

Towards the Design of Robots Inspired in Ancient Cultures as Educational Tools

Christian Penalzoa^(✉), Cesar Lucho, and Francisco Cuellar

Pontificia Universidad Catolica del Peru (PUCP), Lima, Peru
{cpenaloza,cesar.lucho,cuellar.ff}@pucp.pe

Abstract. The use of robots as educational tools has demonstrated to be highly effective for attracting students to science and technology related academic fields. Although these academic fields are very important, we believe that other subjects such as language, music, arts, literature, history, etc., are also essential for future generations. For this reason, the goal of this research is to explore the potential use of robots as educational tools for non-technology related fields such as history. We discuss an alternative approach for designing robots inspired in traits and characteristics of historical figures that play an important role in the topic to be studied. We provide several examples of conceptual designs of robots inspired in ancient gods or historical characters of Mesoamerican and South American cultures. We discuss how some of the traits of ancient gods and characters could serve as inspiration for the appearance design of commercial robots, and how these robots could be used in educational environments to attract the attention of students to learn about this history topic.

1 Introduction

Robots have been used around the world in workshops for children as educational tools for experimenting with concepts that go from mobile robots [1] to the acquisition of physics knowledge through programming robotic platforms [2]. These types of workshops have demonstrated to be highly effective in attracting the interest of children and increasing the achievement scores in an informal learning environment [3]. The most commonly preferred tool is the LEGO Robotic Kit created as the expression of constructivist learning [4]. One of the first institutions to use this robotic kit as an educational tool was the Carnegie Mellon University and the results of years of experience are highly satisfactory [5].

Until now, the main goal of the use of robots as educational tools has been focused on attracting students to science and technology related areas for majors such as physics, math, computer science, electrical and computer engineering [6]. Although these academic fields are important for the development and economic growth of a country, other academic fields such as language, music, arts, literature, history, etc., are also essential for creating an identity for future generations. We believe that science and technology should be used to generate knowledge about non-technical topics, in particular about culture since cultural

development is a source of creativity. For this reason, the goal of this research is to explore the potential use of robots as educational tools for non-technology related fields such as cultural studies and history. Our aim is to enhance and enrich the experience of learning, as well as to attract the interest of students so they can appreciate the cultural aspects of history through robotic platforms.

2 Alternative Approach for Robot Design

Robot appearance design plays an important role in how people perceive the robot and get attracted to them. So far, most robot designs are based on proposals of experts, such as Kismet developed by Breazel *et al.* [8], or human-like Geminoid developed by Prof. Ishiguro [7]. However, robot design can highly affect the perspective of the people who interact with, as suggested by Bartneck *et al.* [9] who investigated the negative attitudes toward robots that people have.

Instead of using an arbitrary design proposed by a particular research group or person, we suggest that robot design for educational purposes should take inspiration from the academic topic to be studied. For example, we present the concept of a robot design to be used as an educational tool for the academic field of ancient history. Although ancient history covers a wide variety of topics, we chose to design our first robotic prototypes to study the cultural aspects of ancient Mesoamerican and South American religious belief history. In this sense, we take some design concepts from famous characters that play an important role in this particular topic, and use these concepts as inspiration for the design of the robot appearance, as detailed in the following section.

3 Ancient Cultural Based Robot Design

Mesoamerican religious belief history is perhaps one of the crucial topics to understand the roots of cultural practices that influenced economic and military activities of ancient cultures such as the Maya or Aztecs in the period that lies within the late pre-classic to early classic period (400 BC 600 AD) of Mesoamerican chronology [10]. Some of those cultural practices and even territorial domains still are alive today in territories such as the southern part of Mexico and Central America.

In ancient Mesoamerican beliefs, the existence of an extensive and complex array of deities and gods not only explained the origins of the world but also served as models for human behavior for commoners and elites alike [11]. We take the example of Quetzalcoatl (pron. Quet-zal-co-atl), one of the most important gods in ancient Mesoamerica, whose name comes from the Nahuatl language meaning “feathered serpent” and was regarded as the god of winds and rain and as the creator of the world and mankind [11].

