



BurnSync

Your Personal Workout Assistant

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Live Demo

The background is a light gray with various geometric shapes and a red string. In the top left, a red string is coiled and ends in a pink and blue cylindrical object. In the top right, there is a blue triangle and a blue cylinder. In the bottom right, there is a pink and blue circular object with a blue cylinder passing through it. On the left side, there is a blue circular shape. In the center, there is a blue square with the number '01' in white.

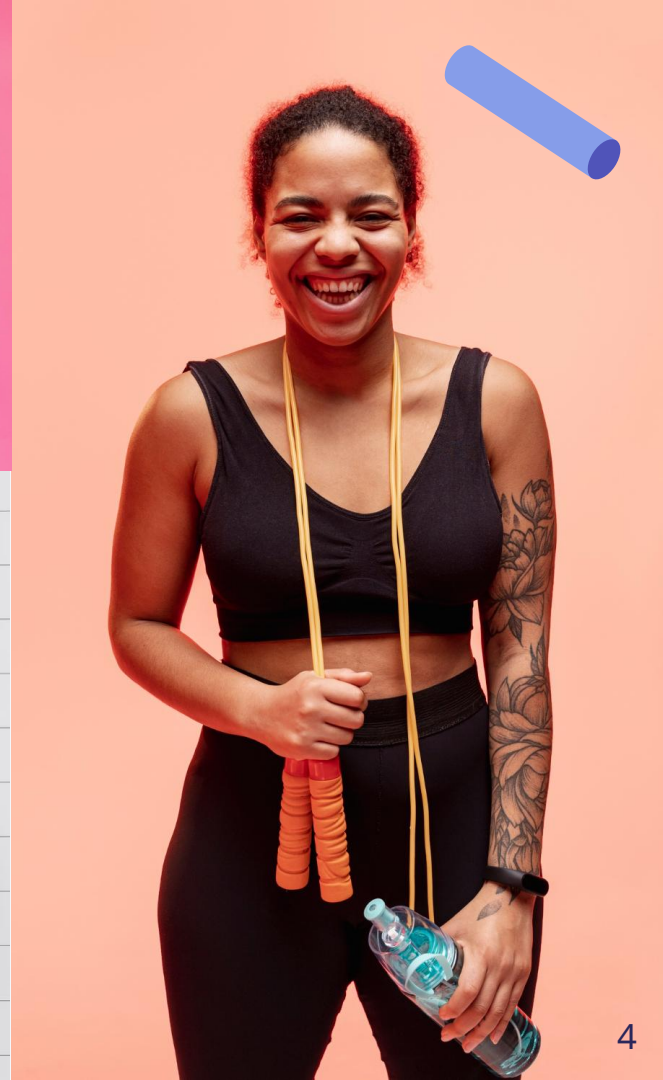
01

Motivation & Introduction

“Working Out Everyday ”

Nowadays people put more emphasis on health.

Exercise is the key to maintain well-being.





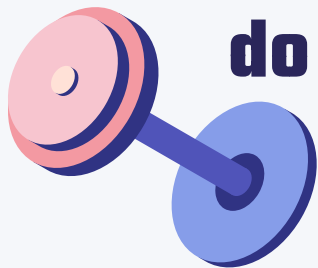
31%

Adults

80%

Adolescents

**do not meet the recommended levels of
physical activity**



3Ls of Modern People



Lack of Time

- Busy schedule
- Leisure activities



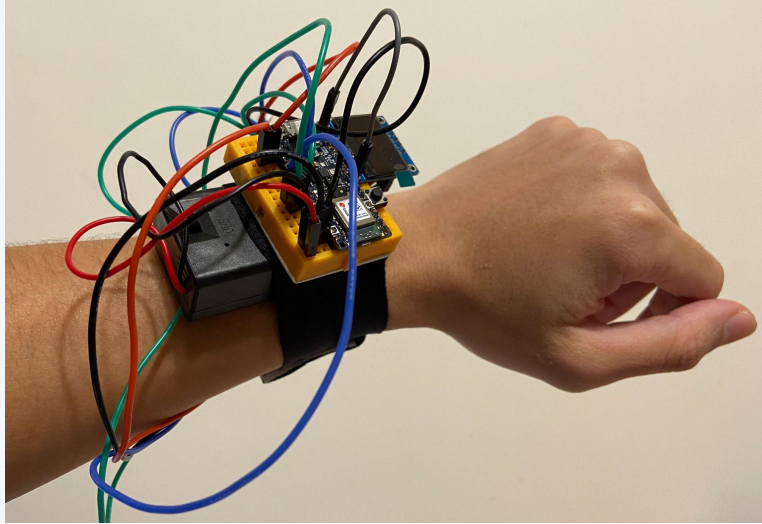
Lack of Money

- Sports equipment
- Renting venues



Lack of Motivation

- Fatigue
- Limited access to facilities
- Absence of immediate rewards



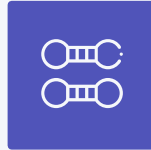
BurnSync: Your Personal Workout Assistant

