Your Name : Nupoor Bibawe, Rahul Thorat

Professor Name : Tejaswi Gowda

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Three.js Game and IMU controller development

The development of a Three.js game and IMU controller constituted a research and technical project with the overarching objective of leveraging 3D environment libraries available on the three.js website for the simulation of 3D character control through hand gestures. Emphasis was placed on providing an engaging rehabilitative experience for individuals in recovery and fostering interactive learning opportunities for students in the realm of IoT devices and tools.

OBJECTIVE

The project's objectives encompassed three key facets: 1) the comprehension of hand gestures, 2) the implementation of character control based on these gestures, and 3) the establishment of communication between the client and server.

In the realm of understanding gesture control, hand gestures were delineated utilizing roll, pitch, and yaw, with an Inertial Measurement Unit (IMU) capable of accurately measuring these parameters, including smaller gestures. The BNO080 IMU unit and ESP32 were employed to collect and transmit data to the server, where slight data preprocessing facilitated accurate identification of hand motion types.

The challenge of controlling the character based on these gestures involved a profound exploration of the environment and control parameters within the three.js library. The identification of the character control block necessitated a nuanced understanding, and preprocessing of the data became imperative before feeding it into the control algorithms.

Regarding the establishment of communication between the client and server, the initial project phase involved setting up ESP32 communication with the server using WiFi protocols. The successful transmission of IMU gesture data to the server marked the completion of this phase. Subsequently, in response to the introduction of Web Bluetooth technology in the classroom, the project's second and final stages were dedicated to utilizing web Bluetooth. The deployment of Bluetooth technology demanded an in-depth comprehension of both Bluetooth and web Bluetooth libraries. The successful transmission of data to the server through Bluetooth, utilizing web Bluetooth, represented a notable achievement in the project's culmination.

Initially, the objective was to exercise control over the character; however, the outcome involved the creation of a highly interactive game that harnessed the maximum potential of the three.js libraries. Each successful step in the project was characterized by a progression towards surpassing the initial project conception. The project was propelled to a level exceeding the envisioned scope at its commencement.

