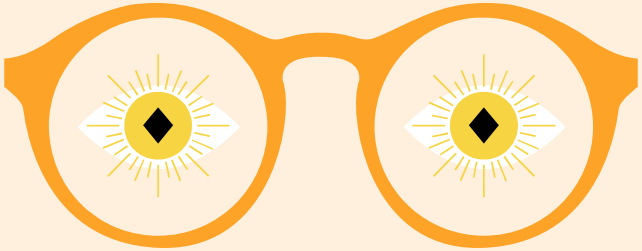


BEYOND VISION

BLIND ASSISTANCE TOOL

TABLE OF CONTENTS

01 Motivations

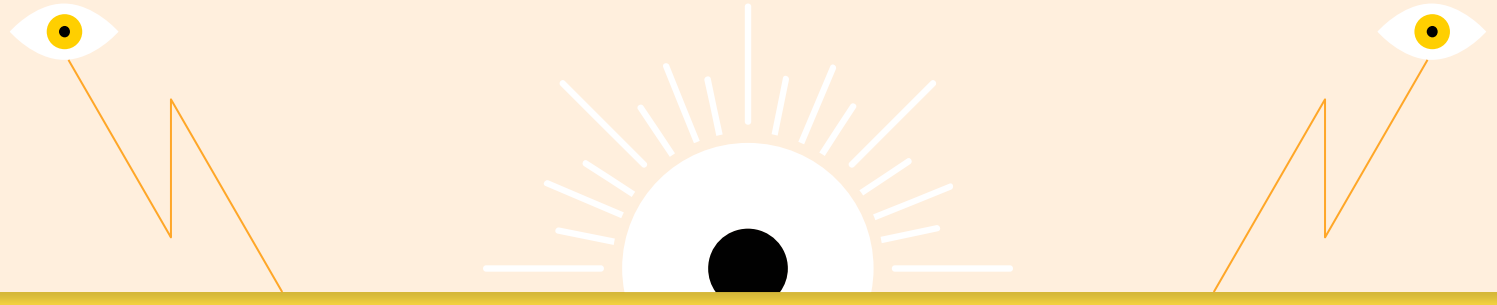
02 Overall Architecture

03 Demo

04 HW & SW Specs

05 Other Considerations

MOTIVATION



MOTIVATION

ACCESSIBILITY

Navigating curbs, stairs, ledges could be a challenge

SAFETY

Smoke detectors are not mandatory in households prior to 2018 [2]

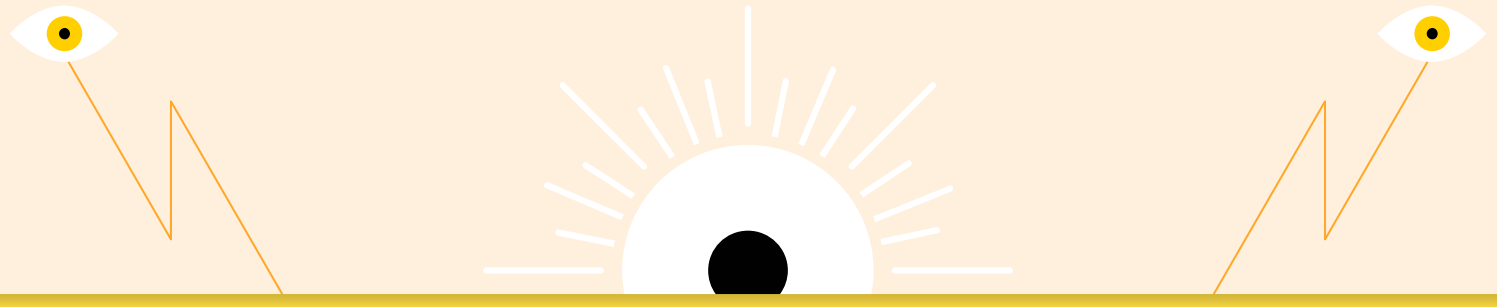
COSTLY

Training both guide dogs and users can cost up to $50000 [1]

[1] Guide Dogs Singapore, "Guide Dog Programme," [Online]. Available: https://guidedogs.org.sg/guide-dogs/guide-dog-programme/

[2] N. J. Sen, "Smoke detectors mandatory in all new homes from June 2018; existing home owners also urged to comply," The Straits Times, 16 November 2017.

