



NuvoMotion

AI Fitness Mirror

Team Members



Ian Kim

ML Development,
Hardware



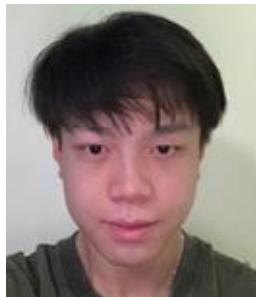
Jiesheng He

ML Development,
Training, CAD,
Dataset Creation



Austin Quach

Hardware,
Embedded
Development



Justin Fan

Landmark
Recognition,
Embedded
Development



Edward Ding

Team Leader,
Hardware,
Feedback Model



The Problem

Fix improper exercise form and lack of guidance

Exercising improperly could lead to:

- Injuries (improper form)
- Inefficiencies (not exercising the right muscles)
- Loss of motivation (“Am I even doing this right?”)

Goal: Improve fitness for everyone



Our Solution

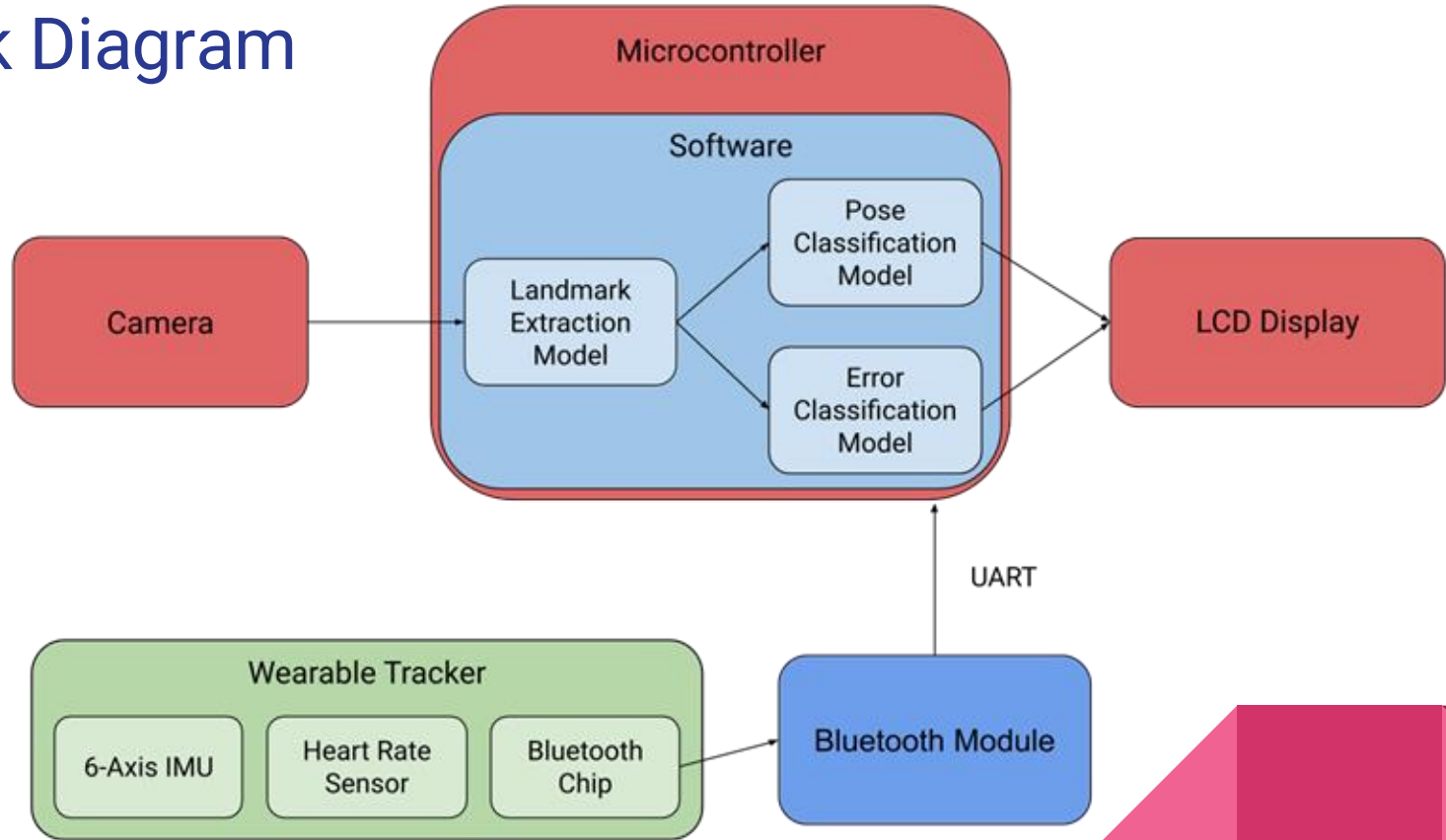
Create a product that functions as a mirror, providing the user with **real-time exercise detection, repetition counting, and feedback** on how well they perform an exercise.