BurnSync



Convenient

- Highly connected
- User-friendly
- Time-efficient
- Accessible anywhere



Cheap

- 500 NTD↓
(excluding the Arduino Nano board)
- Cheaper for mass production



Achievement

- Personal records
- A sense of accomplishment



Functions

Detect Heart Rate



**Exercise
Classification**



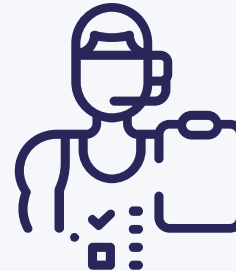
**Sets/Repetitions
Recording**



**Calories
Estimation**



**Fitness
Recommendation**





02

Video Demo

AI Recommendation

The screenshot displays a web application interface with a light green background. At the top, there is a header bar with the text "Recommendation" on the left and "Version 1.0.0" on the right. Below the header, there is a large green button labeled "Recommendation". Underneath this button, there is a section titled "Target Audience" with a text input field containing the number "10" and a green button labeled "Recommend". Below the "Target Audience" section, there is a section titled "Feature Training" with a table of features and a green button labeled "Train Model". The table has four columns: "Feature", "Type", "Value", and "Importance". The rows are: "Age", "Gender", "Income", and "Education". The "Value" column contains the values "18-24", "Male", "50000", and "High School". The "Importance" column contains the values "0.1", "0.2", "0.3", and "0.4". Below the table, there is a green button labeled "Train Model". At the bottom of the interface, there is a section titled "Model Status" with two columns: "Model" and "Status". The "Model" column contains the text "Model 1" and "Model 2". The "Status" column contains the text "Training" and "Completed".

Feature	Type	Value	Importance
Age	Age	18-24	0.1
Gender	Gender	Male	0.2
Income	Income	50000	0.3
Education	Education	High School	0.4

Sit-ups



Push-ups





Squats



Dumbbells



Heart Rate Detection



Personal Records



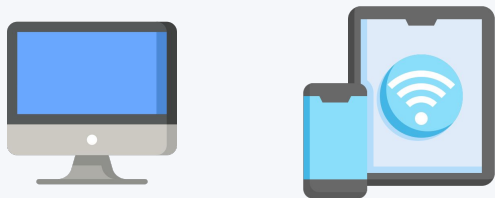


03

System Architecture

System Architecture

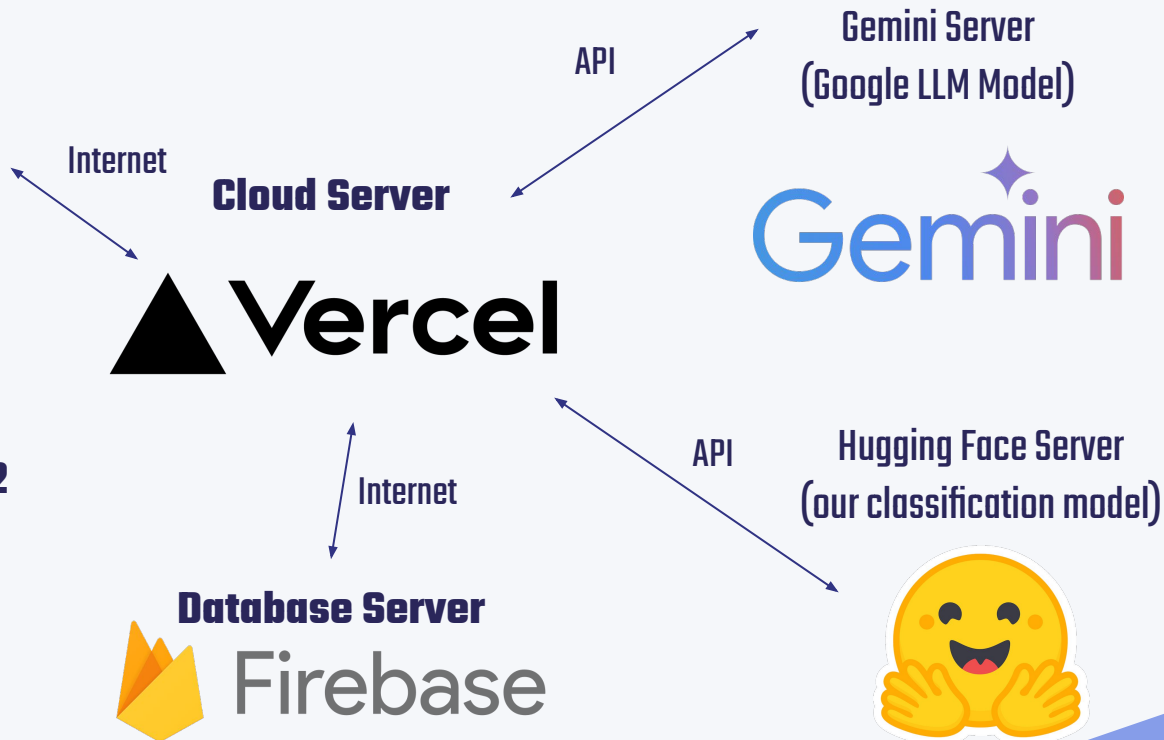
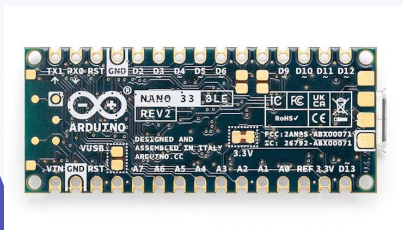
Personal Device
(Laptop / Phone / Tablet)



