Civic Engagement Projects for Electrical and Computing Engineering Students

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Abstract

This paper will discuss the involvement of undergraduate students from the electrical and computer engineering program in civic engagement projects. The main objectives of these projects are: 1) allow students to participate in an activity that meets identified community needs, 2) allow the students to gain further understanding in their area of specialty, and at the same time, 3) enhance their sense of civic responsibility.

To start identifying possible projects for the ECE students, faculty from the ECE department at the University of Minnesota Duluth met with educators and parents of children with special needs from the Duluth district, to identify some of the necessities that could be addressed by student with knowledge and skills in the electrical and computer engineering field. Two main projects were identified. The first project was to have an intelligent toy that could obey voice commands. This toy could motivate children, who are visually impaired, to interact with their environment. The second project was to modify a remote control car in order that it could be controlled by special switches, the type that is used by people with gross motor skills. These toys were tested with some of the children and results are presented in the paper.

1.- Introduction

Civic engagement, sometimes also called service learning or public engagement is not new. It has been widely used in liberal arts and education programs as an effective method to provide authentic learning experience for students. Civic engagement [1,2] combines community service with academic instruction focusing on critical, reflective thinking and civic responsibility. Civic engagement addresses local needs, while developing students' academic skills, sense of civic responsibilities, and commitment to the community.

In engineering, civic engagement is relatively new, and in the last decade it has becoming an important element in engineering education. Civic engagement makes students be more aware of their community and how their technical skills can be used to benefit and retribute society, by addressing some of the community problems and to make a difference in their community.

For example at Purdue University, the EPICS program [3] was established several years ago and has been proved to be an effective way to involve students in engineering projects that contribute in some way to benefit their community.

Recently, at the University of Minnesota Duluth, the involvement of students in civic engagement activities has becoming more important and faculty in all areas are encouraged to work with their students in projects, that in some way, can make an impact in their community. In particular, the Electrical and Computer Engineering (ECE) department has started to be aware of the importance of involving ECE students in projects that can have some civic engagement component. Adding civic engagement components in engineering courses is part of the growing globalization where engineering students must become more aware of the impact that technology can have in the communities. Civic engagement will help students to become more socially responsible and be prepared to address the needs of their community, as well as to make more ethical decisions and have social conscience about how their decisions affect society.

In this paper we describe our first experience in including a civic engagement component as a pedagogical approach that allows students to develop their academic skills while serving the needs of a community.

2.- Background and Motivation

In order to include civic engagement in our ECE program, we had to decide first in what way we wanted to incorporate it. We envisioned four possible ways. 1. Through a course, where the topics covered in that course could, in some way, address community problems and find possible solutions. 2. Through an independent study, where academic goals could be achieved through a project that would address community issues. 3. Through the development of a senior design project where the problem to be solved would be related to community issues and students should use their academic and technical skills they have learned in the ECE program. 4. Address a community problem through the undergraduate research opportunity program (UROP). In this program students submit to the College of Science and Engineering a research proposal which will be developed under the advising of a faculty member. If the research proposal is approved, the student will receive a stipend to develop the project. We found this last option to be the most suitable to start with a civil engagement project since it only involved a small group of students that could be better monitored.

The next step was to identify what type of projects we wanted to develop. The projects should have civic engagement components as well as a need of electrical and computer engineering skills. Because our successful experience in advising projects related with robotics and intelligent systems [4-6], we decided to focus in this area. In recent years, researchers have been investigating robotic toys as a therapy partner for children with autism [7, 8]. Robotics has also been applied to assist people with disabilities [9, 10]. Therefore we decided to focus our effort in projects that could apply robotics and intelligent systems to help people with disabilities. The following step was to find a partner in our community to work with, and identify real life problems that our students could address. We started by contacting two institutions, the Vision Loss Resources Center in Minneapolis, and the Duluth center for children with special needs. We met with the coordinators of these centers to discuss our ideas and obtain their viewpoints. Both institutions expressed their interest in collaborating with us, and helping us to identify possible

projects that our students could develop, and at the same time, could be useful for their institutions. Following this, students interested in participating in this type of projects had to be identified. Two students were chosen, and meetings with our partner institutions were scheduled. In the meeting students discussed and exchanged ideas with the coordinators of our partner institutions about possible projects. As result of this, two projects were defined. The first project was to have a robotic pet that could be controlled by voice commands in such a way that children who are blind or visually impaired could interact with it. The second project was directed toward a particular child with a brain injury that restricts him to have only gross motor skills. Because the particular interest of this child in cars, it was proposed to modify a remote control car in such a way that this child could in some way control the car. In the next section the details and results of the developed projects are explained.