SYSTEM ARCHITECTURE



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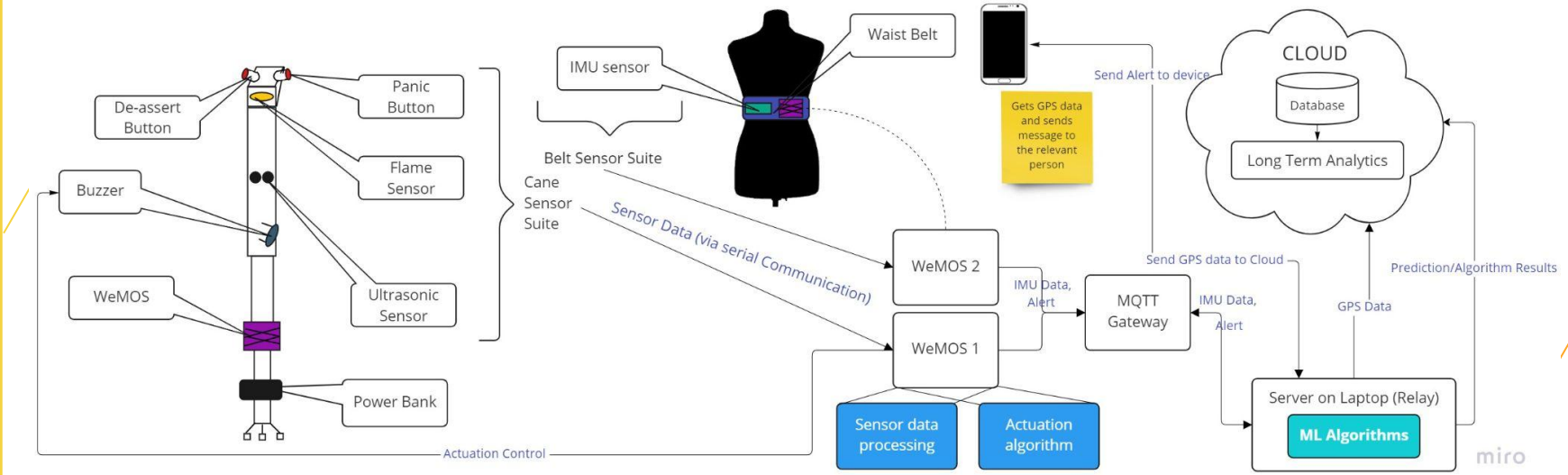
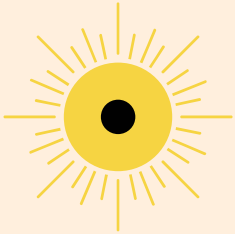
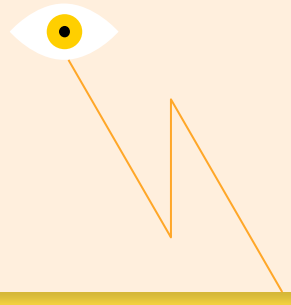
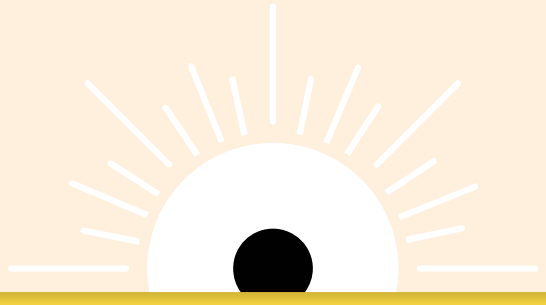
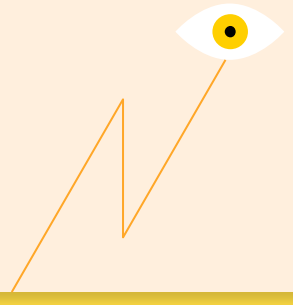




DEMO







DEMO

01

Smart Walking Cane

Panic Button → Fast Beep → Telegram Message
Flame Sensor →Slow Beep →Telegram Message
Proximity sensor → Normal Beep