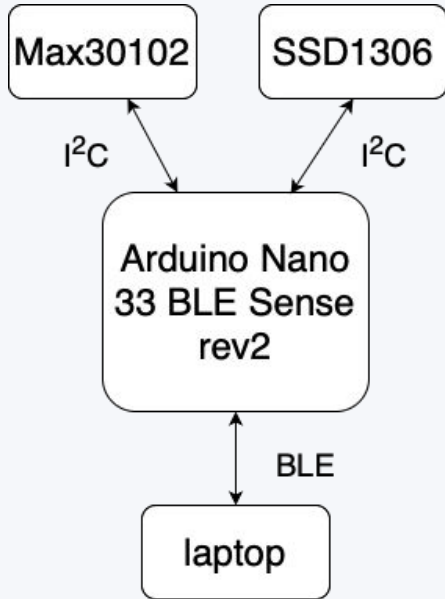
BLE



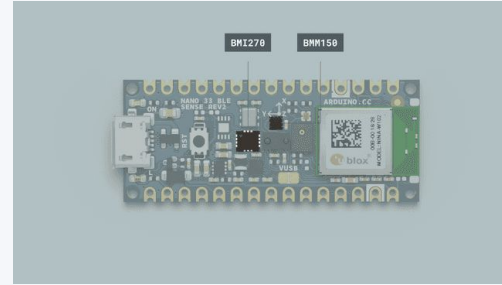
Arduino Nano 33 BLE Sense Rev2
(BurnSync Device)



