Mastering Volume Control: A Smartwatch Gesture Project

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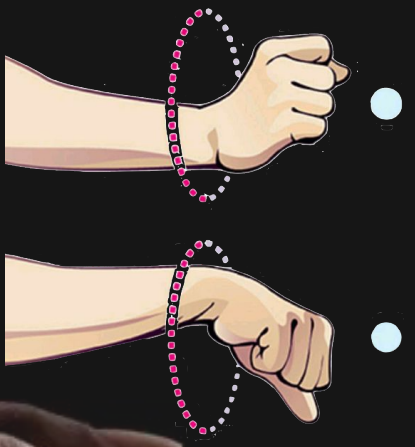
Introduction



- **Gesture:** Wrist Rotation for Volume Control
- **Devise and Sensor:** Smartwatch Accelerometer

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- **Motivation:**
  Intuitive and hands-free human computer interaction
  Efficiency and Convenience
  Reducing Physical Barriers (for disabled people)
  Hands-Free Contexts (while people are driving, cooking, …)

Workflow

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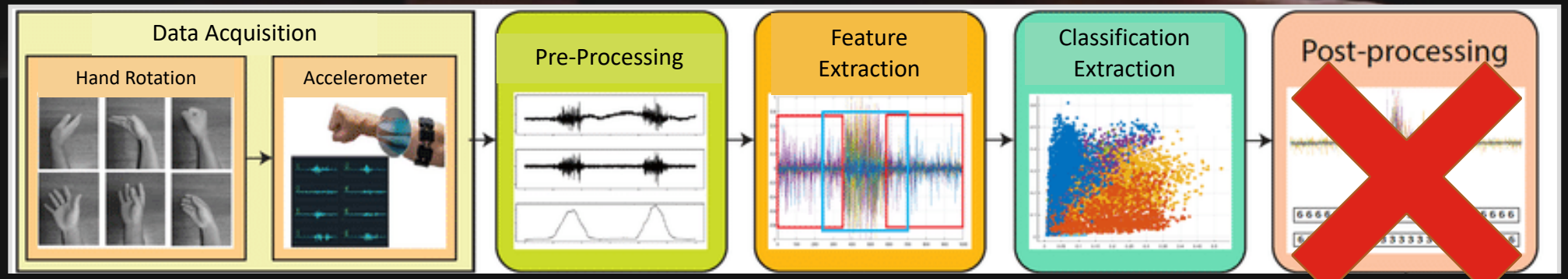
1. **Data collection :**
   Clockwise & Anti-clockwise: 40 Tests each —> at least 5 Sec each
   No Action: 4 tests, at least 5 min each
2. **Pre-Processing: (cleaning and 3 label)**
   Clockwise & Anti-clockwise: 500 data sample each —> sampling in 1 sec window(100 data rows) —> 500*40 total rows of data = 20,000 data
   No action: sampling in 1 sec windows —> 5000*4 total rows of data = 20,000 data
   } balanced
3. **Feature Extraction:**
   12 features: mean, std_dev, median, RMS for x, y, z direction



Workflow

4. Classification:

Using the Best features of Random Forest, SVM, and Decision Tree
Accuracy Consideration

