

SW3025 Artificial Intelligence of Things

IntelliFit: Smart AIoT Fitness Companion

Group 10

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Background

As more people are becoming interested in fitness, many lack proper technique which can lead to injuries. The IntelliFit system uses AI and internet-connected cameras to monitor exercise form in real time. It alerts users to mistakes in technique in order to reduce injury risk and help people optimize workouts to reach their fitness goals more efficiently.



Pre-thought

The IntelliFit system uses a camera connected to a Raspberry Pi to capture real-time video of the user exercising. The video is processed using computer vision and machine learning techniques to **classify** the correctness of the user's exercise movements. The classification results are sent via MQTT to a web server, which displays real-time feedback to the user through a web interface. The results are also transmitted via serial port to a Micro:bit device, which uses LEDs to provide feedback on exercise form.

This allows the user to receive immediate guidance on improper movements, reducing injury risk and improving workout effectiveness. The web interface also enables users to track progress over time.

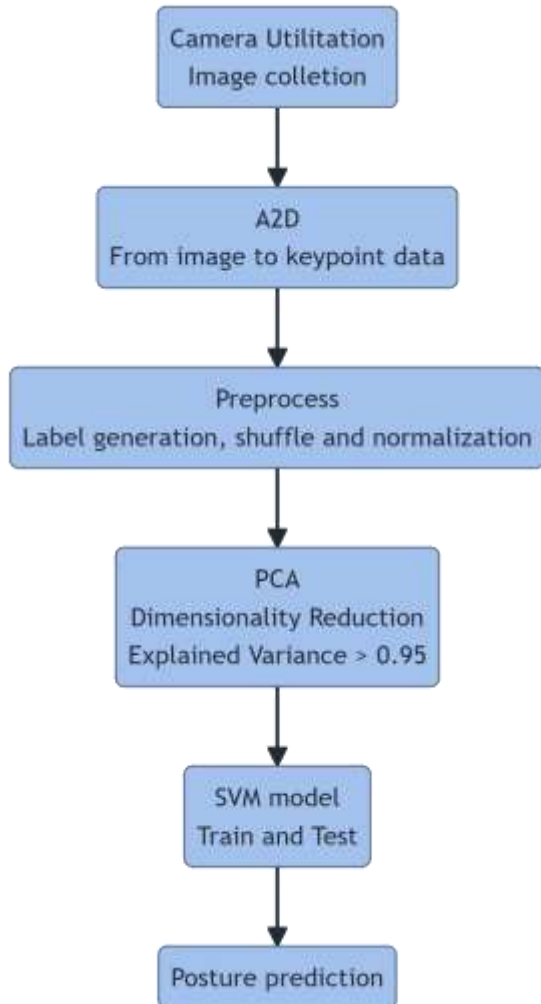
Where AI is implemented.

Where IoT concept is exemplified.

Where users can easily operate the system and protect themselves when exercising.

AI(ML) Part

Workflow



Dataset

Well-captured images for training and testing.
(with 1800+ negative samples and 1200+ positive samples)

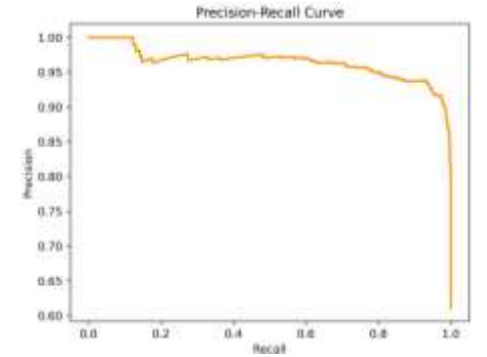
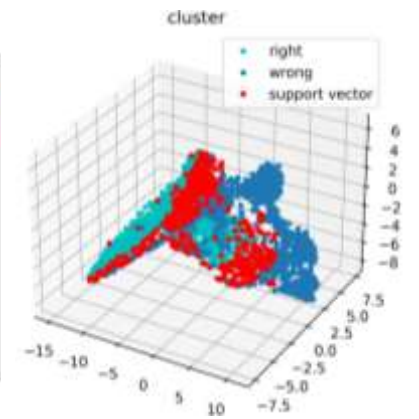
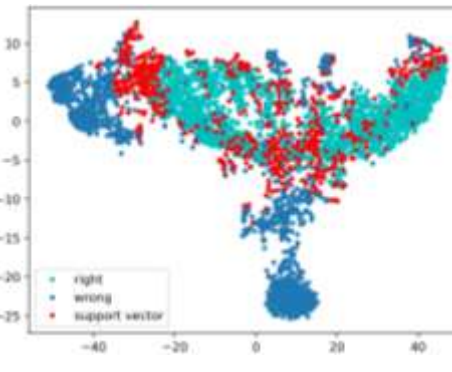
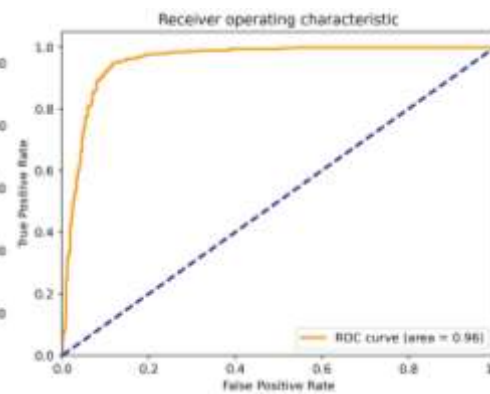
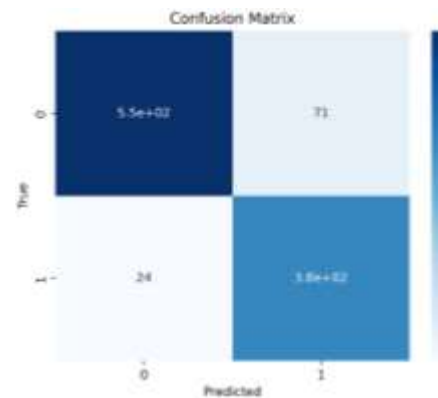
Preprocessing

Mediapipe library → Key points coordinates.
Labelling, shuffle and splitting (with train: test = 7:3).

