

## Prototype of a facial recognition system for the identification of university students at university entrances

Prototipo de sistema de reconocimiento facial para la identificación el ingresar de estudiantes universitarios

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### ABSTRACT

The problems of insecurity in many areas of the nation, lead to generate protection measures for the integrity of individuals. The use of technology can facilitate the entry of those who are related to a particular space, and protect people and facilities from strangers, which could lead to criminal acts and dangers. This article responded to a research project of the Instituto Superior Tecnológico Espíritu Santo, with University Status (TES), with the participation of teachers and students of the career of Higher Technology in Software Development, which was based on the hypothesis: the application of a facial recognition system for identification at the time of entry to the facilities of the TES, can increase security and speed up the entry to the institution. The objective of the study was to propose the creation of a facial recognition system for identification at the moment of entering the TES facilities. The study was based on a quantitative field research, and as an instrument for data collection a questionnaire was applied to 20 teachers and 100 students of the TES. As a result, the sample consulted was willing to create a facial recognition system in order to optimize the entrance to TES, to speed up the entrance movement and additionally as a security factor through a system based on facial biometrics, since it has the ability to recognize people by the characteristics present in their face.

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## RESUMEN

Los problemas de inseguridad en muchos espacios de la nación, conllevan a generar medidas de protección para la integridad de los individuos. El uso de la tecnología puede facilitar el ingreso de quienes son afines a un espacio determinado, y resguardar a las personas e instalaciones de extraños, que pudiesen dar lugar a hechos delictivos y peligros. Este artículo respondió a un proyecto de investigación Instituto Superior Tecnológico Espíritu Santo, con condición de Universitario (TES), en la que participaron docentes y estudiantes de la carrera de Tecnología Superior en Desarrollo de Software, que partió de la hipótesis: la aplicación de un sistema de reconocimiento facial para la identificación al momento de ingreso a las instalaciones del TES, puede incrementar la seguridad y agilizar el ingreso a la institución. Tuvo como objetivo proponer la creación de un sistema de reconocimiento facial para la identificación al momento de ingreso a las instalaciones del TES. Se sustentó el estudio en una investigación de campo de corte cuantitativo, y como instrumento para la recolección de los datos se aplicó un cuestionario a 20 docentes y 100 estudiantes del TES. Se obtuvo como resultado la disposición de la muestra consultada a la creación de un sistema de reconocimiento facial con la finalidad de optimizar el ingreso al TES, para la agilización del movimiento de entrada y adicionalmente como factor de seguridad mediante un sistema basado en biometría facial, puesto que tiene la capacidad de reconocer a las personas por las características presente en su rostro.

**Palabras clave:** Aplicación informática; Reconocimiento de Formas; Robótica; Cibernética

## INTRODUCTION

In today's reality, human beings have within their reach a variety of technologies that offer help, comfort, economy, security, to name a few. All these benefits allow people to have a better quality of life, by offering comfort, and in other cases to save time and resources.

In the specific case of security, a series of devices have been created with the purpose of providing protection to personal integrity and property. Nowadays there are several technologies that help people to optimize their quality of life, as well as to make better use of time and/or resources in a specific task.

In the case of generating security measures for access to the TES facilities, it is essential to select a system that offers the greatest guarantee in terms of preventing the entry of people who are not allowed to enter; hence the need to use a recognition mechanism that prevents people not linked to the institute from entering and, at the same time, facilitates entry to those who are part of the community of teachers or students of this house of study.

To accomplish this, artificial intelligence must be implemented with facial recognition technology, which through the placement of cameras, the intelligent algorithm detects the facial biometrics of each visitor, identifying truthfully whether it is a student or not. This is in accordance with what is stated by Gómez (2021), who points out that:

Digital technologies and everything related to big data, automated learning, Internet platforms, among other phenomena, have been increasing the use of psychometric measurements and, at the same time, have generated that measurements integrate new tools and theories. (p. 68)

One of these digital technologies is facial recognition, which is a

By means of a system capable of identifying people by means of an image, video, or other audiovisual device of their face. This is based on what is known as biometric identification, taking measurements of the body which, in the specific case of facial recognition, is located in the face and head, to verify the identity of a subject. It should be noted then, that facial recognition is a kind of biometric security that allows the identification of individuals in photos, videos, or in real time.