3.- Project I: Intelligent Robotic Pet.

The objective of this project was to investigate the interaction of visually impaired children with an intelligent robotic pet in order to evaluate if these interactions could contribute to the improvement of the social development of the children. For the development of this project, the Sony Aibo robotic dog [11] was used to assist young children who are visually impaired, in the process of learning to interact with their surroundings. The Sony Aibo robot was modified and programmed to interact with the children. The Sony Aibo dog has vision, audio and touch sensing devices which facilitates the programming of the robot with various actions and voices. Touch sensors are located at the chin, head and back of the robot. Its limbs are flexible and allow the robotic dog to move in any direction. The robot also has a camera that can be used to detect objects according to their shape and/or color. The robotic toy was programmed for different behaviors and actions including the generation of music and different movements. In order to select the different behaviors and actions, our students met with the coordinators of our community partners to decide the type of actions that could be of interest to the children who are visually impaired.

To identify the possible children that could be interested in participate in our project, we had the help of our community partners. After the consent of parents and children, a first meeting was scheduled with the families interested in participate in our project. There were five children and their families that attended this first meeting. It was explained to the children and their parents about our project. From the result of this meeting, three children and their parents accepted to participate in our project. An individual meeting with each family was scheduled. In the individual meeting our students worked with the child, explaining about the Sony Aibo robot and showing him (her) how to interact with the robotic toy. The responses of the children to the robotic toy were very positive, and the students obtained useful feedback from the children and their parents about ways to improve the robotic toy. With our second community partner, there were another three children with disabilities that participated in our project.

4.- Project II: Remote control car for children with gross motor skills and speech disorders.

The objective of this project was to have a remote control car that could be controlled by children with gross motor skills, as well as by children with speech disorders. In particular we wanted to test the car with one of the children that was identified as a possible participant during the meetings with our community partners. In the development of this project, an out of the shelf

remote control car was modified to incorporate two of the special switches that are used by people with gross motor skills. This remote control car will also feature a user dependent voice recognition system. This feature will allow us to train the system to recognize the words or sounds that children with speech disorders can handle. Our goal is to have a remote control car that will recognize and execute voice commands that a particular child can produce. With this, we hope that children with speech disorder can be motivated to practice and improve their speech skills.

5.- Results and Conclusion

The Sony Aibo was programmed to respond to several voice commands. Among the most popular commands for the children were: dance, howl, sit, walk, stand, pink ball, happy, sad. With each command the Sony Aibo also emitted a specific sound and light pattern with the LEDs located in it head and tail. The programmed robotic dog was presented to six different children, in an individual way. One of the children who was 10 years old and totally blind, did not really showany enthusiasm about interacting with the robotic dog. A second child, who was 8 years old, and partially blind, showed a great enthusiasm in interacting with the robot. This child enjoyed given the commands to the dog and in particular, loved the task where the robot follows a pink ball. A third child, 5 years old and partially blind also interacted with the robotic toy, but did not show much interest or enthusiasm in giving the voice commands. From comments with this child, it seemed that the texture of the robotic dog was not very appealing to her. She mentioned that would be very good if the robot could look more similar to real pet, with a kind of furry texture. The other three children had speech disorders, and although they did not were able to give the commands to the robotic dog, they really enjoyed watching how the robotic dog obeyed the commands given by our students. A positive response observed by the children's teachers was that after seeing the way that our students gave the commands, the children also try to give the commands to the toy, resulting in a good way to motivate the children to practice their speech skills.

With respect to the second project, the remote control car for children with gross motor skills, it is still in progress. The special buttons have been incorporated to the car, but the part with the user dependent voice recognition system has not been completed yet. We are planning to have the car ready to test with the children by the end of the fall semester.

From our work with the children it seems that this type of robotic toys could benefit more children who are partially blind as well as children that have some type of speech disorders. The children with some vision were able to see what the dog is actually doing, along with listening to its response and other sounds. Most of the children were amused by the dog's response to their voice commands. Some prefer the ball tracking actions of the dog. It was observed that the children with speech disorder, attempted to repeat the voice commands once they heard it. They also attempted to repeat the response given by the dog. Therefore, it can be concluded that this type of robotic toys can definitely motivate children with speech disorders to work in their speech commands, and hopefully help them to improve their overall speech. The more appealing and interesting the dog could be made; the children will be more willing to interact with it.

With the development of these projects, the original objectives for our ECE students were achieved. These projects allowed the ECE students to interact with the local community and apply their knowledge and technical skills to address some of the real life problems in the community.

Fig 1. Children who are visually impaired, interacting with the Sony Aibo.

Fig 2. A Child with speech disorder, attempting to command the robotic dog

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