Web Application for Robotics Education

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Team 17
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Abstract

Team 17 will be developing a full stack web application that users can interact with to learn robotics principles. The web application will serve as a central hub consisting of multiple learning exercises. Users navigate to a clean yet elegant website to explore the various exercises. In each exercise, users can write their own robotics code and instantly see the output on the website. The application is written with performance in mind, as all processing of the user's code is done on the back end server. Consequently, users using low power devices such as smartphones and tablets can take advantage of this learning platform without sacrificing performance. The team will use well-established platforms to build the robotics web application, including HTML, Bootstrap, JavaScript, and Flask.

Project Description

The following is a description of the project, the requirements, the project's potential, and how the team will pursue developing the application.

Main goals and objectives

The main idea behind this project is to develop a robotics learning web application for students to learn robotics principles. In addition, one of the goals of this project is to allow mobile devices to interact with the robotics learning platform. This will give opportunities to students who primarily use mobile devices to interact with the platform. To achieve this, the team will develop a web application in which all computations are done on the server side. In addition, another goal for this project is to make the website fully responsive, allowing users to have a consistent experience no matter what size of device they use. All in all, providing a central and accessible hub for learning about robotics will be the main focus of the team's project.

Main functionality and characteristics

The robotics learning platform will require a publicly accessible website, a back-end server, a database, and robotics exercises. The team will design a website that serves as a central hub for all students to access the robotics exercises. The back-end server will serve up the content of the website and process the code given by users. The database will house the user's information and progress with each robotics exercise. Finally, the robotics exercises will be implemented on the website and provide a component in which the user can enter in code to be processed.

Intended audience

The project is primarily being developed with college students in mind. The robotics exercises that have been shared with the team are currently being used by students taking robotics classes. Students taking robotics are interested in combining computers and machinery, and having an engaging learning tool will help make these concepts more concrete. Therefore, the

project that the team is building will help meet the requirements in educating robotics students, as well as anyone else that is interested in these concepts.

Key usability goals

Upon the completion of the project, our team hopes to provide users with a simple, accessible, and efficient platform for learning the principles of robotics. Through the use of our robotics learning platform, users will have access to a visually appealing interface for learning the principles of robotics through experimentation in various environments. Additionally, users will be able to run robotics experiments remotely without the need for a powerful device or the installation of software. Finally, our team hopes to ensure that the platform is efficient such that end users can interact with the website and quickly retrieve feedback and results for any code that was input.

Potential for further development/product enhancements

Although our team hopes to provide end users with a platform that allows users to learn robotics on a variety of platforms with maximal ease of use, there are many ways that we can improve this product, including the addition of new environments, an API for advanced user interaction with the back end server, and further enhancements to the appearance of the website itself. The additions of new environments and enhanced interaction with the web server would provide users with more options for learning robotics principles, and continued refinement of the website's appearance would ensure the optimal user experience during their interaction with the web service.

Challenges and obstacles

There are a variety of challenges our team will need to overcome throughout the development of our project. The first challenge we will need to overcome is learning the various frameworks necessary for the implementation of our project. Throughout project development we will need to learn the Flask web framework, the Bootstrap CSS framework, and the OpenAI gym toolkit. Another challenge we will need to overcome is developing an intuitive and appealing user interface, which may involve expanding our knowledge of the JavaScript programming language in addition to learning the aforementioned Bootstrap CSS framework.

Technology description

Throughout the development of this project, our team intends to use a variety of languages including Python, JavaScript, HTML, and CSS. This project will be deployed using a publicly available website that is intended to be accessible on any device with access to a web browser. Currently, we plan to utilize Bootstrap, an open source CSS framework, in addition to basic HTML and JavaScript to develop our project's front end user interface. Additionally, we plan on using the Flask web framework for back end development and data processing. Robotics

experiments written by users will be reproduced using the OpenAI gym toolkit, which is a toolkit for developing and comparing reinforcement learning algorithms.

Team overview

Team 17 consists of four members with varying levels of experience regarding full stack web development. Zach has experience with developing websites using Bootstrap, CSS, and Django. He will help design the website and implement the back-end functionality. Sean has experience with the Django web framework, in addition to Python, HTML, and basic CSS. Sean is interested in database maintenance. Ryan has experience mainly with Python and understands the basics of HTML and CSS, and has a strong interest in doing anything involving writing, managing, and debugging code, which would be in regards to Python, JavaScript, SQL, and HTML / CSS. Herman has experience with Java and a bit of HTML, and is planning on coming up with the best design(s) for the application.

Advisory overview

We have two advisors we have on our mind that we'd like to enlist for this project. The first advisor that we have already reached out to and had agreed to work with us is Ben Gallagher, a security analyst at UNR. He has experience working with both front and back-end web development. The second advisor that we are still considering reaching out to will be David Feil-Seifer, an instructor at UNR. Robotics falls under Dr. Feil-Seifer's domain and we believe his knowledge could be invaluable for the project.

Professional growth

This project will aid us in our professional growth through having us learn and adapt to new professional softwares / platforms to successfully create our project. With such a large scale project, we will need to learn the thought process regarding how to plan ahead and thoroughly come up with a design before we begin implementing anything. We will furthermore improve how to work on a team to develop software - a skill that will be used with us for the entirety of our professional careers.

Social and environmental impact/benefits

This project will help improve society by creating an application that aims to teach robotics concepts as simply as possible. While this application teaches robotics - it will also improve the education of those interested in technology as well as students in computer science, computer engineering, and electrical engineering - three of the big fields responsible for improving society through advancements in technology.

Market Potential

The following is a brief analysis of the project's potential in the marketplace and any competitors that exhibit similar functionality to the proposed project.

Market analysis

The main market for this program would be the CS robotics students of UNR. A more advanced way to practice and test out code in real time will allow students to practice at home, and also means professors can better utilize this tool to grade and give feedback to students. The user interest is already here with the many types of robotics, artificial intelligence, and autonomous learning classes offered, students will very much utilize this tool a great deal.

Competitive analysis

Some similar or related products are other free online compilers. One major one is Repl.it which contains both java and python and compiles multiple files of code in it's online compiler. Some direct competition is mostly Repl.it as it contains both python and java to use as well as other IDEs as online compiling takes a bit longer and may be less reliable than using an IDE on a local machine.

Competitive Advantage

The more innovative characteristics of our solution is that it can compile and execute the code using a 3d model of a robot for students to manipulate. As well as allowing students to immediately turn in projects without having to import files. Unlike the competition, everything the students need to code the solution will be in one place so the student will not have to have different IDEs and compilers as it will all be easily accessible in one place.

Time Worked on Project Concept

Sean spent about 3 hours on this assignment and worked on the following sections: cover page, key usability goals, potential for future development, challenges and obstacles, and technology description. Ryan spent about 1.5 hours and worked on the following sections: team overview, advisory overview, and professional growth. Zach spent about 2 hours and worked on the following sections: abstract, main goals, main functionality, and intended audience. Herman spent about 1 hour and worked on the market potential section.