5. Post-Processing:

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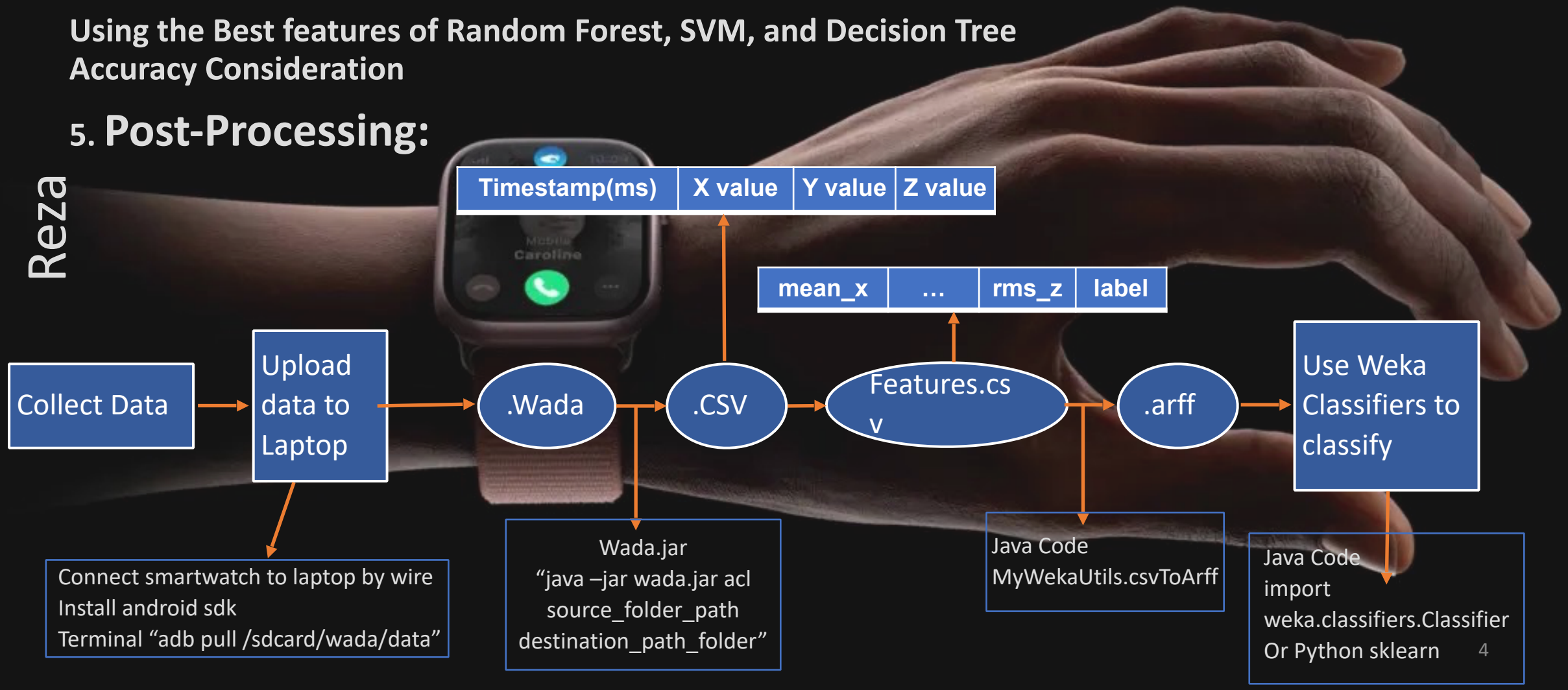
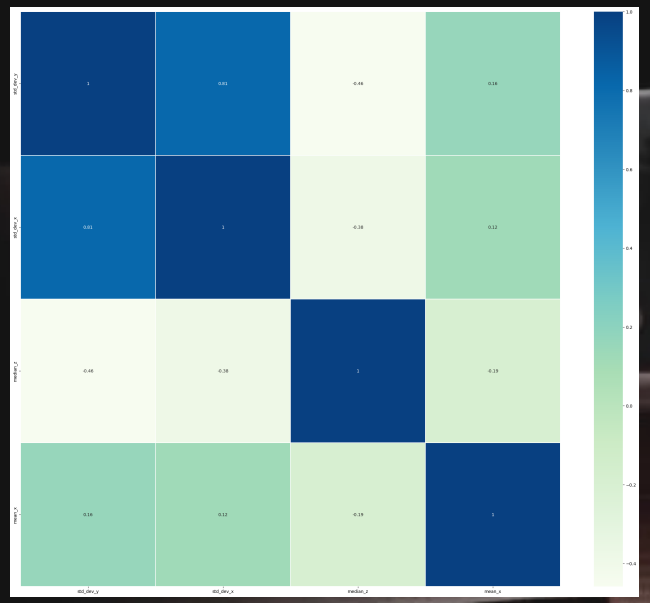