Leverage custom edge ML models to perform keypoint detection and pose estimation.

Ensure device is low-power and portable.



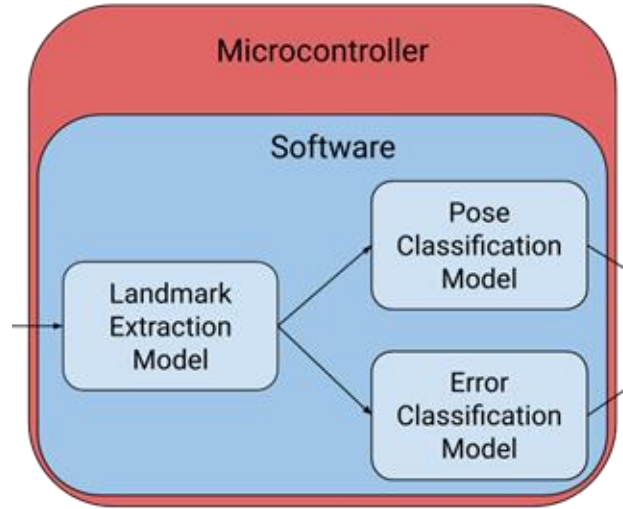
Block Diagram





Hardware

Microcontroller

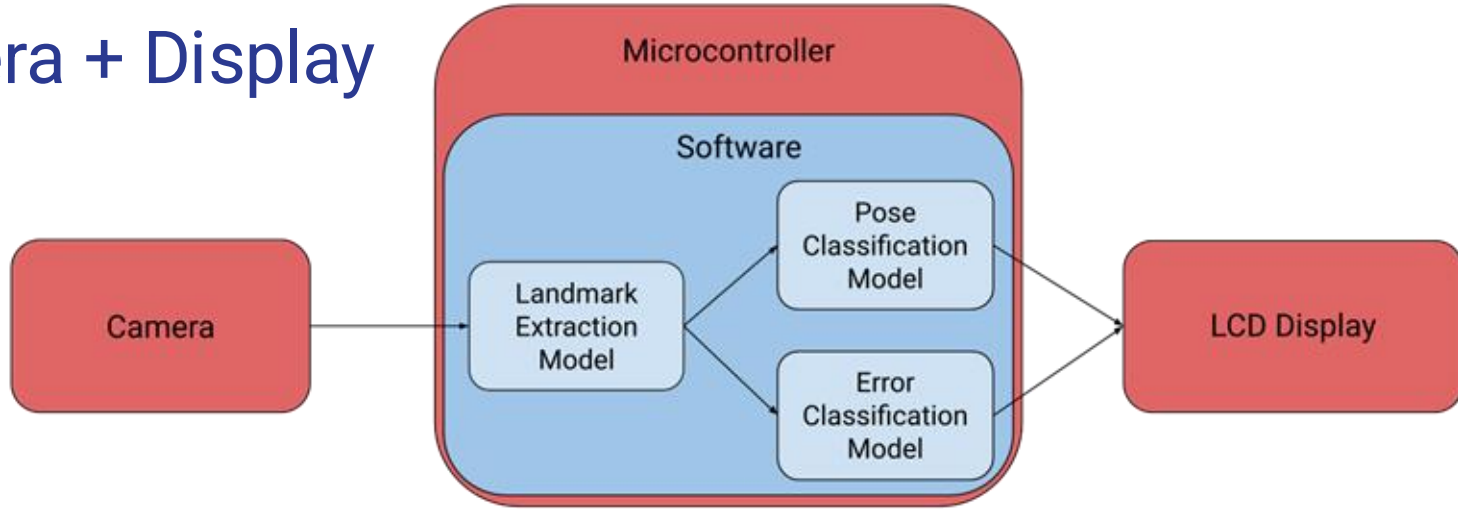


Bluetooth Module



- Adafruit BLE UART Friend
- Provides bluetooth functionality to microcontroller
- Enables wireless communication with wearable

Camera + Display



Camera



- HM1055 CMOS Image Sensor
- 1280x720p, 30 FPS
- Provides images to ML models

LCD Display



- NuMaker-TFT-LCD5
- 5", 800x400p
- Connected directly on microcontroller

