SOUNDQUEST – SOUND BASED GAMEPLAY

PROJECT OVERVIEW

Touchless Simon Says game with sound recognition. Using MATLAB and ESP32, the system detects snap, clap, and knock sounds as user inputs and provides real-time LED feedback, showcasing advanced audio processing and interactive gameplay.
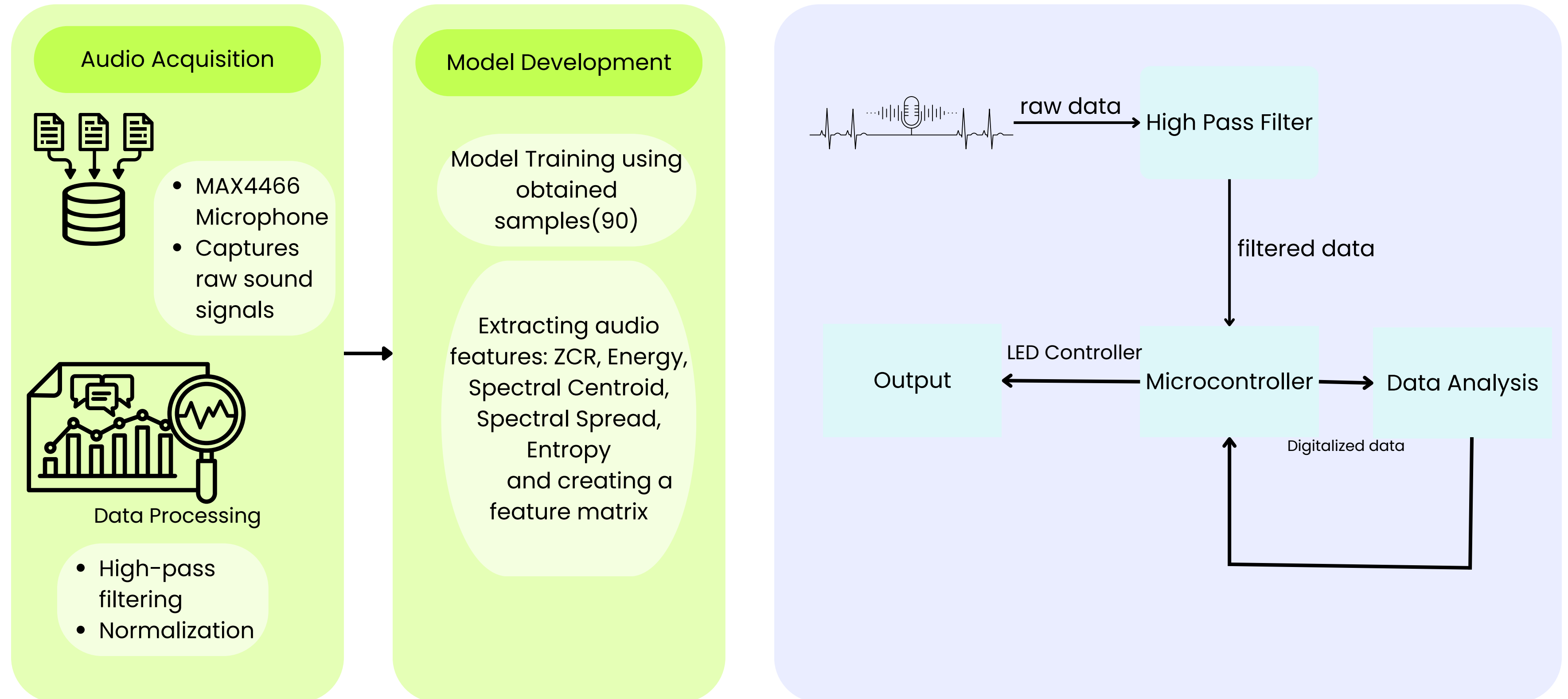
AIM