In order to take some of the concepts of Quetzalcoatl and portrait them into a robot design, we explored the actual meaning of the name which is a combination of the Nahuatl words for the *quetzal* - the emerald plumed bird Fig. 1b - and *coatl* - rattle snake Fig. 1c. Although there are some pictorial representations of

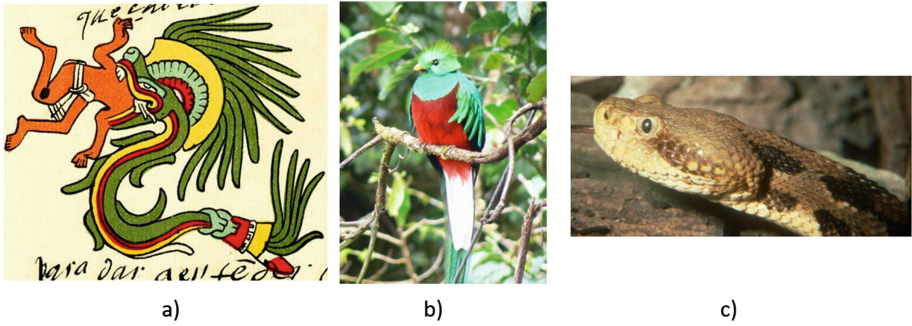


Fig. 1. (a) portrait from the Codex Telleriano-Remensis, (b) Emerald plumed bird, (c) Rattle snake

Quetzalcoatl that give more emphasis on the serpent characteristics, such as the one portrayed in the Codex Telleriano-Remensis [12], shown in Fig. 1a, we also considered emphasizing the characteristics of the emerald plumed bird.

Figure 2 shows the conceptual design that portrays our representation of Quetzalcoatl as a flying robot (characteristic of the Quetzal bird) with its corresponding colors of green-yellow red that are also emphasized in the portrait of Codex Telleriano-Remensis. On the other hand, the head and tail of the robot are inspired on the rattle snake. This robot could be realized from a commercial flying robot such as Parrot AR.Drone [13], or in our case, using a custom-built drone robot. Nowadays there are commercial drone robots that are inexpensive and can be operated with a smartphone or tablet. Most importantly, they are easy to use even for people without technical background.

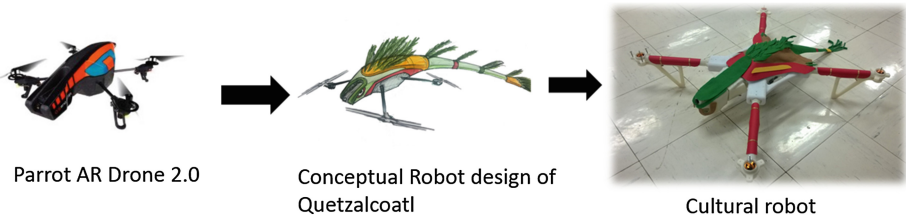


Fig. 2. Quetzalcoatl conceptual robot design (Color figure online)

In the same way, we can also take the example of Xbalanque (pron. X-balam-ke) one of the twins (along with Hunahpu) considered as a mythical ancestor to the Maya ruling lineages, and whose narrative is included in the famous book of Popol Vuh [14]. Figure 3a shows the commercial robot Nao from Aldebaran representing Xbalanque. The appearance takes into consideration the humanoid traits described in the Popol Vuh. On the other hand, the name of Xbalanque could be translated from the Maya language as ‘Jaguar Deer’ and thus could

