[4] shows a design of a home automation system which is intended to perform automation activities to mention the following, turn on lights, open door locks up and down blinds.

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Concluding that the items proposed in the design of Python language that allows receiving requests and in turn have control of various actuators have been met.

On the other hand, in the research entitled "Warning system used by sensors for obstacle detection for visually impaired people" [5] shows a design of a system for detection and monitoring of objects, so that visually impaired people can avoid obstacles and have an effective displacement. It also concluded that the use of ultrasonic sensors is a viable option for the development of devices and allows the guidance of people with disabilities.

In the research entitled "Study of lighting conditions within the facilities of the Faculty of Mechanical and Electrical Engineering Poza Rica - Tuxpan region" [6] shows a study of lighting for people performing daily activities.

In the research entitled "Design and implementation of an alarm prototype made up of infrared and vibration sensors applied to the community mainly to visually and hearing impaired pedestrians, installed to the traffic light system" [7] in general, a prototype was designed to test the traffic light system to which a vibration system was adapted with motors, infrared sensors, controlled by Raspberry pi.

Their contribution would help visually impaired people to move more efficiently and know when to cross the street.

In the Mexican standard NOM - 0O3 SEGOB/2002 [8], the characteristics of the signaling system for civil protection are specifically described, allowing the population to identify messages such as caution, no trespassing and obligation in order to act correctly.

4. Characteristics of the population

This section describes the target population of the project, for which a survey was conducted among the student community of the School of Mechanical and Electrical Engineering of the Universidad Veracruzana in the Poza Rica - Tuxpan region, which has a total population of 616 students, 59 teachers and 15 administrative staff, in addition, it has an infrastructure of 9 classrooms, an auditorium and two laboratories as enclosed spaces.

Figure 1 shows one of the classrooms of the School of Mechanical and Electrical Engineering, the space where the project is to be implemented.

Box 2

Figure 1
Classroom of the Faculty of Mechanical and Electrical Engineering [9]
Source: https://www.uv.mx/pozarica/fime/amplias-y-modernas-aulas-con-aire-acondicionado/

The survey conducted in support of this work was carried out in May 2024 through the google forms platform reaching 132 people from the student community, the results are shown below in figures 2 to 5.

Figure 2 corresponds to the question "Do you consider that you have hearing problems?", figure 3 corresponds to the question "Do you use any device as a visual or auditory support?", figure 4 corresponds to the question "Do you consider that you hear clearly?" and finally figure 5 corresponds to the question "In your free time, do you use hearing aids to distract you from any activity or to concentrate on it?".

Box 3

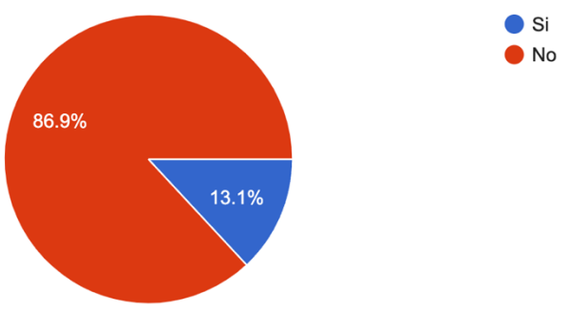

Figure 2
Answer to the question "Do you consider yourself to be hearing impaired?
Source: Student survey

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Box 4

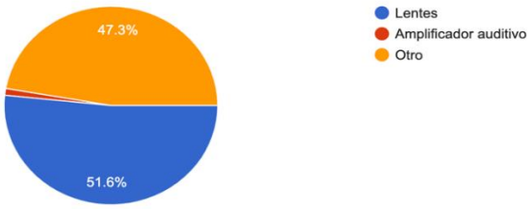

Figure 3

Answer to the question do you use any device as a visual or auditory support?

Source: Student survey.

Box 5

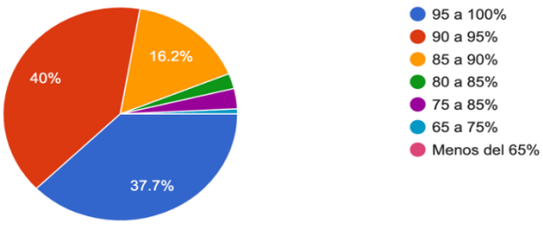

Figure 4

Answer to the question "Do you consider yourself a clear listener?

