Project Description:

In our research lab at The University of Wisconsin–Madison (UWM) we study how embodied behaviors help students learn and understand mathematics concepts, such as forming proofs for high school and college geometry. We use computer-based motion capture to create engaging activities that complement classroom instruction.

The vision for our platform, *The Hidden Village Online* (THVO), is a new type of video game platform (UX currently via *ReactPIXI, but with plans to update to* JSPixi) that delivers a physically interactive narrative over the internet for learning through movement. Our research focuses mostly on mathematical thinking in subject areas such as geometry and algebra. Over the course of many experimental studies with school-age children, we have found significant evidence to support the fact that learners express their thinking not only in what they say, but often in the gestures they make while they're saying it. This is why THVO, as a motion-capture platform, allows us to create activities for learning in which students' success in school includes what they THINK, SAY, and DO.

In Spring of 2023 the MNSU *eMotions* team created a login system that verified users by matching their credentials to an existing list. Successful login brings the user to the start of the game and incorrect login delivered an error message. Upon start, the eMotions solution initiates MediaPipe, an open-source computer vision algorithm API that allows THV to detect over 500 body landmarks on individuals seated in front of the computer - rendering their face, fingers and body as an avatar on-screen. Each landmark consists of *X, Y, Z* and *Visibility* parameters, sampled at up to 30 frames per second. The data is collected and stored in a database using Firebase, an Amazon data service. In Fall of 2023, *The* MNSU *Motion Squad,* built: (1) **a data distiller** that allows researchers to download data collected by THVO in .csv and .json formats. Additionally, they constructed several components of THVO: (2) A **conjecture editor** module that allows users (teachers, parents, students) to create new tasks (e.g., math conjectures) for players to consider (a conjecture name, text, authors, PIN, keywords, multiple choices (3) **m-clip pose authoring** (i.e., Users move/pose in front of the computer, poses are recorded via the local web-camera, displayed, stored, and retrievable for designated usage in the game; and (4) **completed wiki and guarantees documentation**.

For Spring 2024, we hope to again work with a team to complete: (1a) A module* that initiates the MediaPipe API and **compares** a player's real-time movements/poses to poses from the database, and determines when a player's performance accurately matches the movement/pose; (1b) The comparison provides **feedback** that scaffolds players towards correctly performing the movement/pose (e.g., hot/cold colors for closer/farther match); (1c) A **tween** function that takes data from multiple poses and creates an animation of the movement; (2) A **curricular content editor** module that allows administrators (e.g., teachers, researchers, students) to create a collection of conjectures for gameplay; (3) A **script editor** module that allows us to modify the video game storyline delivered by THVO in between the poses/tasks delivery.

The project team will work with us to define, implement, and connect new and existing modules into a working motion capture detection and delivery sub-system that will serve as a main component of our overall THVO classroom experimental platform. Overall, we will create a working platform that users can either play or create content to learn through movement and language.

The clients for this project will be UWM Professor Mitchell Nathan and Lab Manager Michael Swart.

** A module imports content from an external text file located in a specific directory*

Deliverables	Type of work	Activities	Resources	Tech Skills	Priority
Review of existing Requirements Analysis Document (RAD) and current system/code base/user experience	Customer need and project state analysis	Client input, use existing system, review existing documentation and artifacts, **write SHORT report** – quickly. **Do not spend a long time on this!**	Client, handover from previous project, source code and documentation	User research, user experience, requirements analysis, coding and Github	High
Short prioritized list of user stories based on the RAD and system review above	Product management, technical writing	**Quickly** determine the most important capabilities and detail the user-facing impacts; define the minimum amount of acceptable functionality	Tools selected by team with client approval, further client and coach interactions	Product management	High
Revised RAD	Design and system planning	Update the RAD to reflect this semester's priorities and goals. Do not spend a long time on this – **move with alacrity**!	Client, coaches, existing project materials, newly developed user stories	Requirements analysis and documentation	High
Working extended software system	Software development and testing	Working software system as agreed in revised RAD. Supporting test plans, execution, and reporting to assure quality of working system.	Coding and testing tools including Github	Software development, and testing; JavaScript, JSON; ReactPixi, PixiJS, Xstate, MediaPipe, and Firebase	High
Recommendations for next project phase	Project planning	Create and document roadmap for future development efforts – know issues, desired new functionality, interesting untapped use scenarios	Client, coaches	Project planning	Low
Internal documentation	Documentation	Develop detailed internal documentation as to how the extended system was constructed	Client, coaches, project artifacts	Software development and documentation	Medium
External documentation	Documentation	User-facing documentation ensuring proper readiness to use and avail selves of functionality	Client, possible access to end users for feedback	Documentation	Medium