It is worth noting that this technology groups a variety of unique biometric data of each person associated with their face and facial expression to confirm the identity of a subject. This means that designing and implementing a face detection tool is nowadays a necessity in various applications such as video conferencing, indexing and especially video surveillance.

From this perspective, facial recognition is a tool used to verify that people are who they say they are. This system has had a great acceptance demonstrating its effectiveness to verify identities, eliminating the possibility of fraud in this aspect, simply by the user standing in front of the camera screen, until the camera takes the picture. In this way, the use of a great variety of methods destined to identify people is dispensed with, among which can be mentioned, username and password, personalization digits or numbers, individualization card, keys, passport, or any other document used to prove identity, having the characteristic of the feasibility of loss, forgetfulness, subtraction, deterioration,

which can lead to economic, legal or security problems. According to Bravo, Ramírez, and Arenas, (2018).

Facial recognition is a method with which it is possible to identify a person by means of an image or a video frame, this method dates back to 1960, where its concept began to see the light, however, its massive use is more recent. (p. 116)

However, the face is an axis of great importance as it becomes a primary element of attention, when encounters or social interrelations take place, since the interest is basically focused on facial characteristics and expressions, leading to remember and recognize numerous faces, in a few moments, even though, in some cases, some time has passed since the last time the person's face was observed. This particularity led to be inspired to somehow trace this singularity with the support of some disciplines such as computer science, artificial vision and biometrics. As Aznarte, Melendo and Lacruz (2022) point out:

Furthermore, according to its promoters, the use of biometric technologies could bring a number of additional advantages to education. Thanks to them, a more efficient use of time could be promoted, saving procedures such as attendance control and facilitating curricular adaptation for absent students. Classroom security could be increased by automatically detecting outsiders. (p. 263)

Biometrics can be understood as the science that determines the identity of a person based on the study of the physiological or behavioral particularities of the human body. In any case, biometric data according to Quintanilla (2020) "have been defined in the literature as the physical, psychological and behavioral traits that uniquely identify an individual". (p. 66).

In the same vein, when the subject of biometric traits is addressed, it can be said that they are physiological or behavioral characteristics of the human body, which can be elements to be recorded, quantified and processed through the use of computers.

This compendium of element discussed so far leads Garrido and Becker (2017), to point out the following:

The relevance of biometrics today is given by the great increase of automated systems to identify people, either by governments or private companies. Along the same lines, other authors add more elements to be considered in biometrics: not only physical characteristics or features, but also behaviors that would allow identification. (p. 69)

In this sense, identification techniques based on biometrics provide a solid identification solution, since they make use of the physical or behavioral traits of the human body, whose properties are unique, permanent and impossible to transfer. Thus, physical traits can be extracted from the eye, from the iris or retina, from the hands, from fingerprints, or from facial features.

Based on the above, it is worth noting that facial recognition is part of the area of study called Biometrics, whose objective is focused on developing automated methods for the individualization or confirmation of people based on certain characteristics. Which leads to bring up Santi (2018), who regarding biometrics highlights the following:

Current human biometrics is based on an identification system that relies on static indicators, mainly stable biological data (such as facial features, iris characteristics, fingerprints, vascular mapping, etc.) and/or dynamic patterns, such as certain behavioral data (regularities in handwriting and signature, gait, etc.), authenticated by means of digital processes. However, examples of biometric uses date back several centuries. (p. 250)

Within the field of biometrics, it is worth mentioning that any person who is registered in the biometric system is designated as a user. Another aspect to highlight is that the systems of recognition of persons base their activity on three main premises, what the user knows, what he/she has and who he/she really is, being this last method referred to biometric systems, where it stands out, a form of individualization that identification techniques based on biometrics offer a solid identification solution, because its way of identifying has its hold on the physical or behavioral traits of the human body, whose main characteristics are that they are unique, permanent and non-transferable.