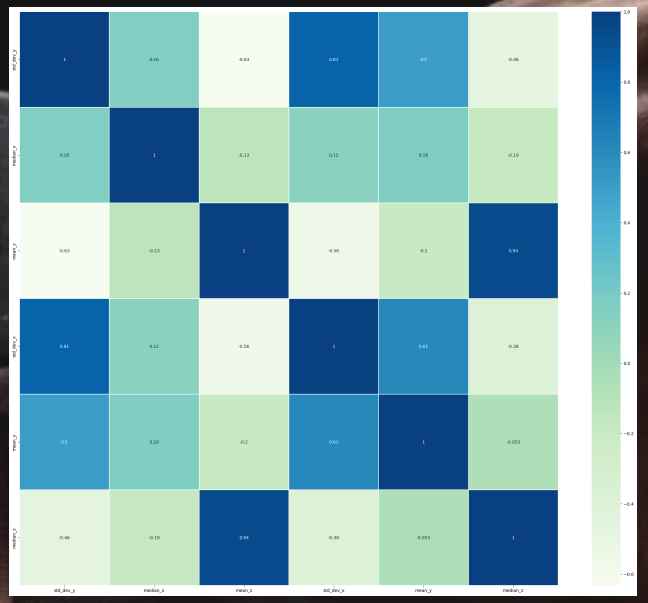
Model Selection and Training

SVM, Random Forest, and Decision Tree

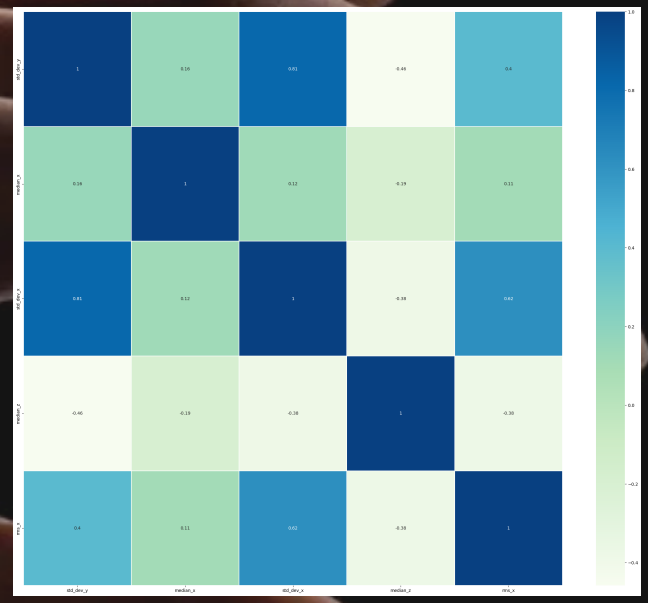
Svm features



random forest features



DecisionTree



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Pearson correlation coefficient plot between selected features

Most selected features are low correlated, which reduces information redundancy

Results : Evaluation and Comparison

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Model	SVM	RF	DT
Best Features Set (Sequential Feature Selection)	4, 3, 8, 0 std_dev_y, std_dev_x, median_z, mean_x	4, 6,2, 3, 1, 8 std_dev_y, median_x, mean_z, std_dev_x, mean_y, median_z	4, 6, 3, 8, 9 std_dev_y, median_x, std_dev_x, median_z, rms_x
Accuracy	71.83, 76.3, 79.6, 80.5	66.4, 75.7, 84.0, 88.7, 90.16, 90.84	69.3, 75.7, 79.5,85.5
Best Accuracy	80.50	90.84	85.50

- **Result: The best model is Random Forest with 6 features**

Decision Tree (Python)

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Model	Default DT	Depth 2	Depth 3	Depth 4
Validation Acc	84.58	75.4	82.08	83.12
Test Accuracy	89.16	74.16	86.6	86.6
F1 Score	88.8	71.71	85.98	86.27
Precision	88.79	78.81	87.23	86.3
Recall	88.79	74.49	85.78	86.35