Source: Student survey

Box 6

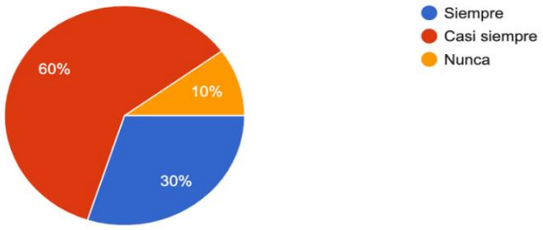

Figure 5

Answer to the question: in your free time, do you use headphones to distract yourself from or concentrate on an activity?

Source: Student survey

In addition, in the same survey, 51.5% of the respondents indicated that they identify the drill due to the megaphone or horn announcing the event. Also noteworthy in this survey is the fact that 2.3% mentioned that civil protection personnel had to pass through the spaces where they were to give them indications and that 17% of the respondents indicated that they have had problems hearing the alarm signals or know someone who has had problems hearing the alarms, which provides feasibility to the project being developed.

5. Alarm project design for people with disabilities

The proposed design has three main features, the first is the easy operation for the user, the second is a low cost and the third is that it is independent of residential power.

The idea is that the alarm system will have two warning lights, one of red color indicating the earthquake and another of a different color to indicate that there is an emergency of another type such as fire, smoke, among others, which are activated in three cases: first, when they detect the signal of the tremor through the internet interconnection, another case is through manual activation by the management or the people in charge of the drill and the last one through manual activation inside the classroom.

And the objective is to be installed in one of the front parts of the classroom so that it is visible to the hearing impaired, as shown in Figure 6.

Box 7

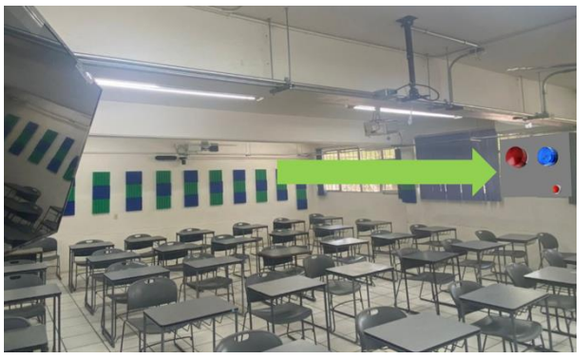

Figure 6

Implementation of the system in the classroom

For the design, we looked for elements that were easy to access economically, resulting in those shown in Table 2.

Box 8

Table 2

Cost of alarm system elements

Element	Cost
Warning light flashing red [10].	218.70
Warning light flashing blue [11].	129.00
Alarm button [11]	29.00
Solar panel 12V 5W [11]	323.00
Arduino Wifi [10]	626.00

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According to Table 2, a first approach to the cost of the project is approximately 1,325.70 pesos, however, some elements for optimal operation are not considered, such as cabling, connectivity devices and the panel in which it will be installed, but it is useful to realize the approximately low cost of the project.

6. Results

The first approach that was established was the one shown in figure 7, this shows 3 displays showing the 911 alarm signal connected to a regulated voltage source at 5 v and with an input switch.

Box 9

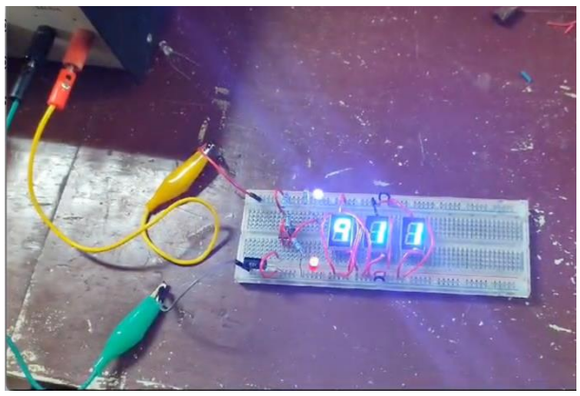

Figure 7
First approach to the alarm system idea

This prototype fulfilled two of the characteristics mentioned in the project, since it was easy to use and the cost was very low, however it presented other problems, among which are the size, the lack of autonomous connection and the wireless connection for its activation, so at this moment we are in the stage of purchasing the elements for the next approach to the project.

7. Conclusions

We achieved a first approach to the development of the alarm system and the design which are being considered important in the development of the project, although the construction and implementation is important, the idea is that this project can be incorporated in all educational institutions for the inclusion of people with hearing disabilities.

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