Based on the above, it is worth noting that facial recognition is part of the area of study called Biometrics, whose objective is focused on developing automated methods for the individualization or confirmation of persons based on certain characteristics. This brings us to Boris, Chiara, and Muñoz (2020) who, with respect to biometrics, point out the following: "Biometrics involves the management of characteristic data, either of a particular individual or of a group of individuals, which are stored by the person who manages such data as a representation of a biological profile" (p. 44). (p. 44)

Facial recognition is a technology that, at present, has focused the attention of researchers, directing studies focused on image analysis, extraction of features from digital files, among others. According to Schindel, (2018), regarding facial recognition technology, the following stands out:

Biometrics are considered more secure than paper documentation because they supposedly make identity theft or the use of multiple identities more difficult. Biometric indicators are basically measurable characteristics that can be used to mark individuals. Whatever the type of characteristic in question, what we are talking about when we talk about biometrics is our bodies. (p. 16)

For this recognition an electronic device is used, which is responsible for identifying the scanned person, being used in housing developments, companies, educational institutions, among others.

Following this order of ideas, it is stated that the most regularly used method is a camera, which is used to capture the image of the face, being the same object of analysis through some key points, such as the distance between the two eyes, or the width of the nose, to mention a few.

Given the problems of insecurity present in many areas of the nation, it is necessary to generate protection measures for the integrity of individuals, as well as to facilitate protocols to expedite the entry of those who are related to a given space, in order to protect people and facilities from strangers, which could lead to criminal acts, dangers, nuisances, among others. With the application of a facial recognition system, access will be allowed only to those who are properly identified. In general terms and based on the benefits that a facial recognition system can provide, given the aforementioned insecurity events that can also affect the TES and, in order to streamline the procedures for the entry of managers, teachers, workers and students inside the institution, a research project was considered with the participation of teachers and students of the Software career. This project is based on the hypothesis: If a facial recognition system is applied for identification at the moment of entering the TES facilities, security can be increased and the entrance to the institution can be speeded up. In correspondence with the hypothesis, the creation of a facial recognition system for identification at the moment of entering the TES facilities is proposed as an objective.

## **MATERIALS AND METHODS**

The design of this research is field-based, coinciding with what is defined by the Bicentennial University (2017) for whom "Studies whose source of information is field-based are characterized because the required information must be obtained directly from the reality from which the problems arise." (p. 43), In that order of ideas, the object of study was established in the Instituto Superior Tecnológico Espíritu Santo, with University status in the city of Guayaquil.

Quantitative methodology was used, it focuses on collecting and analyzing data in order to answer research questions and test hypotheses that have been previously determined, basing its confidence in numerical measurement and statistics to accurately establish patterns of behavior of the sample under study.

We agree with Sanchez (2018), who defines the sample as "the set of cases or individuals drawn from a population by some probability or non-probability sampling system" (p. 93). In this research the population was composed of 96 teachers and 1100 students of the TES, from which a sample of 20 teachers was taken, and 100 students total 120 selected intentionally or by convenience, following the criteria of Otzen, and Manterola (2017) who point out that the purposive sample "Allows selecting those accessible cases that accept to be included. This, based on the convenient accessibility and proximity of the subjects for the researcher." (p. 230)

A questionnaire was applied to 20 teachers and 100 students of the TES, since it was a quantitative research. From there, the information was processed in a table for the appreciation of the answers obtained, allowing to evidence the trends and opinions of the sample under study on the problem raised; which focused on the need for the creation of a facial recognition system for student identification to facilitate the entry to the TES facilities.

**Table I. Statistical Analysis**

<b>QUESTION</b>	<b>Yes %</b>	<b>No %</b>	<b>Do not know %</b>
Consider the identification system for accessing the TES to be efficient.	65,8	54,2	0
Have you encountered problems or delays in entering TES facilities?	64,2	55,8	0
Have you perceived the intention of outsiders to enter the TES?	67,5	52,5	0
Would like to have a system for quicker access to TES	110,8	9,2	0
Are you aware that all human beings have particular characteristics that differentiate them from the rest?	102,5	0	17,50
Considers that the community of teachers, students and workers would agree with the installation of technological recognition devices.	103,3	4,2	12,5
Agrees with the need to implement a system to assist in the safety of the members of the educational community of the institute.	116,5	0	3,5
Have you heard or know of any person recognition system?	109,6	10,4	0
The implementation of a biometric reader would reduce the time for entering and exiting the TES.	97,5	0	22,5
Agrees with the use of facial recognition systems to verify the identity of people who regularly live in the TES.	105,8	10,1	4,1
Agrees to place a facial recognition system at strategic points for entry to the TES.	104,2	8,3	7,5

Source: Survey applied by the authors

## RESULTS

The research objective was to propose the creation of a facial recognition system for identification at the moment of entering the TES facilities. From the answers obtained, it is possible to highlight the willingness to implement a facial recognition system based on the physical characteristics that stand out in living beings and that stand out for being unique, unchangeable and characteristic of each living being.