To create a fun, interactive game that challenges you to use sound showing off the power of real-world audio recognition in a playful way.
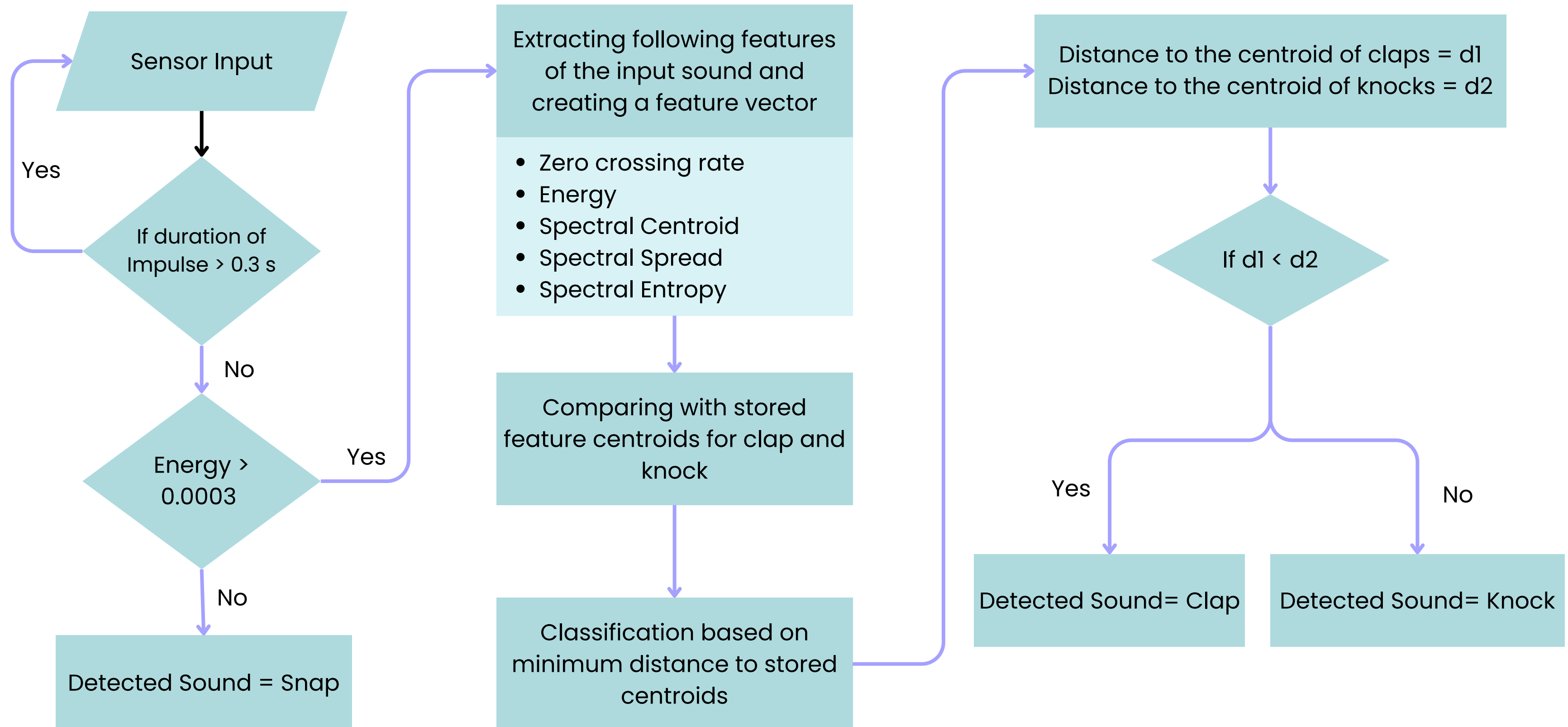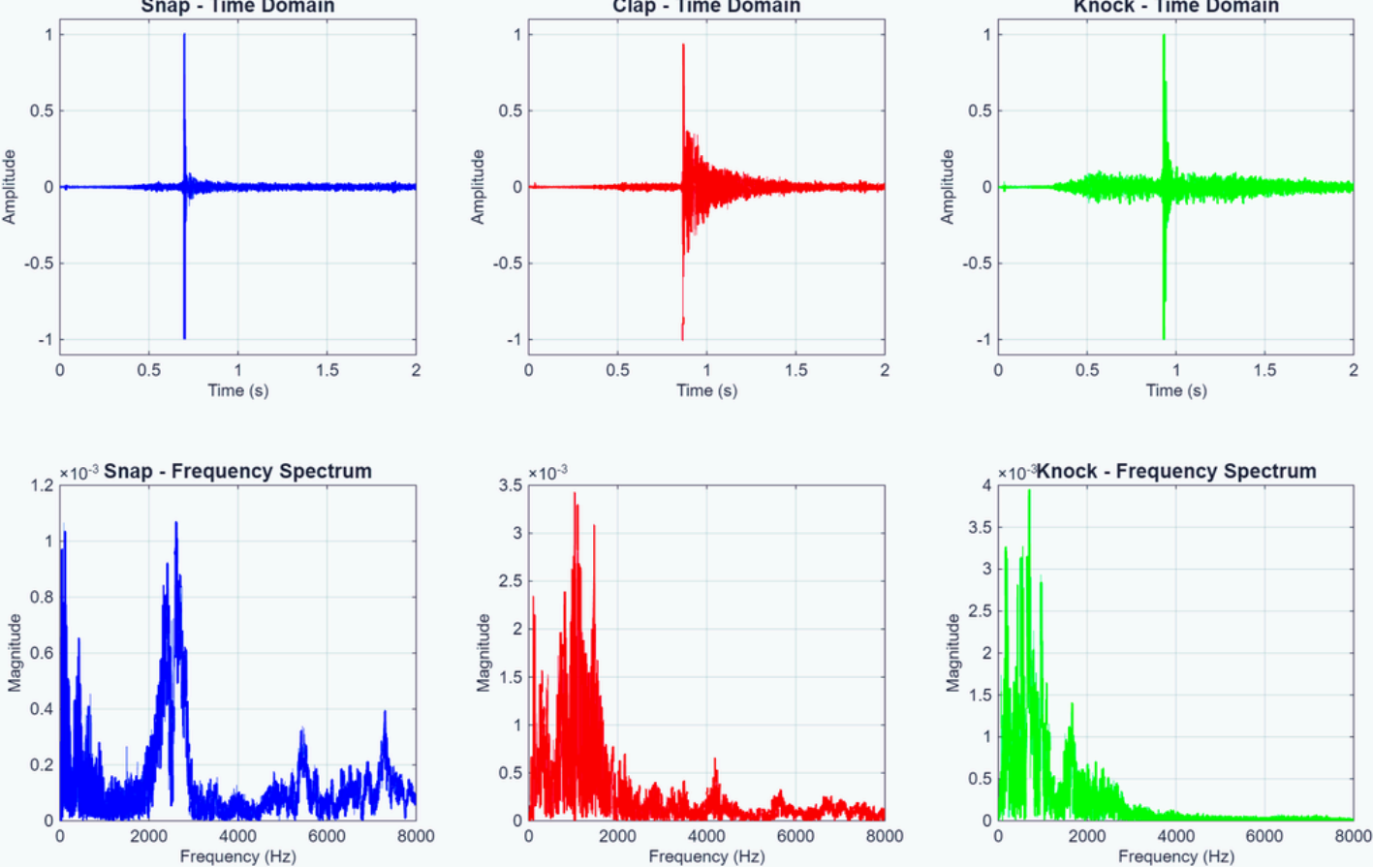
OBJECTIVES