02

Waist Belt

Idle, Walking, Sitting / Getting Up

Fall → Telegram Message

03

Long Term Analytics

Front-End Showcase

TECHNICAL DETAILS

HARDWARE: WALKING CANE

Flame Sensor [1]

Operating Current: 15 mA
Voltage: 5V
Power: 0.075W

Buzzer [3]

Operating Current: 30 mA
Voltage: 5V
Power: 0.150W

Ultrasonic Sensor [2]

Operating Current: 15 mA
Voltage: 5V
Power: 0.075W

Life-Time

10000 mAh / 60mA = 166 h = 1 Week

[1] https://www.sunrom.com/p/fire-flame-sensor-module
[2] https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf
[3] https://www.farnell.com/datasheets/2171929.pdf

HARDWARE: WAIST BELT

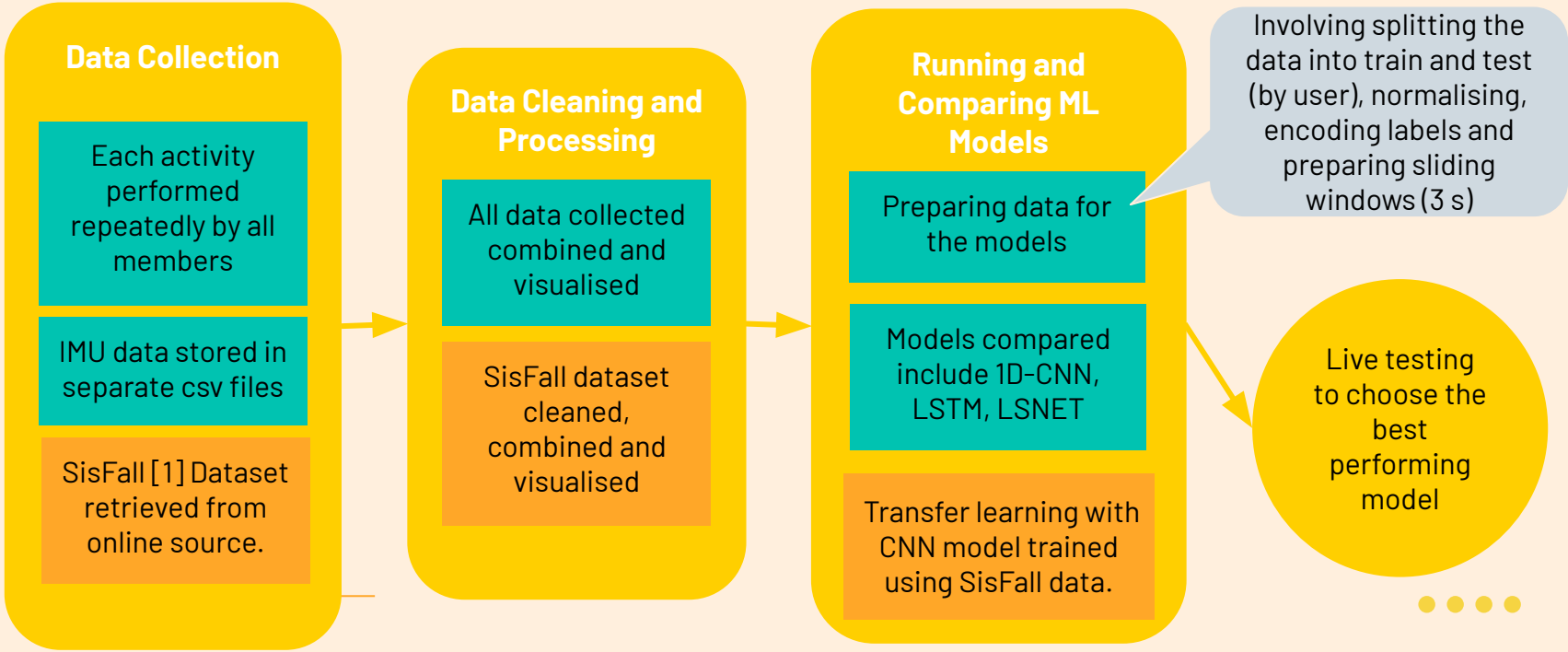
MPU-6500 [1]

