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Animatronic system for promoting the learning of the nahuatl language

Sistema animatrónico para el fomento del aprendizaje de la lengua nahuatl

CASTILLO-QUIROZ, Gregorio†*, LIMON-DIAZ, Miguel Ángel, SAMPAYO-CARCAMO, Matilde and ROJAS-BALBUENA, Dorian

Tecnológico Nacional de México, Instituto Tecnológico Superior de Huauchinango, Ingeniería Mecatrónica, México.

ID 1st Author: *Gregorio, Castillo-Quiroz* / **ORC ID:** 0000-0002-1904-4172, **Researcher ID Thomson:** H-9402-2018, **CVU CONACYT ID:** 162009

ID 1st Co-author: *Miguel Angel, Limon-Diaz* / **ORC ID:** 0000-0002-7578-7077, **Researcher ID Thomson:** T-6486-2017, **CVU CONACYT ID:** 349952

ID 2nd Co-author: *Matilde, Sampayo-Carcamo* / **ORC ID:** 0000-0003-4506-5396, **CVU CONACYT ID:** 368456

ID 3rd Co-author: *Dorian, Rojas-Balbuena* / **ORC ID:** 0000-0002-4770-8669, **Researcher ID Thomson:** AAN-1530-2020, **CVU CONACYT ID:** 299726

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Abstract

Currently, communication in the Nahuatl language in the Sierra Norte region of the State of Puebla is a minority language, that is to say, it is only spoken by adults and is mixed with Spanish words. The objective of this project is to develop an animatronic system as a didactic material for the diffusion and promotion of a native language "nahuatl", by means of an animatronic puppet in the shape of a child, which allows the user to identify himself with the attire and characteristics of a Nahua person of the region, it also has a sound emission in nahuatl language and Spanish: words, phrases and dialogues. The main part consists of various electromechanical systems that allow it to perform synchronized movements with the sounds emitted, providing an expressive, friendly and attractive communication. With the development of this project, the personification of a prototype for the teaching of the Nahuatl language was achieved in order to promote the learning of a language that was being lost.

Indigenous population, Nahuatl, Teaching

Resumen

Actualmente la comunicación en lengua nahuatl en la Región de la Sierra Norte del Estado de Puebla es muy minoritario, es decir solo lo hablan las personas adultas, además está mezclada con palabras del idioma español. El presente proyecto tiene como objetivo desarrollar un sistema animatrónico como material didáctico para la difusión y fomento de una lengua materna "nahuatl", mediante un títere animatrónico en forma de un niño, que permita al usuario identificarse con el atuendo y características de una persona Nahua de la región, además posee una emisión de sonido en lengua nahuatl y español: palabras, frases y diálogos. La parte principal consta de diversos sistemas electromecánicos que le permiten realizar movimientos sincronizados con los sonidos emitidos, proporcionando una comunicación expresiva, amistosa y atrayente. Con el desarrollo de este proyecto se logró la personificación de un prototipo para la enseñanza del lenguaje náhuatl para el fomento del aprendizaje de un idioma que se estaba perdiendo.

Población indígena, Nahuatl, Enseñanza

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* Correspondence of the Author (E-mail: gcquiroz1977@gmail.com)
† Researcher contributing as first author.

Introduction

In Mexico, 364 linguistic variants are spoken, grouped into 68 groupings and 11 linguistic families according to the National Institute of Indigenous Languages (INALI) Chiapas, Oaxaca, Veracruz, Puebla, Yucatan, Guerrero, Quintana Roo, Hidalgo, Campeche and San Luis Potosi are the states with the largest number of speakers of indigenous languages: Nahuatl, Maya, Mixteco, Tseltal, Zapoteco, Tzotzil, Otomi, Totonaco and Mazateco (INALI, 2015). This makes it one of the countries with the greatest linguistic diversity in the American continent (CENEJYD, 2010), i.e., a cultural heritage of all Mexicans, which we all have the task of caring for and promoting.

