**Project Introduction: Smart Glove for Sign Language Detection and Translation**

**Overview:**

The Smart Glove for Sign Language Recognition and Translation is a cutting-edge project that focuses on bridging gap in communication for individuals with hearing impairment. The system utilizes a custom-designed smart glove equipped with flex sensors and MPU6050 to capture hand and finger movements, recognizing and translating American Sign Language (ASL) gestures (Numbers from 0 to 9 and Alphabets A – E) in real time using Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM). The primary goals of the project include achieving wireless functionality, enhancing finger movement detection, and expanding the system's capabilities.

**Completed Milestones:**

1. Hardware Development: A prototype of the smart glove has been successfully developed using resistive flex sensors, an Arduino Mega 2560 microcontroller, and an MPU-6050 sensor for recording hand orientations.
2. Data Collection and Machine Learning: Data from 18 participants performing ASL gestures has been collected and organized in a structured CSV format. Recurrent Neural Network (RNN) with Long Short-Term Memory (LSTM) architecture has been implemented for gesture recognition.
3. Real-Time Prediction: The trained model has demonstrated remarkable accuracy rates, exceeding 85%, in real-time sign detection.
4. Adaptability and Robustness: The system has showcased resilience to environmental factors such as lighting conditions and background interference, ensuring reliability in real-world scenarios.
5. Personalized Adaptation: One innovative aspect of the concept is its ability to adjust to the unique styles of each user, resulting in a highly customised and easy-to-use interface.

**New Objectives:**

The upcoming focus areas for development include making the glove wireless, integrating gyroscope sensors for precise finger movement detection, designing a PCB board for enhanced hardware integration, exploring transformation architectures, researching Kafka for efficient sensor data handling, combining datasets for numbers and letters, and extending the system to detect and translate words.

1. **Make the Glove Wireless:**
2. Integrate the Nano with Wi-Fi capabilities module into the existing smart glove prototype.
3. Verify and test the wireless communication for stable data transmission. (Note: May require some changes in previous code that loads Arduino.)
4. **Use Gyroscope for Finger Movements:**
5. Research and select gyroscope sensors suitable for finger-tip integration.
6. Integrate gyroscope sensors for each fingertip into the smart glove.
7. Modify the code which loads the Arduino and check the data transmission from gyroscope sensors.
8. Modify the code for data collection with new incorporated sensors along with some instructions to keep the hand in a neutral or rest position, allowing the gyroscope readings to stabilize. To determine the duration of the settling time, we need to experiment and determine an appropriate duration based on the observations and requirements.
9. Collect data for ASL Numbers 0 – 9 and alphabets A – E separate
10. Modify the existing machine learning model to incorporate data from gyroscope sensors.
11. Test and calibrate the model with the new gyroscope data.
12. After successful testing, collect data for remaining alphabets except J and Z and repeat the test and modify wherever required.
13. Then we can proceed with J and Z and repeat the same process.
14. **Design PCB Board:**
15. Collaborate with hardware specialists to outline PCB requirements.
16. Design the PCB layout with considerations for compactness and energy efficiency.
17. Review and optimize the PCB design for manufacturability.
18. Reconnect the sensors in the PCB and make it wireless. For this, we require battery that can supply power to Arduino and sensors which can be recharged when low.
19. **Research on Transformation Architecture:**
20. Investigate different feature transformation techniques.
21. Explore dimensionality reduction methods applicable to sensor data.
22. Experiment with different transformation architectures and assess their impact on model performance. We can use these to compare with existing model which can be strong points for our paper.
23. **Research on Kafka for Sensor Data:**
24. Understand the basics of Kafka and its role in handling streaming data.
25. Investigate Kafka integration methods and potential benefits for sensor data.
26. Explore how Kafka can enhance real-time processing and communication within the system.
27. **Combine Number and Letter Dataset:**
28. Merge the existing datasets for numbers and letters into a unified dataset.
29. Ensure proper labelling and distribution of samples in the combined dataset.
30. Test and evaluate the machine learning model's performance on the unified dataset.
31. **Detect Words:**
32. Collaborate with sign language experts to identify and collect data for common words and phrases.
33. Expand the machine learning model to recognize and translate words based on sign gestures.
34. Test the model's accuracy in detecting and translating sign language words.
35. **Two-way communication**
36. Design the mobile app so that person in the front if talking, it can be converted into text. It can be done by integrating APIs.