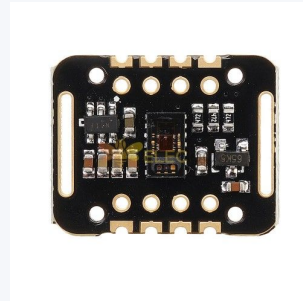
Block Diagram & Hardware Modules



IMU



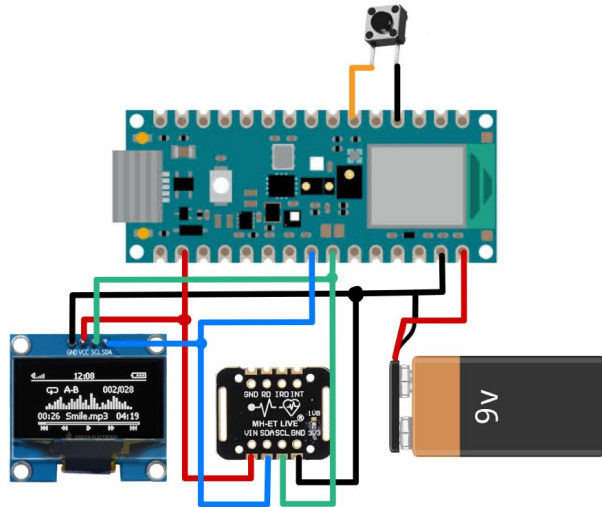
Max30102



SSD1306



Circuit Diagram



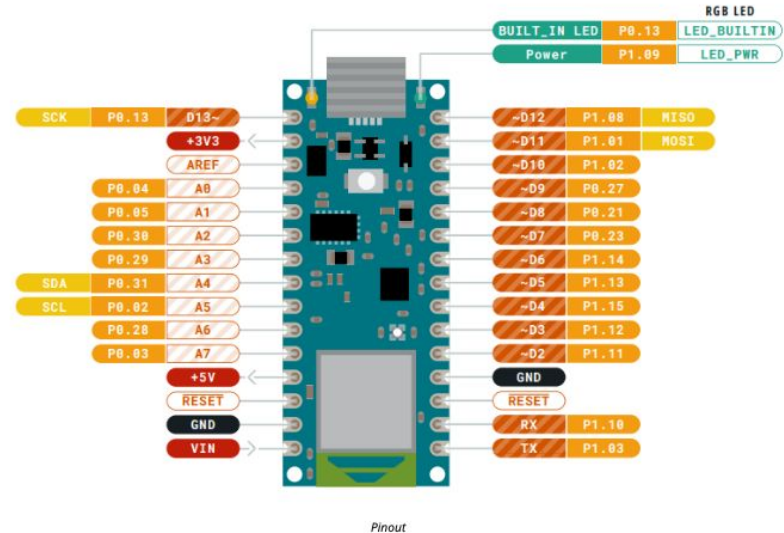
Button: (+) → D3, (-) → GND

Battery: (+) → Vin, (-) → GND

MAX30102: GND → GND, VCC → 3.3V, SCL → A5, SDA → A4

SSD1306: GND → GND, VCC → 3.3V, SCL → A5, SDA → A4

4 Connector Pinouts





04

Implementation Details

Technical Skills

Frontend



Backend & Authentication



Website Deploy



Machine Learning



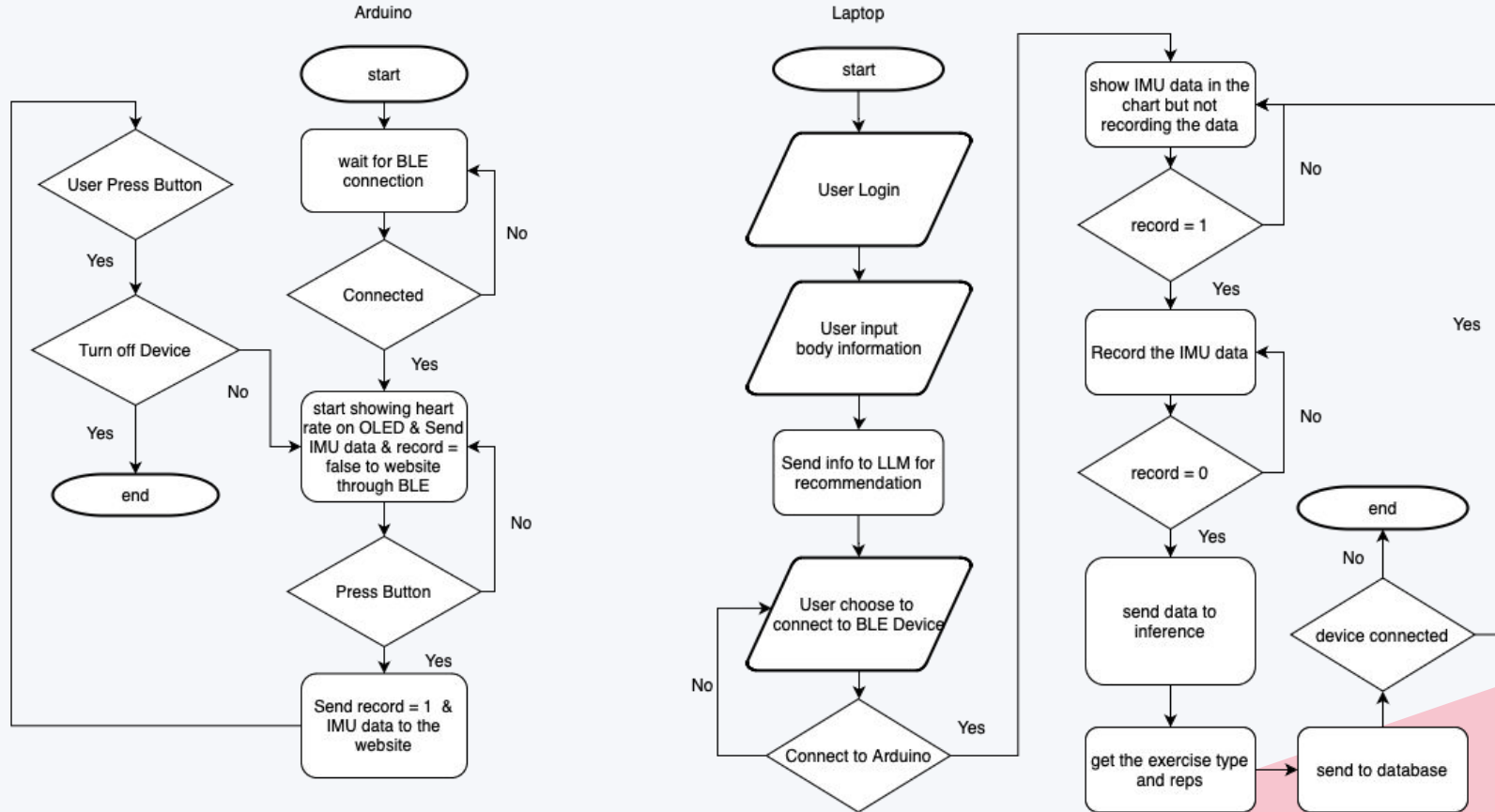
Model Deploy



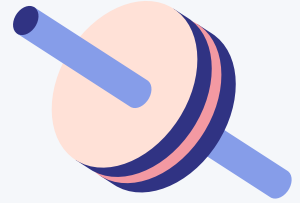
Arduino



System Flow



Hardware Design



OLED (SSD1306)