It should be noted that a biometric-based security system is basically responsible for limiting access, whether to a physical or virtual place, to those who are strangers to the space where they have been installed. In other words, it identifies the people who are allowed access, from those who have limited access; in such a way that it makes a division, to identify the group of those who have registered as users, from those who are not.

The majority of the people surveyed were convinced that this system would optimize the entrance to TES, both from the point of view of speeding up the entrance movement and as a security factor, by only allowing access to those who are active in the educational establishment, through a system based on facial biometrics, since it has the ability to recognize people by the characteristics present in their face.

It appears from the opinions gathered that this would be based on a biometric system, which would automatically confirm the identity of the user who confronts the recognition camera, analyzing certain features of the human body. It should be noted that biometrics involves the application of statistical and mathematical techniques with respect to the physical characteristics that stand out in the subject, verifying that they are authentic.

Also, there is recognition of the need for the implementation of a biometric reader that will help reduce the time required to enter the TES, while helping to ensure greater security inside the facilities, as only those who are recognized by the implemented system will be able to enter.

## DISCUSSION

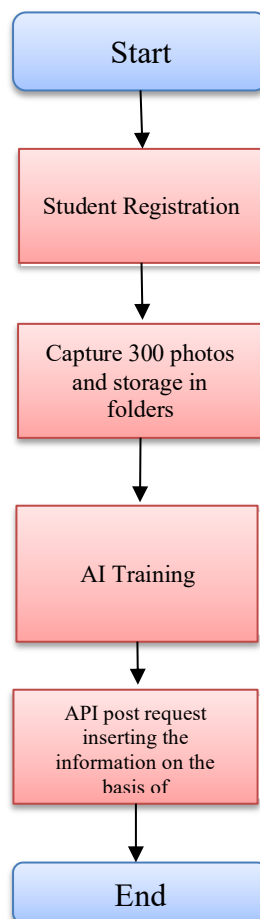
The identification techniques based on biometrics provide a strong identification solution, since it uses the physical or behavioral traits of the human body that are unique, permanent and non-transferable. Similarly, the applications of systems of this nature, in principle, can be used from the entrance/exit control in the area where the TES facilities are located, speeding up the entrance to the different areas of the educational plant.

As a result of the research project and based on the results of the survey, the proposal created for a facial recognition system for identification at the time of entering the TES facilities is presented below. Once obtained the results of the instrument applied to obtain the necessary information for the implementation of the facial recognition system, it will be carried out as follows:

**Registration stage for each student.**

This part of the process is quite easy, in simple words, each student sits in front of the camera that is responsible for capturing the 300 photos of his or her face and making the record that is attached to his or her file. The photos are stored in a storage resource in folders created by students and named after each student's unique identification code. Once the registration process is finished, the artificial intelligence training is executed, validating each face image obtained.