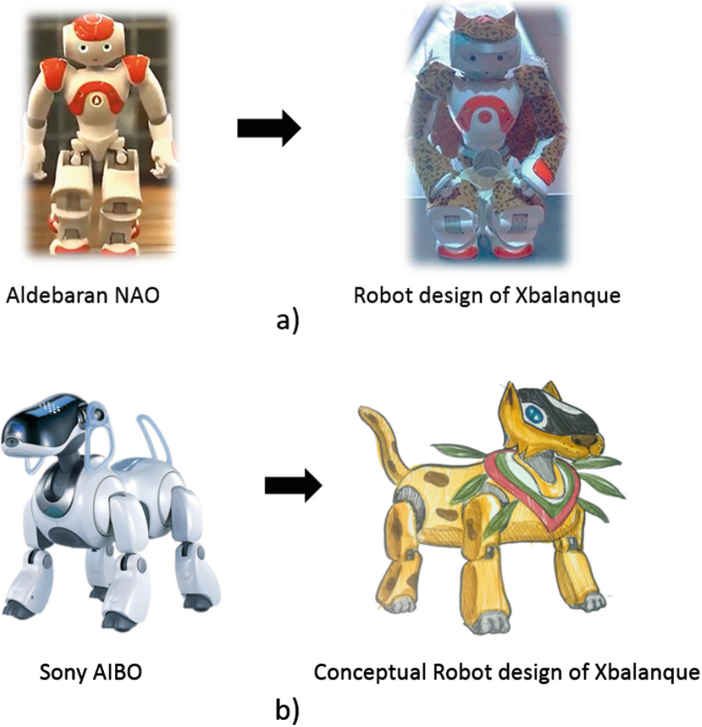


Fig. 3. Xbalanque conceptual robot design

also be used as inspiration for the appearance of a robot as shown in Fig. 3b that uses as baseline the commercial robot AIBO from Sony company.

Apart from Mesoamerica, there are also numerous South American ancient cultures. One of the most representative from pre-Columbus chronology (1438–1533 AD) is the Inca culture. The number of gods of this Andean society is large, and many of them have an anthropomorphic appearance. In the Inca's beliefs, their gods were able to communicate with humans through their representations in stone, metal or wood which become alive figures [15]. As an example Wiracocha, identified as the most important god due to the fact that he brought “light into darkness”, has seven eyes around his head that allowed him to watch everything around the world. He ordered the world and allocated the sun and the moon at the sky creating light, and then ordered humans to leave their caves. A representation of Wiracocha in stone is shown in Fig. 4, along with the conceptual design of a humanoid robot that poses the traits mentioned.

Although there are other historical characters that are representative of Inca culture, the king Pachacutec is perhaps one of the most well-known in the history. Pachacutec was the ninth Inca king of the Kingdom of Cusco which he transformed into the Inca Empire, and it is believed that the famous Inca site of Machu Picchu was built as an estate for Pachacutec [16]. The conceptual design

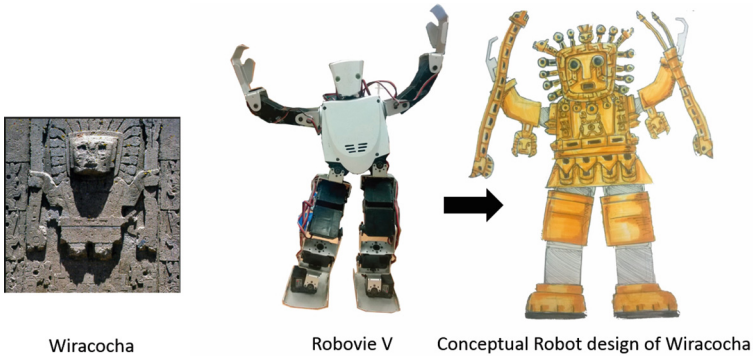


Fig. 4. Wiracocha conceptual robot design

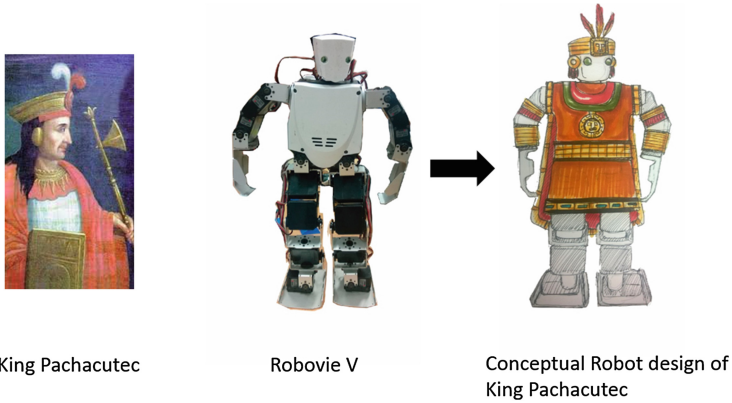


Fig. 5. Panchacutec conceptual robot design

of a humanoid robot inspired in the traditional clothes used by Inca rulers of that time is shown in Fig. 5.

4 Ancient Cultural Robot as Educational Tool

As shown in the previous section, all conceptual prototypes are based on commercial robots that could be easily acquired by academic institutions. These robots can be operated with personalized application software installed in a smartphone or tablet, and are easy to use even for people without technical background. Moreover, the easy access to these robots would allow our methodology to be widely used in schools or museums where the topics of ancient pre-Columbus Mesoamerican and South American religious belief are first taught to students.