Wearable Tracker

6-Axis IMU



- BMI270
- Accelerometer + Gyroscope
- Provides movement data to ML models

Heart Rate Sensor

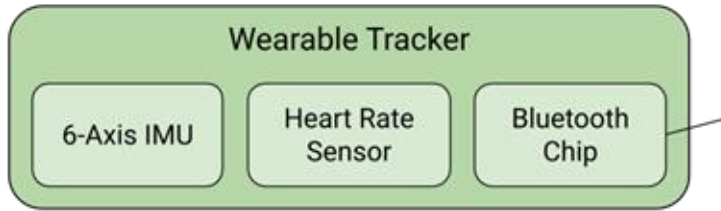


- MAX30102
- Provides heart rate data to the user

Bluetooth Chip



- nRF52840
- Reads data over I2C from IMU and heart rate sensor
- Sends data over bluetooth to microcontroller



Coin Battery



- CR 2032
- Power source

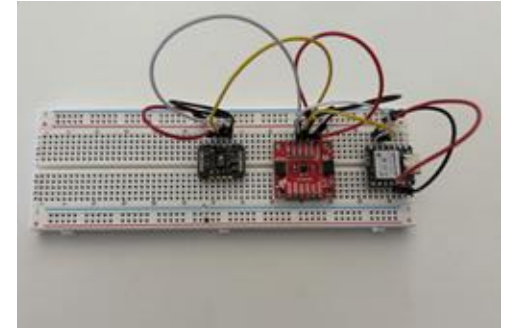
Wearable Tracker PCB + Breadboard Setup



Wearable Tracker PCB +
Encasing (front)



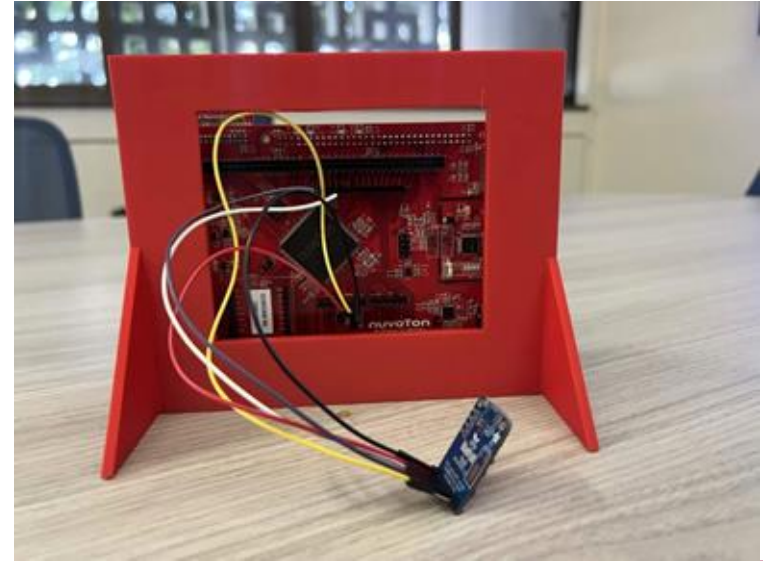
Wearable Tracker PCB +
Encasing (back)