There are indigenous peoples who have already accepted that their language will disappear and thus think that part of their culture will be dispersed and that they will only be able to communicate in Spanish. However, others wish to reverse this trend of the disappearance of their languages and struggle to preserve and strengthen them in many different ways (INALI, 2012). Faced with this problem, INALI has implemented various strategies to prevent their extinction, such as standardization, which is the rescue of the language spoken in each village to put it in a position similar to the dominant language, in this case Spanish. Another project carried out by INALI for the defense and promotion of Mexican indigenous languages is the launching of a compact disc with popular music translated into 12 indigenous languages: Otomí, Zapoteco, Totonaco, Paipai, Tsotsil, Zoque, Maya, Nahuatl, Huichol, Seri, Mixteco and Purépecha (INALI, 2015).

During the last few years there have been several proposals that try to reverse this trend of the disappearance of mother tongues in our country. Among those that stand out are the new technologies that have allowed for greater interaction and communication between people and the possibility of sharing information. These advantages have been taken advantage of by different sectors related to education in Mexico, since they make it possible to expand the school coverage of existing models or to implement a different model (Heredia, 2010).

In 2016, researchers from the Universidad de la Sierra Juárez in the state of Oaxaca proposed a Native Language Learning System, which consists of a collaborative web application to collect, preserve and promote the use of native (or mother) languages of the regions of the State of Oaxaca in the medium term (Valdez et al., 2016). An important contribution in this context was proposed by researchers from the Instituto Tecnológico Superior de Huatusco, which developed a mobile application as a learning tool for Nahuatl in the Orizabese variant, with specific functionalities that help, along with the use of the senses such as sight and hearing, to have a better understanding of the Nahuatl language in the Orizabense variant (Mirón, et al., 2017). Another application to preserve the Mexican cultural baggage, is the Tozcatl application with which you can learn Nahuatl at a basic level and was created by the poblanos Daniel Cuaxiloa and Rigoberto Dominguez, which is composed of 5 levels and the vocabulary is divided into topics such as: greetings, colors, animals, family and everything necessary to begin to understand and speak this language (Axcan, 2016) and (Flounas, 2019). Later, another even more didactic application was developed, since it shows a scenario with various drawings where animals, kitchen utensils or places of a village are shown. Touching each drawing plays an audio where you can hear a word in Nahuatl (Apkpure, 2018).

Regarding the educational aspect, researchers from the National Institute of Astrophysics, Optics and Electronics (INAOE) designed a collection of dolls for the learning of native languages among children from indigenous communities. The dolls are aimed at children between 2 and 4 years old with various types of games. When turned on, the dolls greet and start interacting (INAOE, 2018). Similarly, engineers from the Instituto Tecnológico Superior de Acatlán de Osorio created an electronic doll to disseminate the Mixteco language and safeguard the cultural heritage of the lower Mixteca region of the state of Puebla (Fuentes, et al., 2021). It is clear that it is important to establish educational programs for the preservation of indigenous languages, where the focus is on the educational aspect.

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This project aims to cause great impact in the social area of the state of Puebla with a focus on the Sierra Norte de Puebla. Giving a proposed solution to the problem of the loss of the Nahuatl language in this region, providing the Nahuas a work using innovation and technology, which will make it more attractive to young people encouraging them to rescue their mother tongue, planting in them the seed for academic study, which will be an inspiration to not feel excluded by ethnicity demonstrating that they can also carry out projects with a focus on their roots. It is important to preserve the Nahuatl language in our region avoiding the loss of a cultural heritage, preserving the identity of the Nahuas without them feeling excluded by discrimination, motivating them to preserve their roots at all times, using the process of unified development resulting in an animatronic with characteristics of a child, which is manufactured to speak Nahuatl and Spanish through practical activities such as greeting, numbering, parts of the human body, everyday words, sentences and dialogues.

The development of this project is divided into the following sections:

Methodology

The steps followed for the development of the project are described.

Results

This section analyzes the results to determine whether the aforementioned objective has been achieved.

Acknowledgments

We would like to thank the people and institutions that made this research possible.

Conclusions

The objectives satisfactorily achieved are discussed.

Methodology

The main objective of this project is to provide an animatronic that is able to speak the Nahuatl language at a basic level, to provide communities with an alternative, to prevent the extinction of the language, as well as contribute to the rescue, dissemination, preservation, development, teaching and learning of the Nahuatl language of the region. For the development of the prototype, the Rational Unified Process (Rational Unified Process) was chosen as a methodology, which is a software development process and together with the Unified Modeling Language (UML) constitutes a standard methodology for object-oriented analysis and documentation, see Figure 1.