4.1 Learning by Building Robots

In this section, we propose a particular educational activity whose main goal is to allow students to learn about historic facts and characters in an interactive manner by applying the concept of robot design proposed in this paper.

Our approach consists of educational elements that have proved to be effective for educational purposes, such as team work, discussion, idea proposal and presentation. In particular the proposed activity is described as follows:

- Team Work - create several teams of students.
- Assign Character - assign each team a particular character of the ancient culture such as a god, king, etc.
- Learn and Discuss - allow each team to learn and discuss about the important characteristics or important facts about their assigned character.
- Propose - students should propose ideas of how the important traits could be used for the design of a robot.
- Do - Allow each team to adapt a commercial robot according to their proposed design.
- Present - Each team should make a presentation in front of the other teams about the ancient character assigned to them and the traits they chose to design the appearance of the robot.
- Demonstrate - Make a robot demonstration

Although the educational activity focuses on the learning of ancient religious beliefs of Mesoamerica and South America, this approach could be easily used for other academic subjects.

5 Conclusion

In this paper we proposed the potential use of robots as educational tools for non-technology related fields. Moreover, we proposed an alternative approach for designing robots inspired in traits and characteristics of historical figures that play an important role in the topic to be studied. As an example, we presented the conceptual design robots inspired in ancient gods and historical figures of Mesoamerican and South American cultures. We discussed how some of the traits of these ancient characters could serve as inspiration for the appearance design of commercial robots. Finally, we proposed an educational activity that will allow students to learn about the historic facts and characters in an interactive manner by applying the concept of robot design.

References

1. Jimenez, E., Caicedo, E., Bacca, E.: Tool for experimenting with concepts of mobile robotics as applied to childrens education. *IEEE Trans. Educ.* **53**(1), 88–95 (2010)
2. Williams, D., Ma, Y., Prejean, L., Lai, G., Ford, M.: Acquisition of physics content knowledge and scientific inquiry skills in a robotics summer camp. *J. Res. Technol. Educ.* **40**(2), 201–216 (2007)

3. Barker, B., Ansorge, J.: Robotics as means to increase achievement scores in an informal learning environment. *J. Res. Technol. Educ.* **39**(3), 229–243 (2007)
4. Papert, S.A.: *Mindstorms: Children, Computers, and Powerful Ideas*, 2nd edn. Basic Books, New York (1993)
5. Carnegie mellon robotics academy official webpage (2013). <http://www.education.rec.ri.cmu.edu/>
6. Ruiz-del-Solar, J.: Robotics-centered outreach activities: an integrated approach. *IEEE Trans. Educ.* **53**(1), 38–45 (2010)
7. Breazeal, C.: *Designing Sociable Robots*. MIT Press, Cambridge (2003)
8. Sakamoto, D., Ishiguro, H.: Geminoid: remote-controlled android system for studying human presence. *Kansei Eng. Int.* **8**(1), 3–9 (2009)
9. N. T. Bartneck C., S. T. Kanda T., y Kennusuke K.: Cultural differences in attitudes towards robots. In: *Proceedings of the AISB Convention*, HATfield (2005)
10. Kent Reilly III, F.: Mesoamerican Religious Beliefs: The Practices and Practitioners. *The Oxford Handbook of Mesoamerican Archaeology*, November 2012
11. Taube, K.A.: Creation, Cosmology: Gods and Mythic Origins in Ancient Mesoamerica. *The Oxford Handbook of Mesoamerican Archaeology*, November 2012
12. Evans, S.T., Keber, E.Q.: Ritual, divination, and history in a pictorial aztec manuscript. *Ethnohistory* **44**(2), 419–420 (1997)
13. Parrot AR.Drone 2.0. <http://www.ardrone2.parrot.com/>
14. Coe, M.D.: Myth and image. In: Kerr, B., Kerr, J. (eds.) *The Maya Vase Book: A Corpus of Rollout Photographs of Maya Vases*, Justin Kerr (illus.), vol. 1, pp. 161–184. Kerr Associates, New York (1989)
15. Hampe Martinez, T.: Teodoro. *Historia del Peru Lexus* (2000). ISBN 9972-625-35-4
16. Rowe, J.: Machu Picchu a la luz de documentos de siglo XVI. *Historia* **16**(1), 139–154 (1990). Lima