Button

stretchy fabric

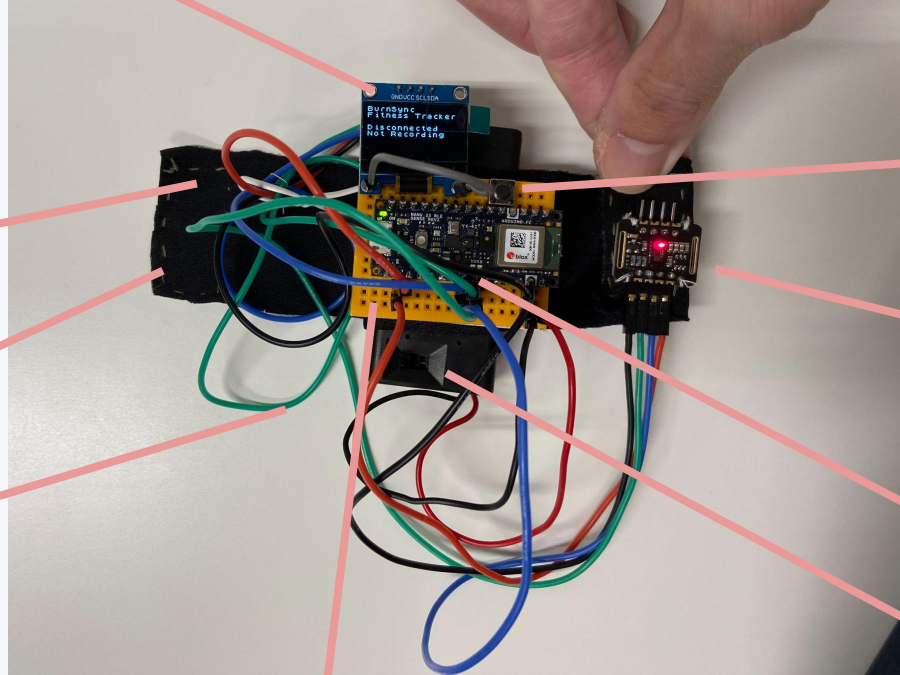
**Velcro (魔鬼氈)
(on the back,
sewn-on)**

soft wires

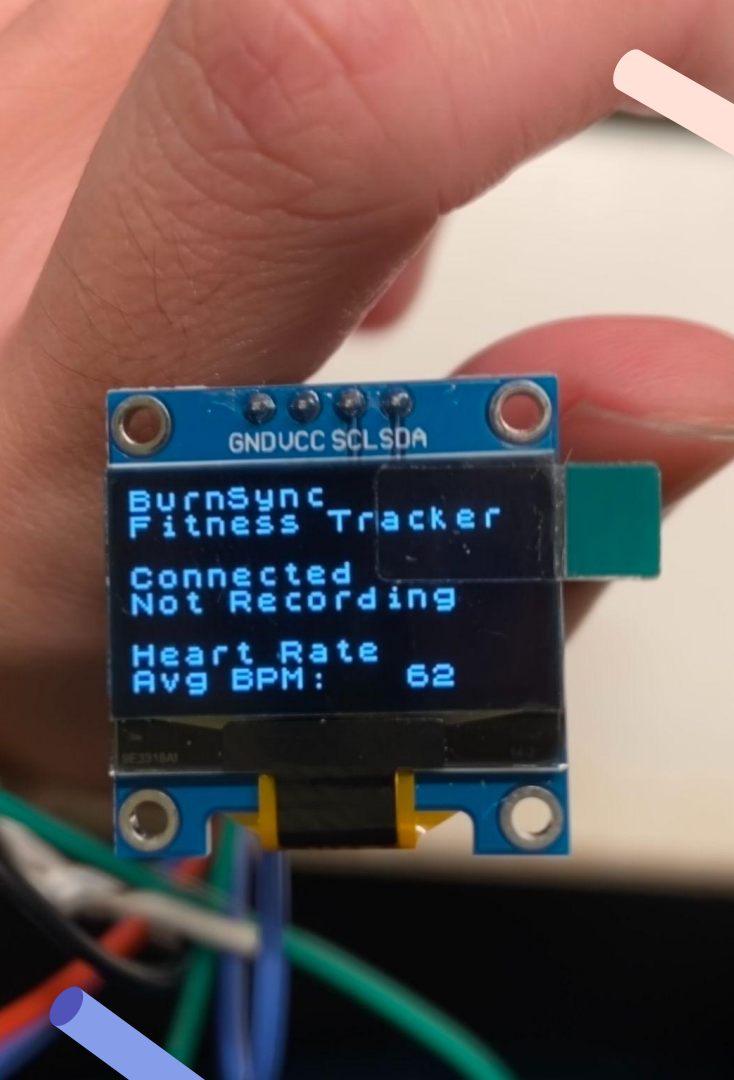
**MAX30102
(sewn-on)**

Arduino Nano

9V Battery



Bread Board



OLED Display

- Line 1: BurnSync
- Line 2: Fitness Tracker
- Line 4: Disconnected / Connected
- Line 5: Recording / Not Recording
- Line 7: Heart Rate
- Line 8: Avg BPM: [Number] / ???



Data Collection

- Steps:
 - Wearing Arduino Nano on the wrist
 - Connect Arduino and computer by BLE