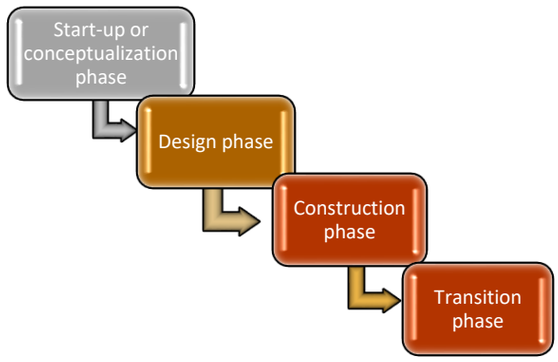

Figure 1 Block diagram of the procedure to follow
Source: own elaboration

Start-up or conceptualization phase

At this stage, through ideas, the ideal concepts were generated for the animatronic system to comply with the following characteristics: it should have the shape of a child (humanoid shape), with a cartoon design that would be acceptable to children, as well as automatic movements in the eyes, eyelids and mouth and a mechanical movement of the head and upper and lower limbs, in addition to a friendly expression and attire of the Nahua group from the northern region of the State of Puebla (see Figure 2).

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Figure 2 Conceptualization of animatronics
Source: own elaboration

For the design of the head, it was considered that it should resemble a cartoon image simulating the body of a Nahua child between 8 and 10 years of age, with a dark complexion, black hair, expressive eyes, and head proportionally larger than the body, bare hands and feet.

A. Design phase

The animatronic is mainly composed of the head containing control and audio systems, which is placed on a base (the body). The animatronic has automatic movements in the eyes, eyelids and mouth and a mechanical movement of the head and upper and lower extremities, see Figure 3.

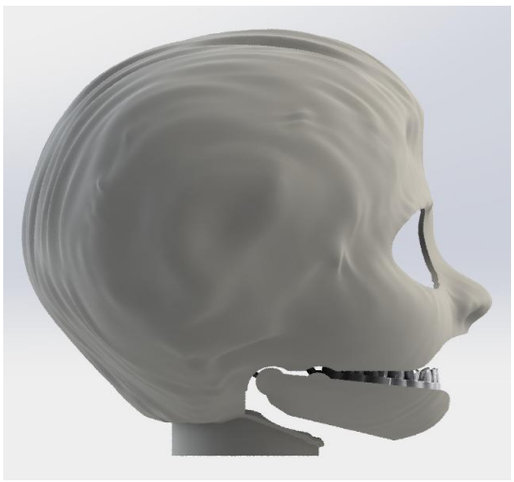

Figure 3 Preview of the animatronic head design
Source: Own elaboration

And to make the animatronic more eye-catching, a system was developed that is able to perform a synchronized jaw movement with the sound, simulating that the animatronic is talking. Finally, in the **¡Error! No se e ncuentra el origen de la referencia.** 4 shows the complete assembly of the aforementioned pieces, resulting in the design of the animatronic head.

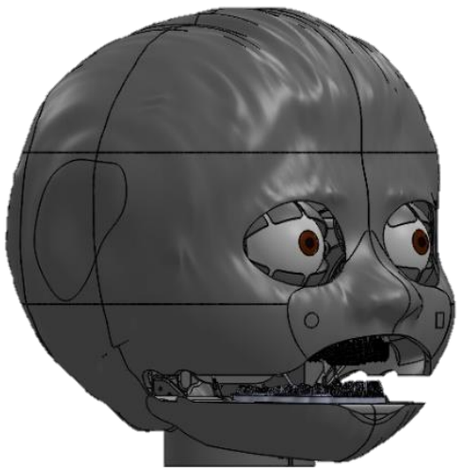

Figure 4 Final view of animatronic head
Source: own elaboration

B. Construction phase

The entire head structure of the animatronic system was manufactured with a polymeric material, PLA (polylactic acid) is a polymer with properties similar to PET with biodegradable qualities, in addition, the thermoplastic contains base materials obtained from corn, cassava or sugar cane starch, which makes our product environmentally friendly (See Figure 5).