- Design and implement a sound classification system
- Integrate MATLAB with an ESP32 microcontroller
- Develop game logic that increases difficulty at each round
- Give users instant and accurate feedback.

SYSTEM ARCHITECTURE

Audio Acquisition

- MAX4466 Microphone
- Captures raw sound signals

Data Processing

- High-pass filtering
- Normalization

Model Development

Model Training using obtained samples(90)

Extracting audio features: ZCR, Energy, Spectral Centroid, Spectral Spread, Entropy and creating a feature matrix

raw data → High Pass Filter

filtered data ↓

Output ← LED Controller ← Microcontroller → Data Analysis

Digitalized data

SOUND CLASSIFICATION

Sensor Input

Yes

If duration of Impulse > 0.3 s

No

Energy > 0.0003

Yes

No

Detected Sound = Snap

Extracting following features of the input sound and creating a feature vector

- Zero crossing rate
- Energy
- Spectral Centroid
- Spectral Spread
- Spectral Entropy

Comparing with stored feature centroids for clap and knock

Classification based on minimum distance to stored centroids

Distance to the centroid of claps = d1
Distance to the centroid of knocks = d2

If d1 < d2

Yes

No

Detected Sound= Clap

Detected Sound= Knock

Snap - Time Domain | Clap - Time Domain | Knock - Time Domain

Snap - Frequency Spectrum | Clap - Frequency Spectrum | Knock - Frequency Spectrum
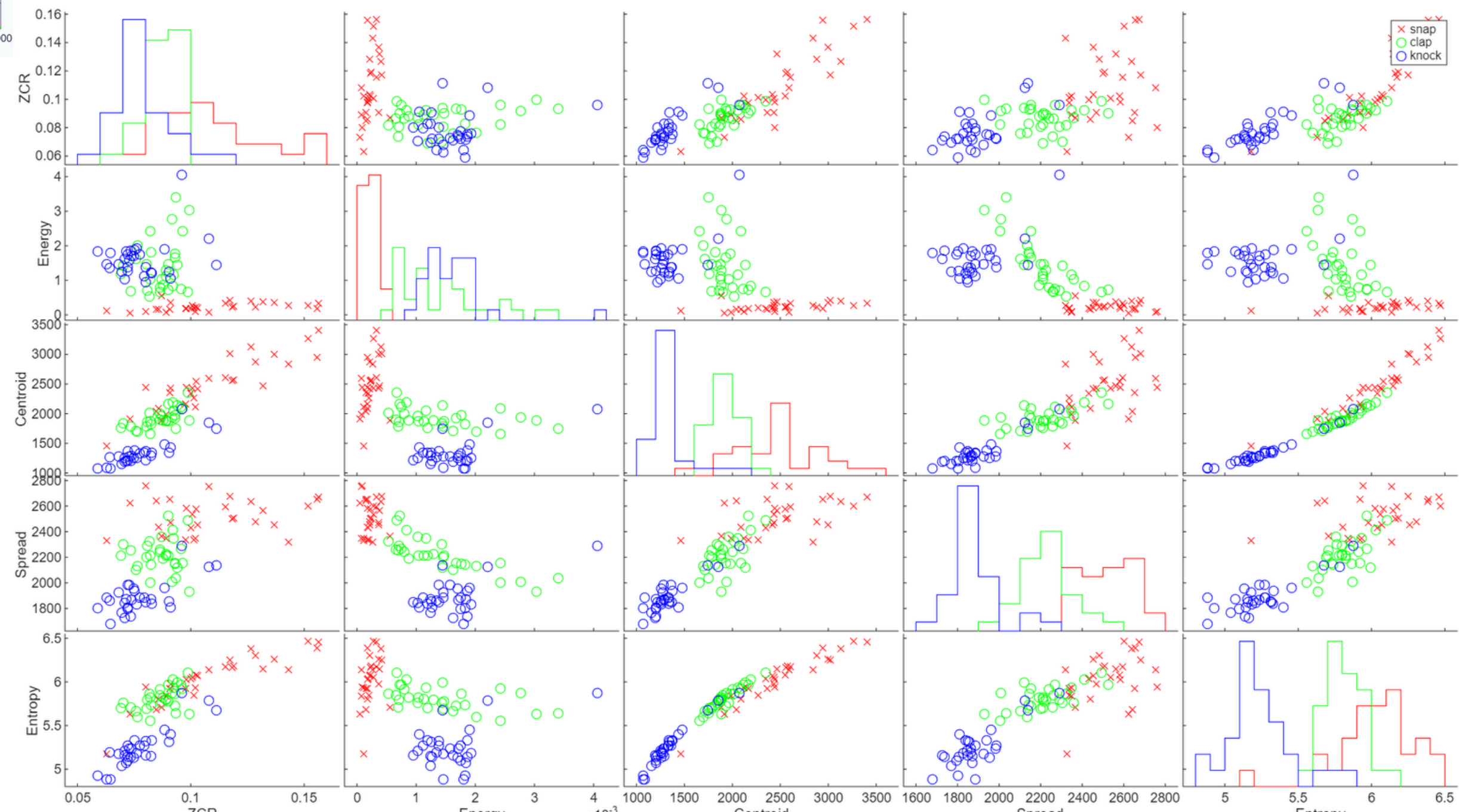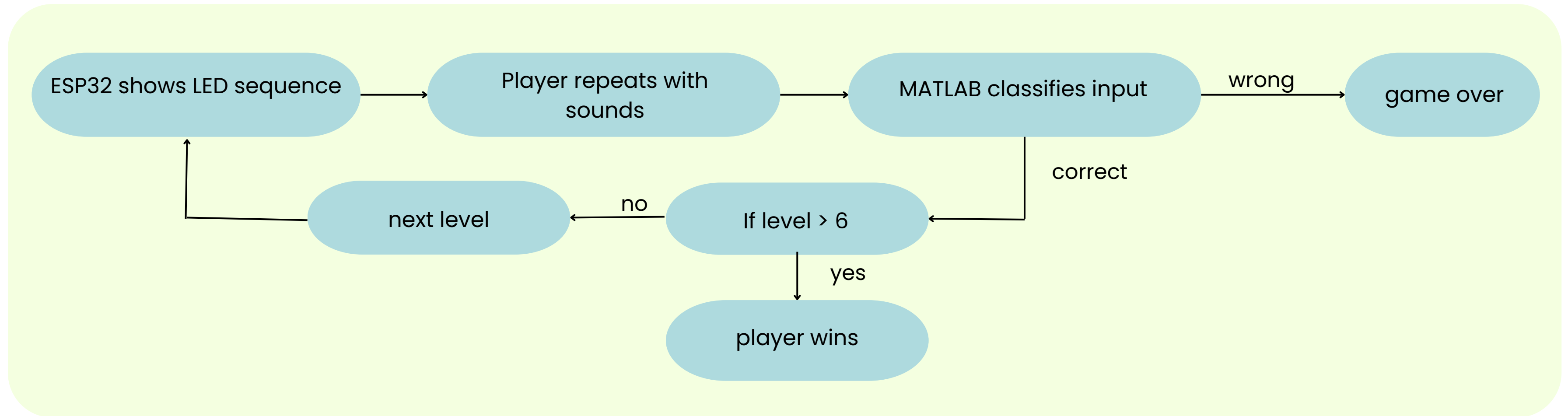
ANALYSIS OF CLAP , SNAP AND KNOCK IN TIME DOMAIN AND FREQUENCY DOMAIN

PAIRWISE PLOT OF EXTRACTED FEATURES

GAME WORKFLOW

ESP32 shows LED sequence → Player repeats with sounds → MATLAB classifies input → wrong → game over

MATLAB classifies input → correct → If level > 6

If level > 6 → no → next level → ESP32 shows LED sequence

If level > 6 → yes → player wins

FUTURE IMPROVEMENTS

- Integration of Wi-Fi communication for remote control and monitoring
- Development of a mobile/web dashboard to display detection results
- Noise robustness using advanced filtering and machine learning models

RESULTS

Accuracy :