Online Simulation in Robotic Education

(Undergraduate)

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1. ABSTRACT

This paper describes ongoing work on Virtual Cozmo, an online simulator that allows students being introduced to robotics with the Anki Cozmo robot, to try out their algorithms in an easy to use drag and drop interface and see how that algorithm can be translated into Python code. The code generated can then be used on an actual Cozmo robot when it becomes available. The goal of this study is to see how much using the online simulator improves the learning experience of students in an undergraduate Introduction to Robotics class.

2. INTRODUCTION

The Virtual Cozmo project is focused on developing an online simulator for the Anki Cozmo robot which will help introduce students to programming and robotics field in general. The simulator consists of a drag-and-drop canvas where students can select commands and build an algorithm based on selected commands, an area that contains the equivalent python code based on the algorithm in the canvas, and an area for simulation. In this study, we will investigate the impact of using an online simulator on students getting introduced to robotics, users who do not have access to the actual robots, and users who need a faster way of developing programs to run on the Cozmo robots. While studies in the past have studied the impact of simulation in teaching robotics, the goal of this project is to expand on those studies by testing for the impact of web-based simulation on teaching robotics to beginners.

3. RESEARCH PROBLEMS

The first goal of this research is to examine the impact of having access to an online simulator has on students just getting introduced to robotics. Beyond giving students access to the online simulator, we will also examine how having access to the online simulator will help them in their understanding of the concepts taught in class. We will also study how making use of an online simulator will speed up the robot-control development cycle when compared with coding and testing on the physical Cozmo robots.

4. RELATED WORK

Our research builds on related research in robotics, robotics simulation, and their impact on education. In the area of robotics simulation, researchers have studied the development of a robotic simulator that allows the simulation of user-defined robots in three-dimension spaces [1]. Studies have also been carried out on developing realistic simulators that help simulate vision-centric balancing robots like the Segway RMP and the Sony AIBO [2]. Work has been done on developing a self-perpetuating STEM pipeline built around robotic activities that will help more grade students choose careers in the field [3]. Researchers have also studied the perceptions of students just being introduced to robotic technology, the usefulness of robots as a teaching tool, and how it can aid students' development [4] [5]. In April 2020, iRobot launched an online simulator, complete with an online robotics curriculum, aimed at introducing kids to programming and robotics with the Root robot [6].

These different works collectively give us an idea of the parameters to consider as we continue to develop our online simulator, the role Robots are already playing in education, and how online simulation is being used in fields outside of education. However, studies are yet to be done on how online robot simulation can be used as an educational tool, its impact on students' understanding of the concepts being taught in a robotics class or students not exposed to robotic hardware, and how online simulation can also affect students' coding times.

5. METHOD

The online simulator, Virtual Cozmo, consists of a command section divided into three sections: Motion, Operator, and Light. Each of these sections will perform functions similar to what is obtainable when python scripts are used to control the Cozmo robot. Virtual Cozmo consists of a user-friendly canvas section where participants can drag and drop the commands from the command section. It is in this canvas that users will be able to design the algorithms needed to run the simulation.

To the right, Virtual Cozmo also has a section that shows the simulation of the command blocks in the canvas section. This will be able to display a simulation of the virtual robot performing tasks like navigating an online maze. The code for the simulation will be loaded into the user's system increasing latency and limiting interaction with our server.

It also consists of a section to view the python code, and a feature to download the python code which can then be used to control a

physical Anki Cozmo robot. The underlying infrastructure for the online simulator is currently being built as a static website with the simulation carried out with the help of the jQuery library. In the future, we plan on making use of the open-source Blockly library for better user experience. A snapshot of the current simulation is shown in Figure 2 below.

5.1 Data Collection

The participants will be exposed to the simulator in a counter-balanced order where each group will be allowed access to the simulator in order and their reactions gauged pre and post-interaction while taking their Introduction to Robotics course. This will last for approximately four months. The questionnaire given before the participants use the simulator will ask questions about their perception of robotics as a field, their expected performance in the course, and their views on whether using the online simulator will help their learning. At the end of the interaction, we will test for those questions again to see if using the online simulator had an impact on their learning and their perception of robotics as a field. We will also gauge the rate at which using the online simulator helped speed up their design and code generation process.

Figure 1. An Anki Cozmo Robot

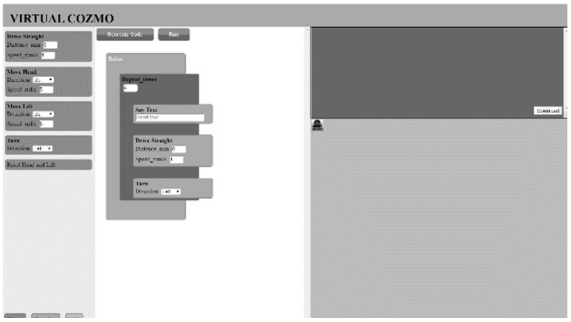

Figure 2. A Snapshot of Virtual Cozmo

6. EXPECTED CONCLUSION

From our study, and based on previous research papers read, we expect to see an increase in the performance and interest of participants after using the online platform. We also expect that making use of the online simulator will speed up the code development cycles for the students and help participants who lack direct access to the Cozmo robots to keep practicing even when the physical robots are not available. The need to facilitate learning in those situations has been heightened during this period of the pandemic. We expect using the simulator to be a fun learning experience for the students. Those are the conclusions we expect to reach through our study.

7. References

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