PCA

Dimensionality reduction (with explained variance > 0.95).
Redundant data (info) diminished.

SVM model train and test performance



Accuracy up to 92.17%.

```
(IntelliFit) C:\Users\jwlia\Desktop\NUS AIoT>python train.py  
[0.77270355 0.10734844 0.04456863 0.0273443 ]  
0.9217462932454695  
0.9390635022450288
```

Sensors

- detect temperature and humidity through DHT11.

Micro:bit

- Control the LED light.

Camera

- Capture images.

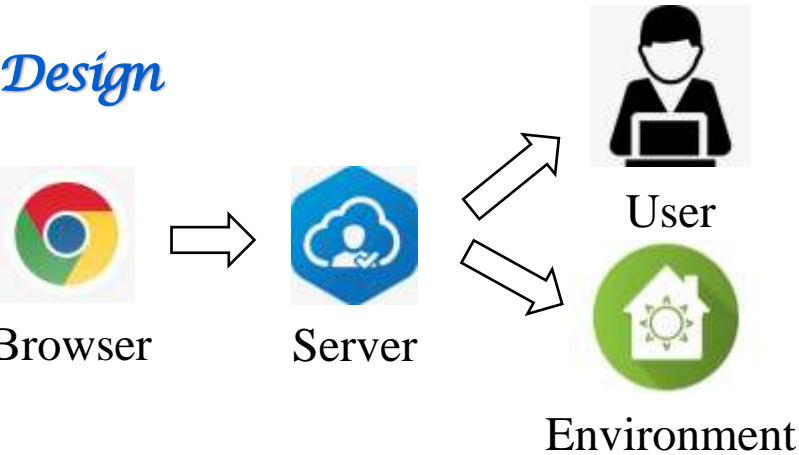
Raspberry PI (edge computing)

- Data (image) collection.
- Data (temperature and humidity) collection.
- Upload results to the cloud server through the MQTT.
- Communicates with the Micro:bit through the serial port.

Frontend and Backend

Backend

Design



Structure



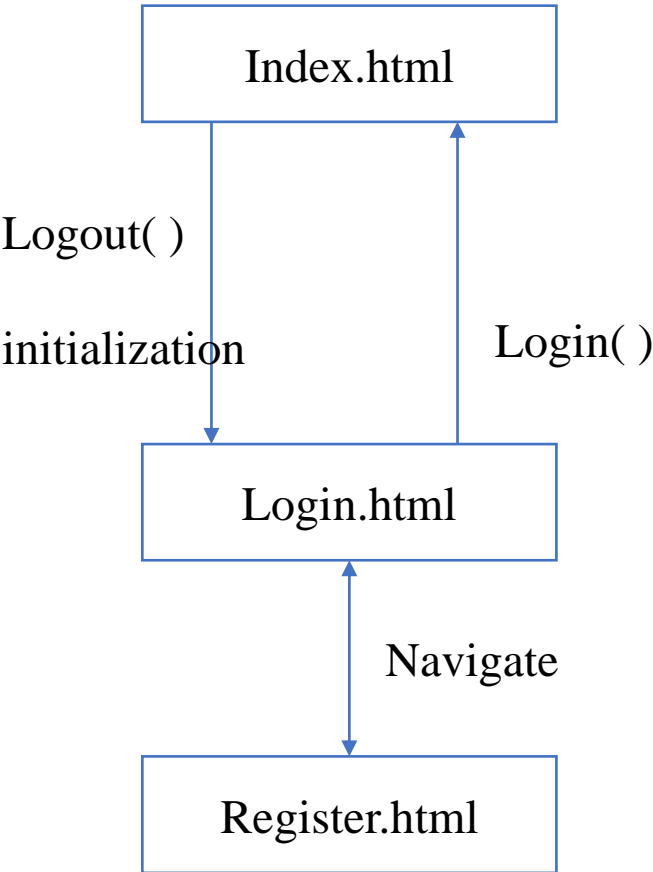
Three-Layer Architecture

Techniques



Frontend

Structure



Techniques



Warp-up

Quick review

IntelliFit, an AIoT-based fitness assistance system, is for helping users avoid injury and optimize workouts.

- AI-powered, as machine learning (classification) is implemented.
- IoT-based, as multiple sensors are utilized.
- User-friendly, as delicate website hits you right away.

Advantages

😬 **Clear visualization** - See your stats, form data, and more on an intuitive display.

😊 **Precision tracking** - Our 92%+ accurate algorithm spots flaws in each move.

♥ **Smart recommendations** - We adjust tips based on weather to optimize your training.



Business value will be generated

1. Era of fitness, surge of need.
2. High accuracy, insurance of your body.
3. Personal analysis, your own care-taker.