**Figure 1.** Functional diagram for student registration



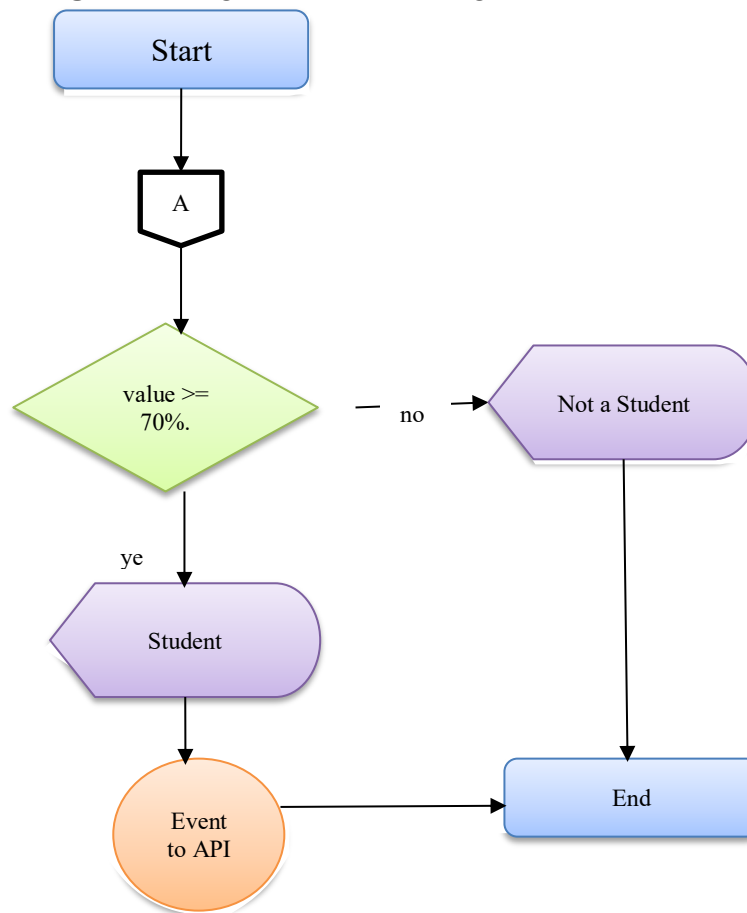
**Source: Prepared by the authors**

**Identification stage through facial recognition.**

At this stage the prototype is on standby and observing the approach of individuals performing face detection and validating if the subject belongs to the group of students in its database. In this process, the various cameras placed in the prototype give the necessary reliability to identify the subject having a high percentage to ensure that the

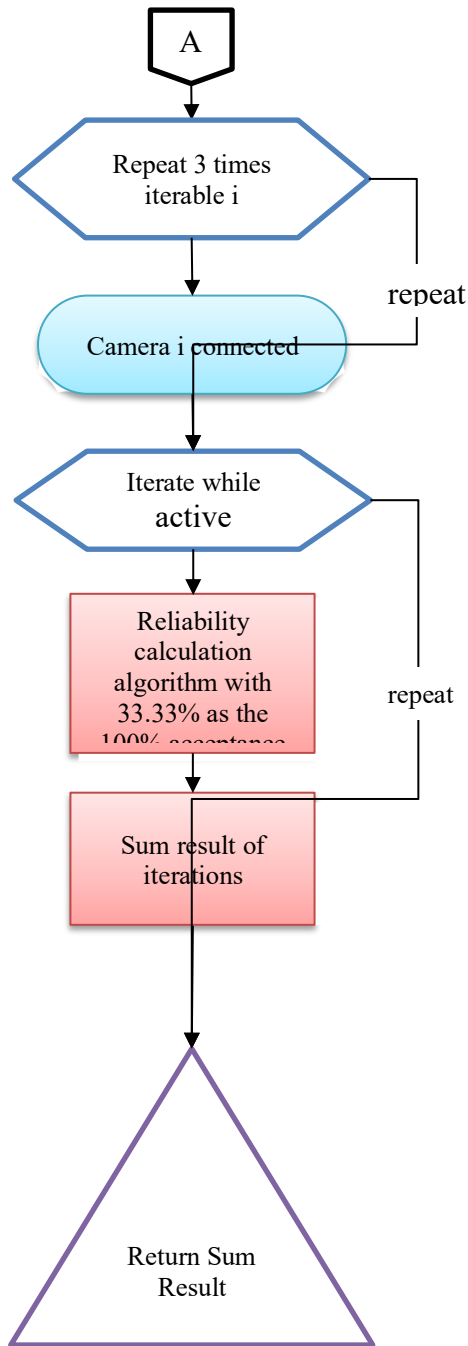
individual is who the AI says he/she is. For this work it is proposed to use 3 cameras, each camera gives the reliability of 33.33% that the individual observing is a student, adding up to 99.99%, with this the system seeks 70% to ensure that it is definitely a student. When the application displayed on the monitor indicates that the person is a student along with personal data such as name and career, the security guard can give way to this without the need to present the student card.

**Figure 2.** Diagram for facial recognition



Source: Prepared by the authors

Figure 3 Diagram for facial recognition.