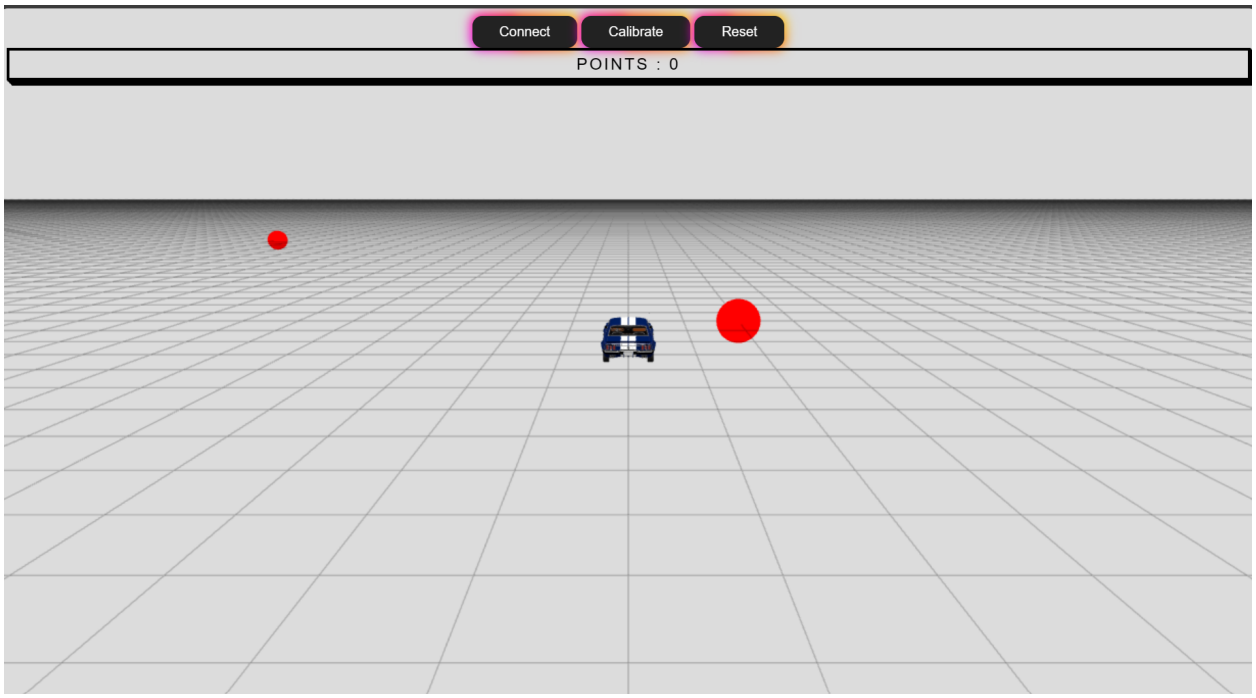
SIMULATION AND RESULTS

In this project, we employed the ESP32 module in conjunction with the Bosch Sensortec BNO080 sensor for enhanced motion sensing capabilities. The primary objective was to establish seamless communication between the ESP32 and a web application using Web Bluetooth. The ESP32 was programmed using Arduino IDE.

A key aspect of the project involved harnessing the power of Three.js to create an interactive 3D representation of the agent controlled by the ESP32. The Web Bluetooth functionality facilitated the

wireless interaction between the ESP32 and the web application, enabling users to manipulate the agent in the 3D space through their web browsers.

The project initially contemplated utilizing an AWS server for communication, but a strategic shift towards Web Bluetooth was made to enable wireless connectivity without internet dependency. This decision prioritized flexibility and eliminated the need for a constant online connection, aligning with the project's requirements.



REFLECTION AND CONCLUSION

The readings and workshops in class have significantly influenced our project by introducing key concepts and technologies that were instrumental in shaping the project's direction. Specifically, the class readings provided insights into the latest advancements in gesture control, 3D environments, and IoT technologies. Workshops, on the other hand, offered practical skills and methodologies, enabling us to effectively implement these concepts in our technical project.

The work in class has indeed shifted the way we initially envisioned our research goals. Originally focused on character control through hand gestures, the exposure to Web Bluetooth technology in class prompted a modification in our project trajectory. The integration of web Bluetooth presented an opportunity to enhance the interactive aspects of the game, which ultimately became a central focus. This shift demonstrates the dynamic nature of research goals, adapting to emerging technologies and methodologies introduced during the course.

Looking ahead, our plans for future research involve delving deeper into the intersection of gesture control, immersive environments, and IoT technologies. We aim to refine the existing game, exploring further possibilities for enhancing user engagement and interaction. Additionally, we plan to explore novel applications of the developed framework, potentially extending its use to other domains such as education, rehabilitation, or virtual training environments. Future research endeavors will be guided by a commitment to innovation, leveraging emerging technologies to continue pushing the boundaries of interactive experiences and human-computer interaction.

In conclusion, the development of a Three.js game coupled with an Inertial Measurement Unit (IMU) controller has yielded a multifaceted and innovative solution that extends beyond its initial rehabilitative and educational objectives. The project successfully navigated the intricacies of hand gesture comprehension through the BNO080 IMU unit and ESP32, translating nuanced movements into character controls within the immersive three.js environment. The establishment of robust communication between the client and server, initially achieved through WiFi protocols and later enhanced with the integration of Web Bluetooth, showcases the project's adaptability and responsiveness to emerging technologies. What began as a pursuit to facilitate rehabilitative experiences evolved into the creation of a highly interactive game, demonstrating the project's capacity to exceed its original scope. This endeavor not only fosters engaging interactions for individuals in recovery but also serves as a valuable educational tool, offering students a hands-on exploration of IoT devices and tools. The project stands as a testament to the transformative power of combining cutting-edge technology, 3D simulations, and innovative control mechanisms to deliver a holistic and enriched user experience.

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