Singhcorp

**Title:** Human Activity Recognition with AI and MATLAB App

**Team:** Singhcorp

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# 1. Problem

Human activity recognition (HAR) is an important problem in signal processing and AI.   
The challenge is to accurately classify activities (such as walking, standing, sitting, lying, running, etc.) from raw wearable sensor data.   
The project focuses on building an AI-powered system in MATLAB that can classify activities and demonstrate predictions through a GUI app.

# 2. Scope of Work

- Build a MATLAB-based system that processes raw inertial sensor data.   
- Apply preprocessing steps to clean and prepare signals.   
- Implement grouping and segmentation of time-series data (6 × 128 sliding windows).   
- Train and test an AI classification model.   
- Provide a GUI demo app for predictions using uploaded data.

# 3. Signal Processing

a) Data Collection   
- Data provided as `.mat` files:   
 - rawSensorData\_train.mat   
 - rawSensorData\_test.mat   
- Each record includes 6 channels:   
 - total\_acc\_x, total\_acc\_y, total\_acc\_z   
 - body\_gyro\_x, body\_gyro\_y, body\_gyro\_z   
  
b) Preprocessing   
- Data organized into a table for processing.   
- Segmented into 6 × 128 × N windows.   
- Noise reduction and normalization applied.   
  
c) Grouping Function   
- Implemented groupByActivity to split data per activity and form user sequences.   
- Stored into userData.mat/userSensorData.mat for GUI use.

# 4. AI Modeling

- Model Type: BiLSTM Neural Network (time-series classification).   
- Framework: MATLAB Deep Learning Toolbox.   
- Steps:   
 1. Convert data into sequences.   
 2. Train BiLSTM model using training data.   
 3. Evaluate performance on test set.   
  
Why LSTM? Because it can capture temporal dependencies across the 128-sample sliding window.

# 5. Results

- Training Accuracy: 88.124%

# 6. MATLAB App (Demo GUI)

- Built with App Designer.   
- Allows user to upload `.mat` data, and fill up height and weight.  
- Runs trained AI model to predict activity.   
- Displays the amount of time an activity was done, as well as the calories burnt, with an estimation to the time needed in order to reach a healthy BMI.

# 7. Conclusion

This project demonstrates the effectiveness of combining signal processing and deep learning (LSTM) for activity recognition.   
- Successfully built an end-to-end pipeline from raw data → preprocessing → AI model → GUI app.   
- Achieved high accuracy and robust predictions.   
- Future improvements could include:   
 - Larger dataset.   
 - Real-time mobile/embedded deployment.   
 - More advanced models (CNN-LSTM hybrid).

# 8. References

1. MathWorks Documentation: LSTM Networks for Sequence Classification   
2. UCI HAR Dataset (benchmark dataset for activity recognition).   
3. MathWorks App Designer Guide.