Wearable Tracker (breadboard)

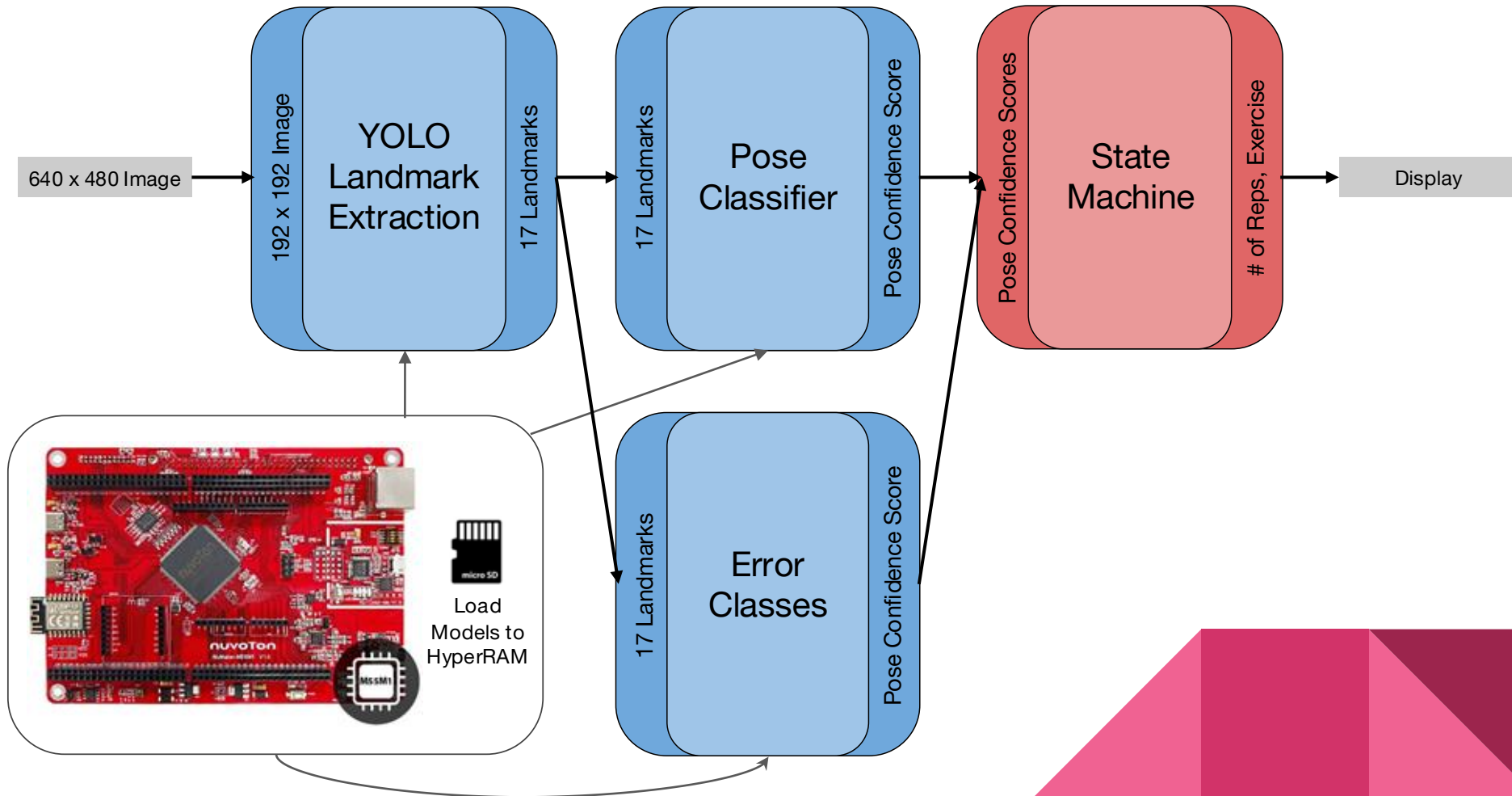
- Augment ML models with acceleration and angular velocity data for more accurate pose and error classification
- Display heart rate on screen