- **Result: Adaboost algorithm with decision tree performs the best.**

ADA-BOOST

Model	Default DT
Validation Acc	85.62
Test Accuracy	88.3
F1 Score	88.06
Precision	88.2
Recall	88.1

Future work

- Train with more data and extract more features to improve accuracy
- Model Deployment : Developing an android application controls the speaker of the watch

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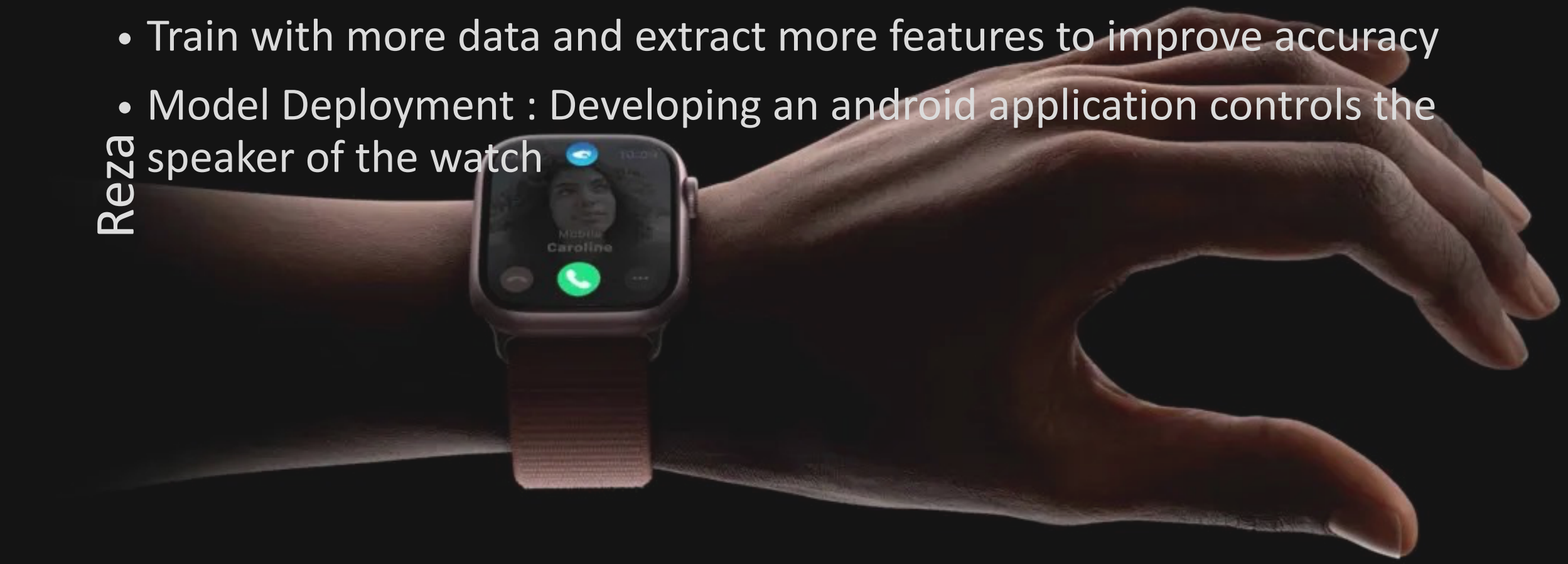

References

- Yiming Zhao, Yanchao Zhao, Huawei Tu, Qihan Huang, Wenlai Zhao, Wenhao Jiang, and Laura Arjona. 2022. Motion Gesture Delimiters for Smartwatch Interaction. Wirel. Commun. Mob. Comput. 2022 (2022). https://doi.org/10.1155/2022/6879206

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Contributions

- 3 team members shared the workload equally and have contributed to all parts of the project. (Idea, data collection, data preprocessing, feature selection, feature extraction, model training and test, tuning parameters, slide making, presentation and report writing)

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