Gesture-Based Learning System for STEM Education

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Problem

According to the U.S. Department of Commerce, STEM occupations are growing 17% annually while others are growing at 9.8% annually. Shortage of STEM workers affects various industries. As the market for STEM positions grow, it is getting more difficult to find qualified workers. The Pew research center reported that most Americans believe educators are unequip to teach K-12 STEM education in the U.S. Some issues associated with this view on STEM include:

- **Cost** and **time** barriers
- Loss of **interest**
- Outdated **materials** and **curriculum**

Solution

The solution developed is a mobile, module gesture based learning system used for STEM recruitment and career readiness. Gesture recognition technology allows the audience to have a richer user experience that understands the human body language. Thereby, fueling the next wave of electronic innovation. This system aims to:

- be openly **available** to anyone in the community
- provide **information** on STEM in a **visually** rewarding way
- enhance individuals **professional skills** by providing **up to date** information in the STEM field

Technologies

NUITRACK unity intel REALSENSE TECHNOLOGY

Key Features

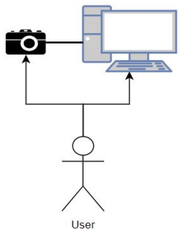
This system consists of 4 main features:

- **Interactive GUI with Gesture Support**
  - A main menu that allows the user to navigate through the system by way of gestures
- **Configurable Gesture Mapping**
  - Ability to configure gestures to perform desired actions.
- **Gamification Support**
  - Ability to access and play several games housed in the module. Allows for save spots and keeps high scores
- **Dynamic Content Addition**
  - Future developers can add content with tools the team has provided.

Results

As a result of development, what was built was an extensible, module based framework with gesture recognition included.

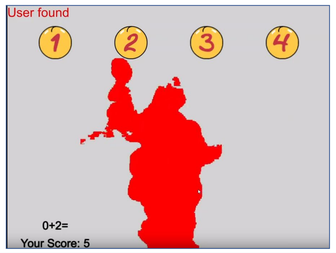
Set-up: The user connects the camera to the computer before starting the application.



System Screenshots:

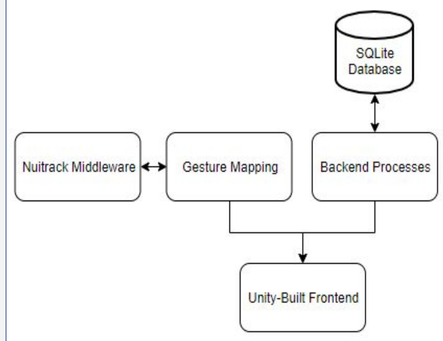
Main Menu: The user has access to other connected pages. A logged-in user will have a log out button and their username displayed.

Math Game: The user destroys the corresponding number bubble to a math equation with their body



Architecture Overview

Our software consists of 5 main components, which can be divided into 3 layers: the local SQLite database, all backend processes, and the Unity-built frontend.



- **SQLite Database:** This is responsible for storing user information, scores, etc.
- **Backend:** C# scripts for software processes and gesture mapping, achieved with the aid of Nuitrack.
- **Unity-Built Frontend**: Built with UI elements provided by Unity, a game development engine.

Software Testing

Unit Testing: For software testing the team used Unity Test Runner which is is Unity's integration of the NUnit library. We have built 16 unit tests that covers each of the major components of our system, such as login, gesture mapping, etc.

Implementation Testing: The team verified that data such as personal profiles were kept consistent throughout all parts of our system.

Usability Testing: While developing the product, the team was mindful with making a user friendly interface. We continuously tested our software with our sponsor and have mapped out a plan for future testing.

Future

This project is a proof-of-concept for our sponsor, Elizabeth Glass. It shows that there can be a system that allows users to engage in STEM and career related content using gesture-based technology. In the future, Mrs. Glass intends to hire programmers to add more age-targeted modules along with expanding on modules we have provided.