 - Python code to collect the IMU data of Arduino and save as CSV file
 - 3 seconds(30 points) as a piece of data
 - Totally 400 piece of data for each class (300 from right hand and 100 from left hand)
- Take only 6 channels of IMU → accelerometer 3 channels, gyroscope 3 channels
- Sample Rate: 10 Hz

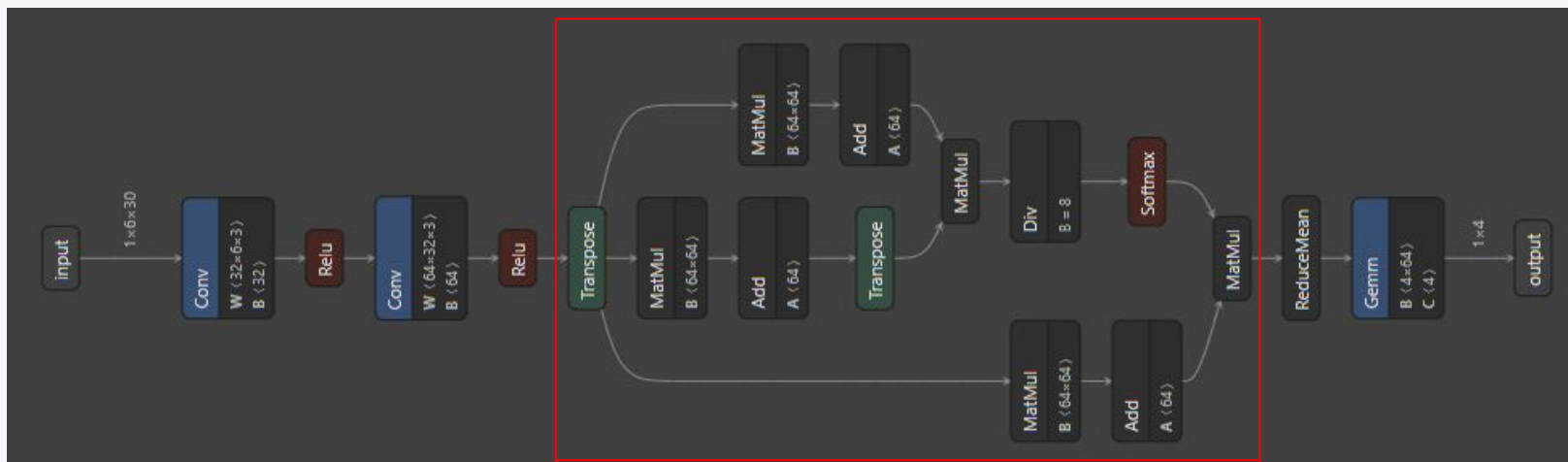


Dataset

	Training 70%	Validation 15%	Testing 15%
Push-up	280 (reps)	60 (reps)	60 (reps)
Sit-ups	280 (reps)	60 (reps)	60 (reps)
Squats	280 (reps)	60 (reps)	60 (reps)
Dumbbells	280 (reps)	60 (reps)	60 (reps)

