Monty Matlab Project SS23

SILLY WALKS AND MATLAB

Group 3

July 13, 2023

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Introduction

- Focus: Classification of walking patterns, normally or silly, using acceleration data.
- Importance: The accuracy of classification.
- Relevance: Acceleration data captures human movement effectively.

Motivation

- Improving human activity recognition for health and performance monitoring
  - Fitness tracking
  - Gait analysis
  - Abnormality monitoring

Workflow and Timeline

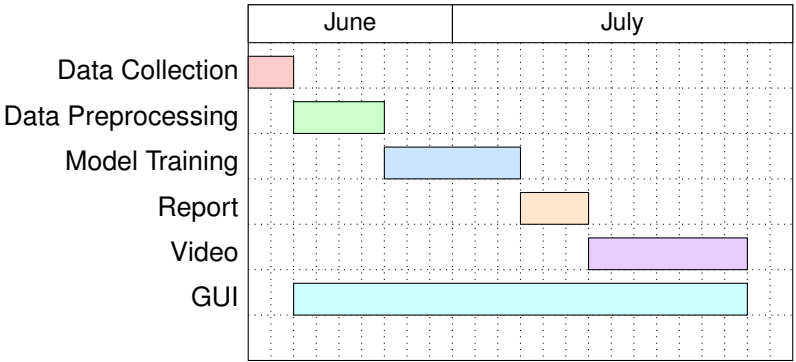


Figure: Project Schedule

Team Collaboration

- Weekly Meetings
- Individual Responsibilities
- Collaboration and Support
- Project Timeline

Data Collection

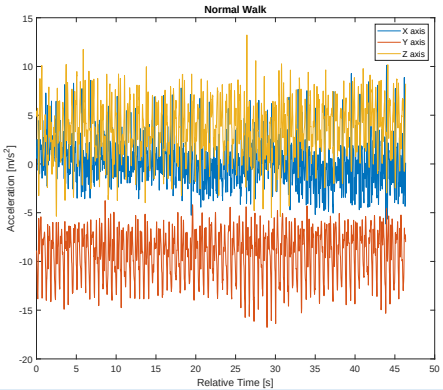
- Using MATLAB Mobile to collect IMU data

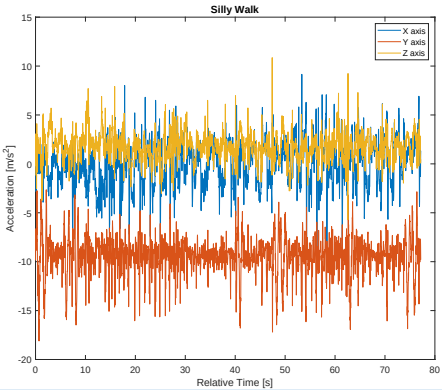
(a) Figure 1

(b) Figure 2

Data Extraction

- Only walks should be contained in the data





Model Selection

- K-Nearest Neighbors (k-NN)
- Long short-term memory (LSTM)

K-Nearest Neighbors (k-NN)

- Machine Learning algorithm
- Purely vote of its k nearest neighbours
- Shorter training time
- Essential pre-processing step: feature extraction

K-NN Settings

- The number of nearest neighbours: $k = 10$
- Extracted features:
  - Mean values of X, Y, Z
  - Standard deviation of X, Y, Z
  - Sum of magnitude of X, Y, Z
  - Range of magnitude of X, Y, Z
  - Maximum magnitude of X, Y, Z

Results of k-NN

- Accuracy = 88.6%
- Confusion chart:

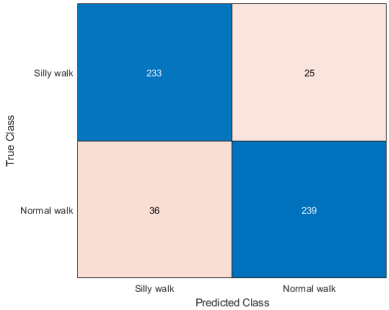
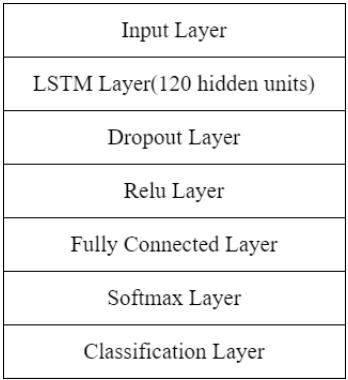


Figure: Confusion chart (k-NN)

LSTM neural network

- Captures long-term dependencies in sequential data.
- Handles variable-length sequences.
- Automatically extracts relevant features from raw data.
- Effectively learns from large datasets.

LSTM neural network



- Learning Rate: 0.001
- Batch Size: 32
- Number of Hidden Units: 120
- Dropout Rate: 0.5

Training and Evaluation

Figure: Training process

```
> learning sample class ratio:   661 silly walks : 1100 normal walks (after windowing).
> test sample class ratio:       300 silly walks : 295 normal walks (after windowing).
> window width:                  3.4 seconds
> target sampling rate:          50 Hz

> Accuracy:                      97.6471%
> Balanced accuracy:             97.6469%
```

Figure: Unit test result

Graphical User Interface (GUI)

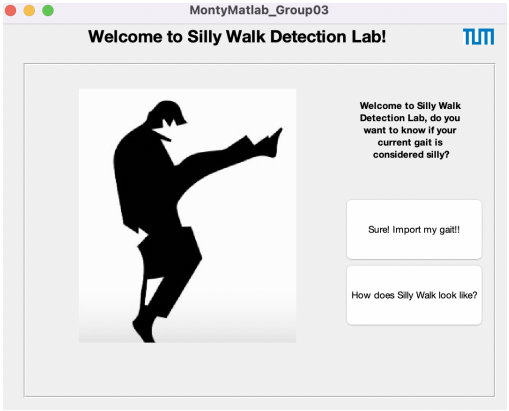


Figure: Start page

Result Interface of GUI

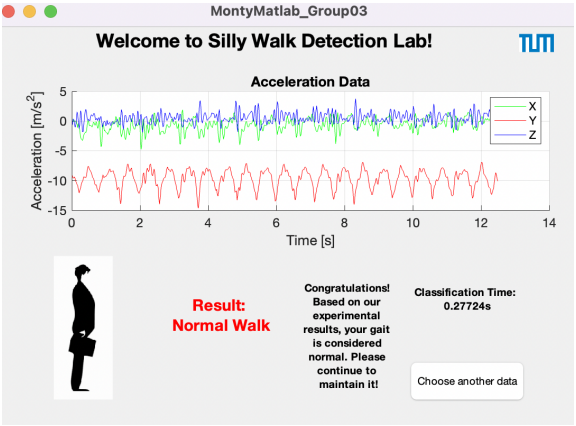


Figure: Result page (normal walk)

Conclusion and Future Work

- Under our situation:
  - K-NN has shorter training time but with lower accuracy
  - LSTM has acceptable training time with higher accuracy

After comparison, we finally choose **LSTM**!

- Future work:
  - Improving k-NN model, finding better features
  - Classification of different types of Silly Walks