1. Names of group members

- Khor Zhi Hong

2. Description of the problem

Develop a gesture-controlled virtual drumstick system using IMU sensors MPU6050. The IMU will detect hand acceleration and movement, and MATLAB will process the signal to determine when a strike occurs and trigger the appropriate drum sound in real-time.

> 1. Noise Filtering: IMUs introduce sensor drift, motion, and environmental noise, requiring digital filtering to extract clean acceleration signals.
>
> 2. Drum Strike Detection: Differentiating intentional drum strikes from normal hand movements based on acceleration peaks.
>
> 3. ~~Drum Sound impact: Mapping strike velocity wave signal to drum sound intensity (only if 2 is possible)~~
>
> 4. ~~Latency Reduction: Ensuring that drum sounds trigger instantly with the sound being played instantly (I put here for fun, I'm don't think I can do fpga)~~
>
> 5. ~~audio from the physical speaker attached to Arduino Uno instead of laptop for real time sound~~

3. Literature review

- <u>IMU noise filtering techniques</u>: Low-pass filters(Kalman filter etc) help remove high-frequency noise from acceleration signals. <u>Link</u>

- <u>Drum stroke detection methods:</u> Peak detection algorithms can accurately identify drumstick strikes. <u>Link</u>

4. Planned work

- Signal Preprocessing: Apply filtering to remove unwanted high-frequency noise from IMU acceleration signals.
- Drum Strike Detection: Detect acceleration peaks and compare against a threshold to determine drum hits.
- Drum strike tracking: gyroscope in the accelerator
- Real-Time Processing: Using MATLAB's Audio Toolbox to trigger sounds instantly.

MATLAB Signal Processing Toolbox & Audio Toolbox.
MPU6050 Sensor – Captures acceleration data and position .
Arduino– Interfaces with MATLAB .

5. Milestones

Week Starting	Milestone
March 24	Hardware Assembly – Connect IMU sensor (MPU6050) to Arduino/ESP32, verify sensor communication with MATLAB.
March 31	Data Acquisition & Preprocessing – Collect IMU acceleration data,
April	Drum Strike Detection – Develop peak detection algorithm to identify drum hits from acceleration spikes.
April	Real-Time Drum Sound Triggering – Map detected strikes to corresponding drum sounds in MATLAB's Audio Toolbox.
Not happening lol	Optimization & Latency Reduction Speaker on the drum Velocity-Based Intensity Control – Adjust drum sound volume based on strike acceleration magnitude.
May 2	Final Testing & Presentation Preparation
May 7	Final Report Submission

6. Materials

Item	Quantity	Estimated cost	link
MPU6050	3	14	MPU6050
Arduino Uno	1	30	Arduino
Speakers	Optional	10	speaker