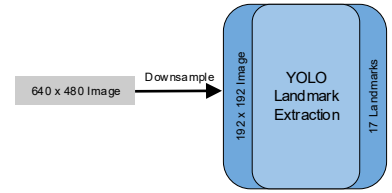
Board Stand Setup





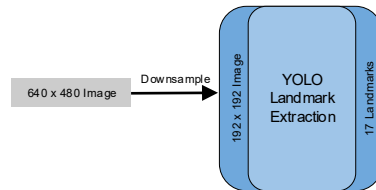
Software



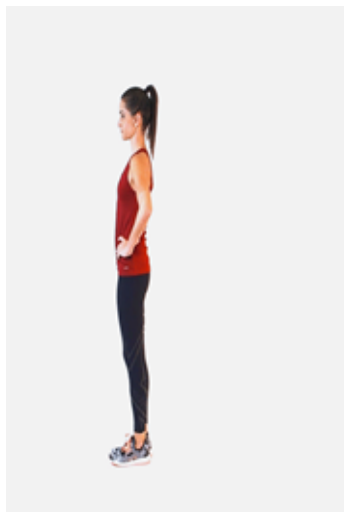


Custom Training Dataset

Five Main Exercise classes



Pushups



Lunges



Squats

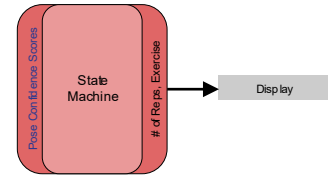
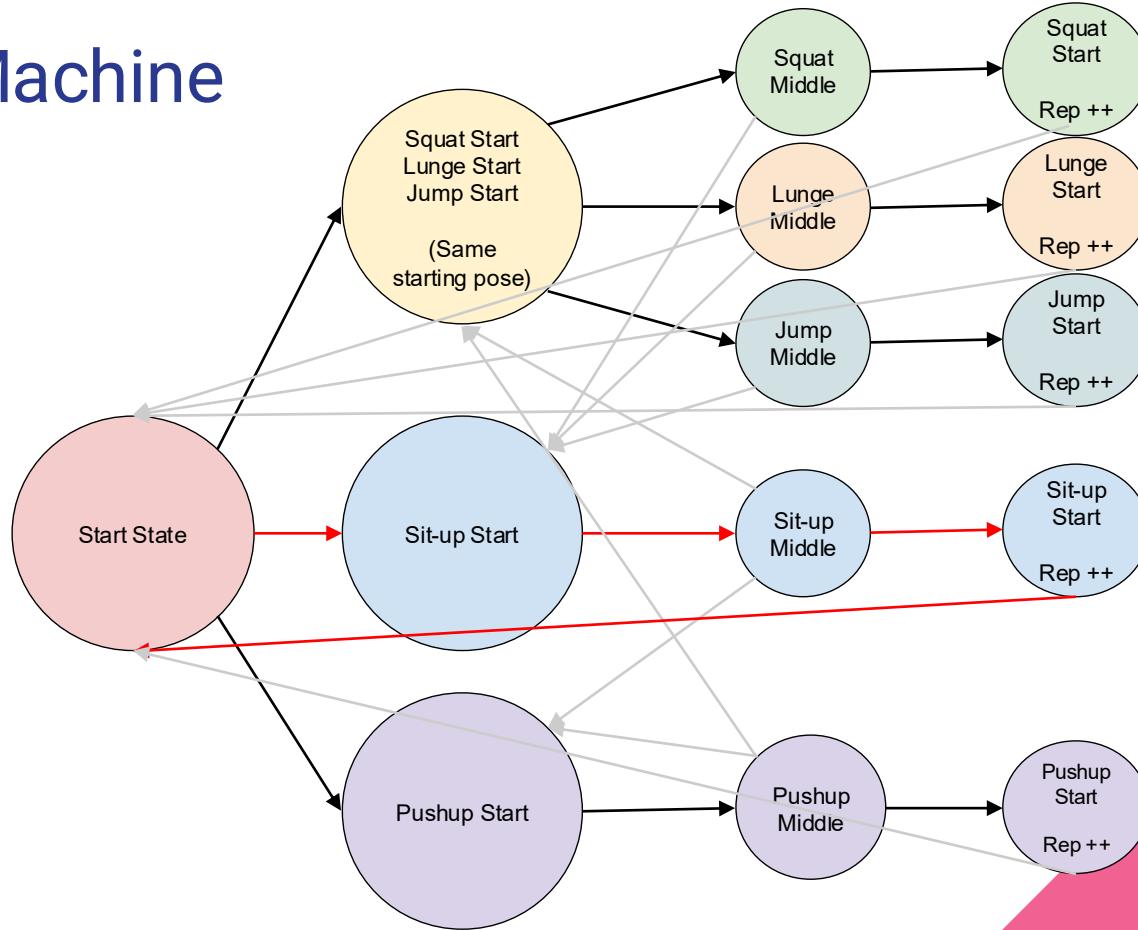