Model Architecture

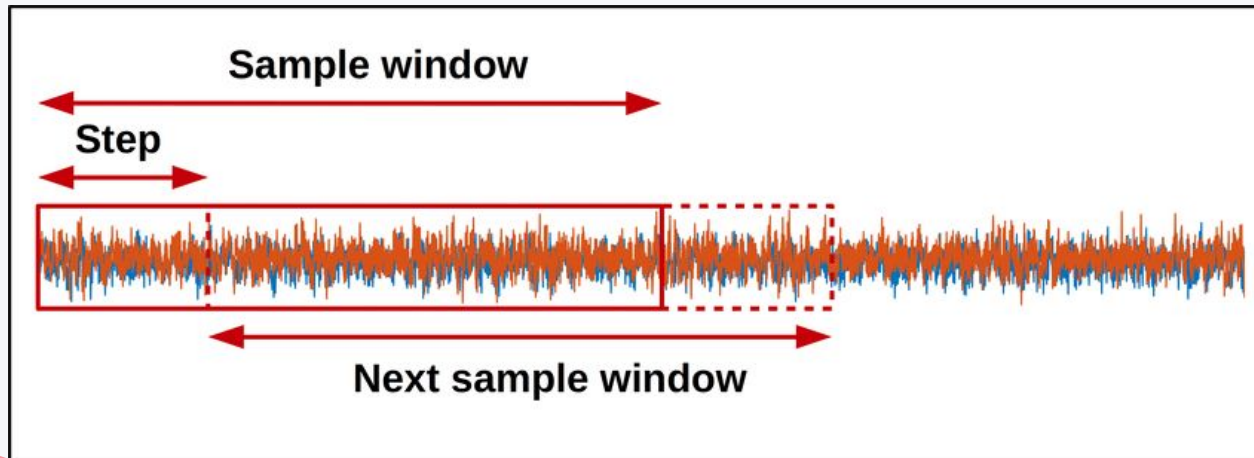
- Task: Classification – 4 classes
- Architecture: Attention with convolution
- Accuracy on testset: **98.75%**



Attention module

Sliding Window – Repetition Counting

- 1-Dimensional Sliding Window on six channels
- Window Size: 30
- Overlap: 15
- Step: Window - Overlap = 15



Inference Details

1. Receive a list of data with 6 channels
 2. Apply **sliding window** on the time sequence data
 3. For each window with **30 data points**, classify it into **4 classes**
 4. If probability of 4 classes in model output are all **< threshold (0.7)**, classify it to **null**
 5. If any class gets a probability **higher than threshold**, the **repetition** of that class **+ 1**
 6. After the sliding window, get the class of the maximum repetitions, **clear other classes to zero**
(Which means we **assume user do the same class each time**)
- Example:
 - { pushups: 8, squats: 1, situps: 3, dumbbells: 2 } →
{ pushups: 8, squats: 0, situps: 0, dumbbells: 0 }

The background is a light blue gradient. It features several decorative elements: a red line in the top left corner that loops and ends in a pink and blue cylindrical object; a blue cylindrical object in the top right corner; a large pink donut shape on the right side; a blue donut shape on the left side; and a pink and blue cylindrical object with a blue rod passing through it in the bottom right corner.

05

Conclusion



Efforts

Arduino

- Button & Pull-up resistance
- BLE Communication
- MAX30102 Module
- SSD1306 OLED Module
- Hardware Design

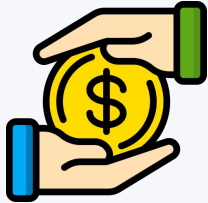
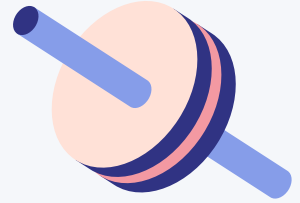
Website

- Frontend UI Design
- RWD Design
- Authentication
- Database Connection

Machine Learning

- Gemini LLM API
- Custom Model Training
- Dataset Collection
- Hugging Face Space Deploy
- Gradio API Connection

Contributions



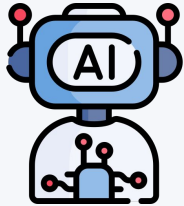
—Cheap & Affordable

Below 500 NTD (excluding Arduino Nano)