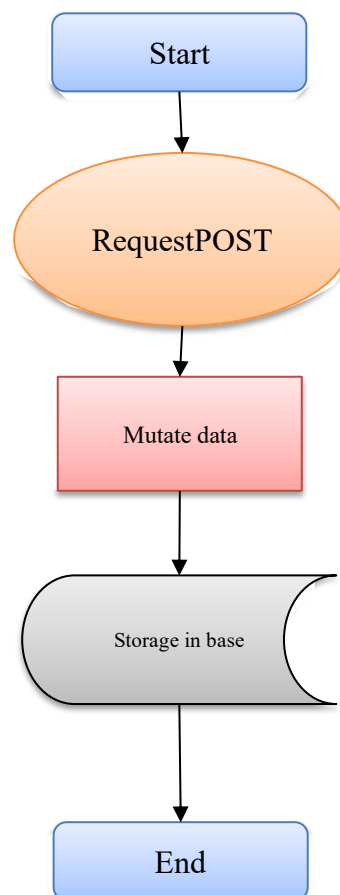


Source: Prepared by the authors

**Data logging stage via API.**

When the student accesses the facilities in a satisfactory way, the information collected is sent through an Http Request to the API that rests in the cloud and this in turn is responsible for storing the information in its database.

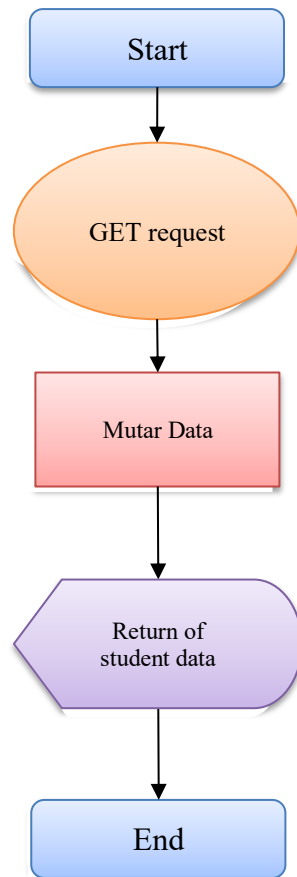
**Figure 4.** Data storage diagram.



**Source:** Prepared by the authors

The API has resources for information consumption, here is the diagram for this process.