Figure 5 Animatronic head general assembly
Source: own elaboration

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To give the animatronic an aesthetic view, a humanistic customization of the puppet was made, a silicone mask was made, the eyes were finished as real as possible and a body was created in which an analog study of the character had to be done first to determine proportions, scales and real dimensions.

Figure 6 Silicone mask for the animatronics
Source: own elaboration

Fulfilling the objective of giving physical features to the animatronic, the mask was created, starting with the sculpting of the shell and then applying a clay asilation to be able to fill with silicone and make the negative of the mold, to place the negative, a rigid shell was made to be filled with silicone with 25% stretch and finally a transportation shell was made. Once the pertinent corrections were made to the mask, it was given an aesthetic finish by adding eyebrows, eye finish, makeup, hair and real eyelid finish, see Figure 7.

Figure 7 Front view of the animatronic
Source: own elaboration

For the body, the hands and feet were manufactured with finger movement in order to interact more closely with the animatronic, the torso and limbs were filled with rigid foam to give it a soft feeling when touched. Before the complete assembly, the typical clothes of the Nahua people of the northern highlands of the state of Puebla were made for the animatronic puppet using quadrillé, considering the opinions obtained from the inhabitants of the region, see Figure 8.

Figure 8 Animatronic puppet's clothing
Source: own elaboration

C. Transition phase

The use tests of the animatronic system included design tests, manufacturing tests (filling, 3D printing time, assembly, assembly time and amount of material used), user tests comprising the operation of the animatronic and audio tests for the pronunciation of the Nahuatl and Spanish languages. In addition, it was verified that it had the capacity to perform a synchronized movement of the jaw with the sound, simulating that the animatronic is speaking. At this stage, an analysis of the verification results was carried out to detect any relevant error in order to make the necessary adjustments to the design. These analyses gave the possibility to correct some details of design, manufacturing, electronic and control design.

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Results

Once corrected all the pertinent corrections in the design, manufacture, electronic system, audio and control, the animatronic system was manufactured again, obtaining as final result the 3D design and manufacture of the animatronic puppet, which can perform routines in the eyes, eyelids and mouth automatically and a mechanical movement of the head and upper and lower limbs, It also has a friendly expression with an attire of the region with physical characteristics of the Nahua people of the Sierra Norte de Puebla, as shown in Figure 9.

Figure 9 Animatronic system for the promotion of Nahuatl language learning
Source: own elaboration

The proposed animatronic system is an alternative to teach Nahuatl in an attractive way. An outstanding aspect that the device has is the ability to promote the Nahuatl language, which has 5 levels of teaching, starting from words such as body parts, numbers, names of objects, to the reproduction of phrases to introduce themselves, stories and legends, for children and people who want or need to start learning the language, or for those who wish to identify themselves with a character that speaks their own language and does it with pride, where the configuration of the characteristic structural elements of the animatronic allows to offer the advantage of teaching Nahuatl in a fun and participatory way, it also has functions that allow to observe expressions of joy while phrases are reproduced in the Nahuatl language.

Without limiting the scope of the animatronic system, the device can also count with the integration of a reprogrammable media processor that allows it to be adapted to the needs of each audience, in levels of complexity, so it could be presented to an audience that does not master any of the Nahuatl language or on the contrary with an audience that is a 100% Nahuatl speaker.

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Conclusions

The animatronic built, meets the proposed objective, since it allows experimental tests with microcontrollers and servomotors. And with this, the personification of a prototype for the teaching of the Nahuatl language was achieved.

The final result of the animatronic gives a view of how mechatronic engineering can contribute in many areas, and as seen in this case, it comes to be a preservation of a language that, as time goes by, less people are interested in knowing. With the help of the animatronic, the indigenous language of the northern highlands of Puebla will be taught to future generations in exhibitions and school visits, hoping that people will be interested in learning more about the language, as well as in the design of the animatronic, which involved a varied use of knowledge of various kinds, but all focused on the automation of the animatronic.

Although the animatronic still has small details such as the uneven movement of the eyes, it is functional to fulfill its purpose, future corrections and additions will be made, such as adding the audio analyzer to synchronize the jaw with the captured audio frequencies, the use of the new board for the components for a better organization of the electronics, use of voltage regulators instead of UBEC for the servo controller board and changes in speeds within the programming, all this will be done to perfect the design and be an educational conduit for learning the Nahuatl language.

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