Jumping Jacks

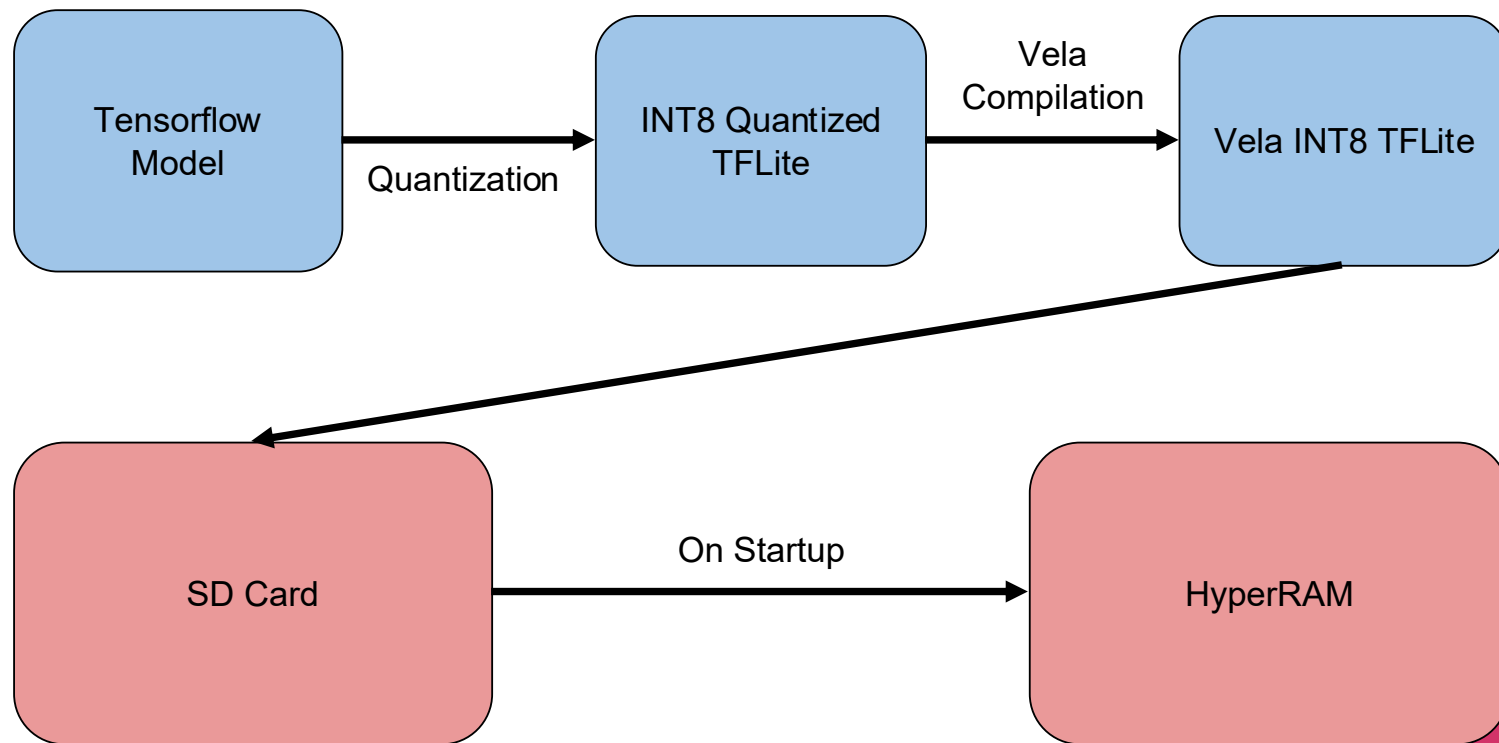


Sit-ups

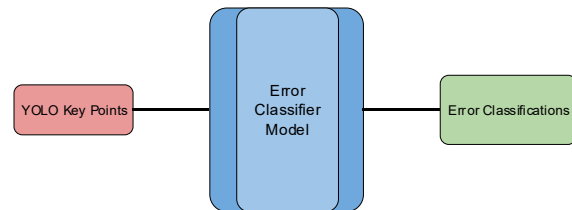
State Machine



Converting Models to Deploy to Board

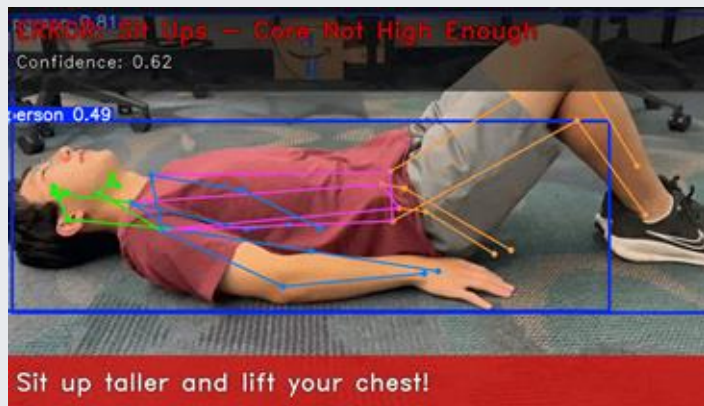


Error Class Dataset



Exercise Class	Errors
Pushups	Knees touching the ground
Lunges	Not lunging low enough
Squats	Not squatting low enough
Sit-ups	Core not going high enough
Jumping Jacks	Arms not high enough Legs not wide enough

Error Classifier Architecture



Input Stream

Real-time video with YOLO Key Points

Error Classifier Model

YOLO Key Points Input

Error Classifications

Situp: Body not high enough



Final Product



NuvoMotion

AI Fitness Mirror

Acknowledgements

Special thanks to Max Dokukin, Raman Sargis, Aaron Zhou, Nuvoton, Professor Isukapalli, Kriteen, Tien, and Lucas!

The Nuvoton logo is displayed in a bold, red, sans-serif font. The letters 'n', 'u', 'v', and 'o' are lowercase, while 'T' and 'o' are uppercase. The logo is centered horizontally in the middle of the slide.

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