**Figure 5.** Diagram of data request to the API.

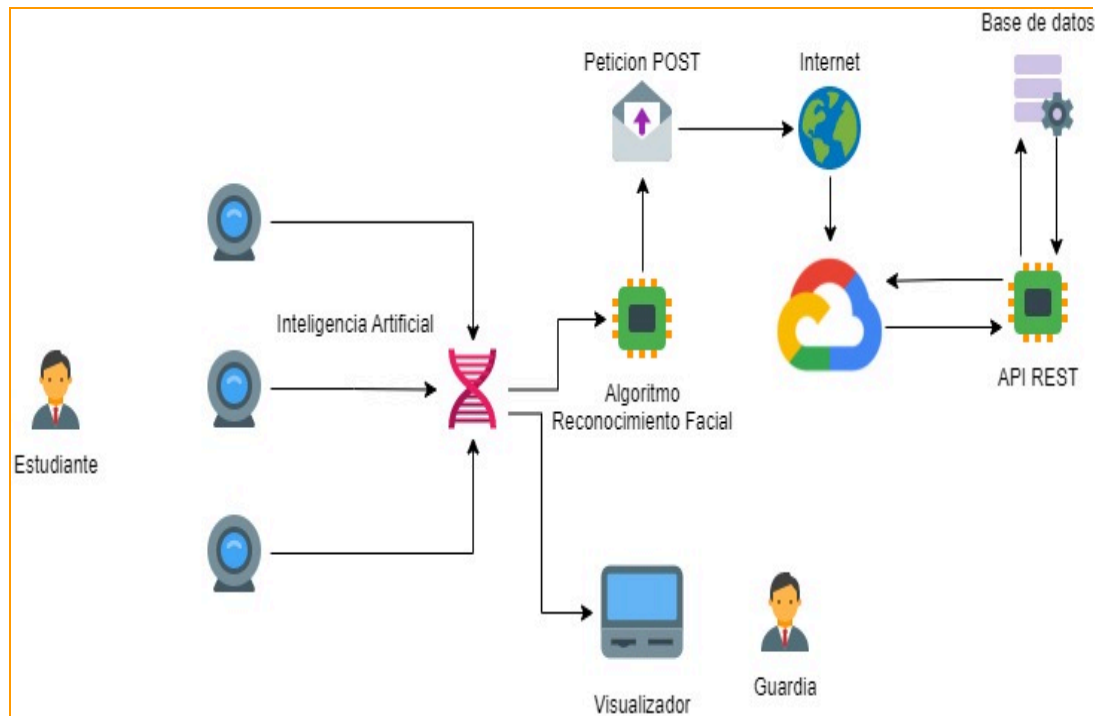


**Source: Prepared by the authors**

### Description and graphical representation

The following section describes the items and technologies used for the design of the systems.

**Figure 6.** Resource diagram



**Source: Prepared by the authors**

The system proposal described above corroborates the hypothesis that guided the research: If a facial recognition system is applied for identification at the time of entry to the TES facilities, security can be increased and entry to the institution can be expedited. With this, the objective of the article is fulfilled concerning: To propose the creation of a facial recognition system for identification at the moment of entering the TES facilities and contributes to solve the problems object of this research.

### REFERENCES

- Aznarte, J., Melendo, M. and Lacruz, J. (2022). On the use of facial recognition technologies at university: the case of UNED. *Revista Iberoamericana de Educación a Distancia*, 25(1), 261-277. doi:<https://doi.org/10.5944/ried.25.1.31533>

- Boris A. Lucero M., Chiara Saracini, Mora M, Muñoz-Quezada MT (2020). Ethical aspects of the use of biometric identifiers. *Acta Bioethica*, 26(1), 43-50. Obtenido de [www.scielo.cl/pdf/abioeth/v26n1/1726-569X-abioeth-26-01-43.pdf](http://www.scielo.cl/pdf/abioeth/v26n1/1726-569X-abioeth-26-01-43.pdf)
- Bravo, C. J., & Ramirez, P. y. (2018). Acceptance of Facial Recognition as a Measure of Surveillance and Security: An Empirical Study in Chile. *Information Technology*, 29(2), 115-122. doi:<http://dx.doi.org/10.4067/S0718-07642018000200115>.
- Garrido, R. and Becker, S. (2017). Biometrics in Chile and its risks. *Chilena de derecho tecnología*, 6(1), 67-91. doi:<http://dx.doi.org/10.5354/0719-2584.2017.45825>.
- Gómez, J. (2021). Psychometrics, profiles and biases. The case of face recognition. *InMediaciones de la Comunicación*, 16(2), 63-81. doi:<https://doi.org/10.18861/ic.2021.16.2.3156>
- Otzen, T. and Manterola C. (2017). Sampling techniques on a population under study. *Int. J. Morphol*, 1(35), 227-232. Retrieved from [scielo.conicyt.cl/pdf/ijmorphol/v35n1/art37.pdf](http://scielo.conicyt.cl/pdf/ijmorphol/v35n1/art37.pdf).
- Quintanilla, G. (2020). Legislation, risks and challenges of biometric systems. *Chilena de Derecho y Tecnología*, 9(1), 63-91. Obtenido de [www.scielo.cl/pdf/rchdt/v9n1/0719-2584-rchdt-9-1-00063.pdf](http://www.scielo.cl/pdf/rchdt/v9n1/0719-2584-rchdt-9-1-00063.pdf)
- Sánchez, H. R. (2018). *Manual de términos en investigación científica, tecnológica y humanística*. Lima: Universidad Ricardo Palma. Retrieved from <https://www.urp.edu.pe/pdf/id/13350/n/libro-manual-de-terminos-en-investigacion.pdf>
- Santi, S. (2018). Biometrics and social surveillance in South America: Argentina as a regional laboratory of migration control. *Mexicana Ciencias Políticas y Sociales*, 63(232), 247-268. doi:<https://doi.org/10.22201/fcpys.2448492xe.2018.232.56580>.
- Schindel, E. (2018). Biometrics, body standardization and border control in the European Union. *Athenea*, 18(1), 11-31. Obtenido de <https://www.redalyc.org/journal/537/53754772002/53754772002.pdf>
- Universidad Bicentennial, d. A. (2017). *Manual para la Elaboración, Presentación y Evaluación del trabajo Final de Investigación de los Programas de Postgrado*. Turmero: Own production.