—Insight on Fitness IMU Data

Left or right hand does not affect result



—LLM Integration & Diverse Development Potential

Hosting our own website and handmade device provide high flexibility

Major Problems



Repetition Count Accuracy

- Miscounting repetitions
- Possible solutions
 - Normalization
 - Feature extraction
 - Fine tuning or Calibration
 - Adjustable threshold & overlap



Heart Rate Accuracy

- Poor heart rate detection
- Possible solutions:
 - Use other sensors
 - Calibration

Future Work

Higher Accuracy



Better Encapsulation

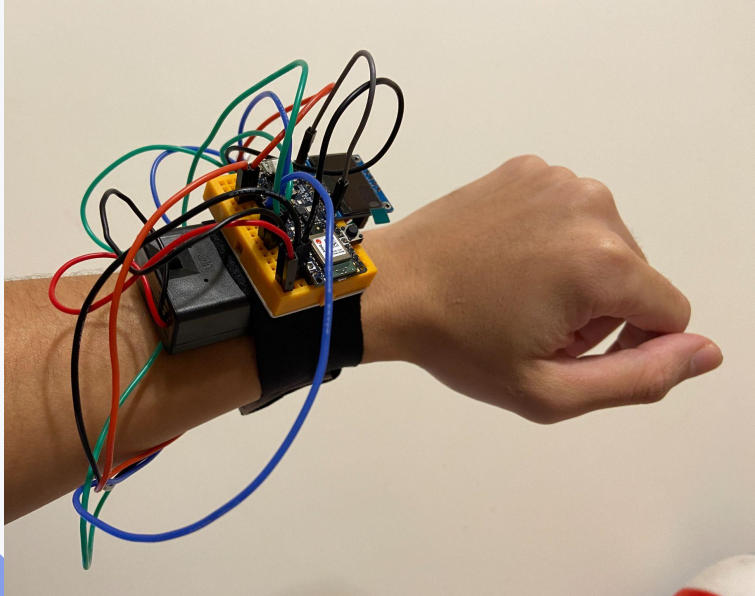


Massive User Study



More Types of Exercise





Conclusion

BurnSync

1. Personal fitness assistant
2. Convenience
3. Ubiquitous
4. Cheap
5. High potential for future development



06

Live Demo

Connect BLE Device

No device connected

Target Calories

0500

Regenerate Suggestion

It's impossible to give a precise workout plan to burn exactly 500 calories based solely on age, height, weight, and gender. Calorie expenditure during exercise varies significantly based on intensity, form, and individual metabolic rate. However, I can provide a sample workout that *could* burn approximately 500 calories for a 24-year-old male weighing 70kg and 180cm tall. This is an estimate, and actual calorie burn will vary. Consider using a fitness tracker for a more accurate measurement.

Important Note: This is a suggestion. Consult a doctor or certified personal trainer before starting any new workout routine. Proper form is crucial to prevent injuries.

Push-ups: 3 sets, 12-15 repetitions

Sit-ups: 3 sets, 15-20 repetitions

Squats: 3 sets, 15-20 repetitions

Dumbbell Rows (using moderate weight): 3 sets, 10-12 repetitions per arm

To potentially reach closer to 500 calories:

- **Increase intensity:** Perform exercises faster, with less rest between sets.

- **Increase weight:** Use heavier dumbbells for rows and potentially add weight to squats and sit-ups (e.g., a weight plate across your chest for sit-ups).

- **Add more exercises:** Include exercises like lunges, burpees, or planks.

- **Increase sets and reps:** Gradually increase the number of sets and repetitions over time.

Remember that proper nutrition and consistent exercise are key to achieving your fitness goals. This workout is a starting point, and adjustments may be necessary to optimize your results. Tracking your progress and adjusting the workout accordingly is recommended.

Exercise Tracking

Edit

Push-ups

Sets: 1

Reps: 6

Sit-ups

Sets: 0

Reps: 0

Squats

Sets: 1

Reps: 5

Dumbbells

Sets: 1

Reps: 3

Calories Burned: 5.83

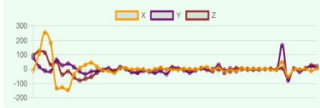
Merge Data

Sensor Data

Accelerometer



Gyroscope



BurnSync Demo

- [Website](#)
- Login
- Edit profile
- LLM Suggestion
- Live IMU data
- 4 classes tracking
- Edit tracking
- Merge data



If you use iPhone, you need to download **Bluefy** and use it as browser since Apple do not make their bluetooth available for browser



THANKS!

DO YOU HAVE ANY QUESTIONS?

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