Operating Current (gyroscope): 3.2 mA
Operating Current (accelerometer): 0.45 mA
Voltage: 3.4V
Power: 0.01241W
Life-time: 1150 mAh [2] / 3.65 mA = 315h = 2 weeks*

* Theoretical life-time before recharge - however, on low power delivery the IMU data becomes inaccurate

[1] https://invensense.tdk.com/download-pdf/mpu-6500-datasheet/
[2] https://www.redcheetah.com/reidsvilleoffice/outpost/item_details/EVEE91BP4

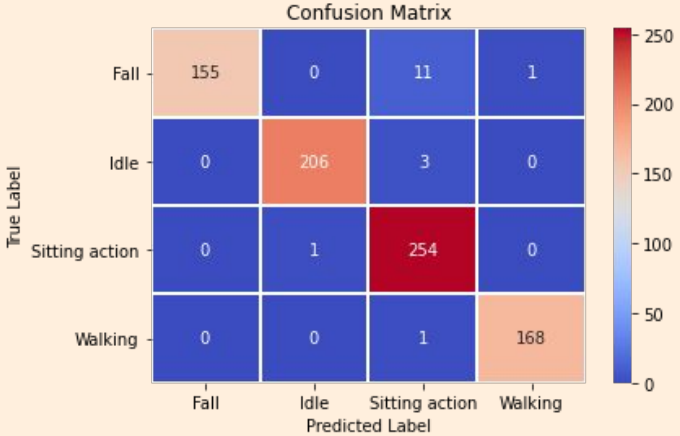
ML MODEL: THE PROCESS



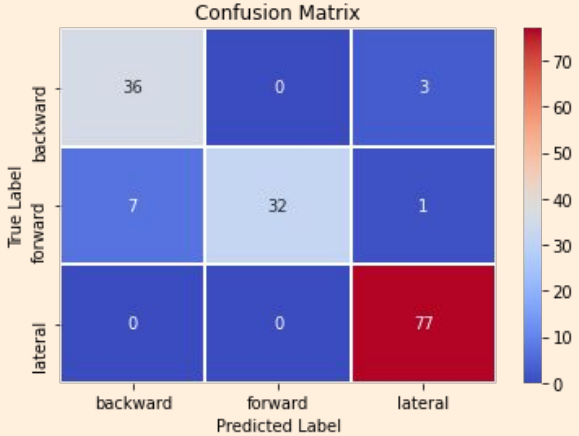
[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5298771/

ML MODEL: TRAINING RESULTS

- The system is supported by ML models for the following:
  - *Active activity monitoring for fall detection*
  - *Detecting fall types for use in long term analytics*



Best Model CNN for activity detection

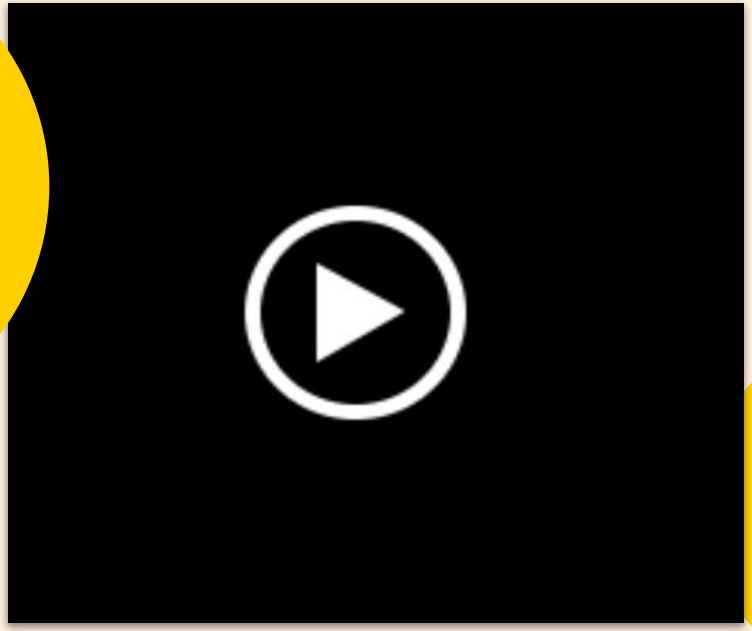


Best Model CNN for fall types

Confusion matrices testing with data collected from one of the team members (not used in training) of the best chosen models

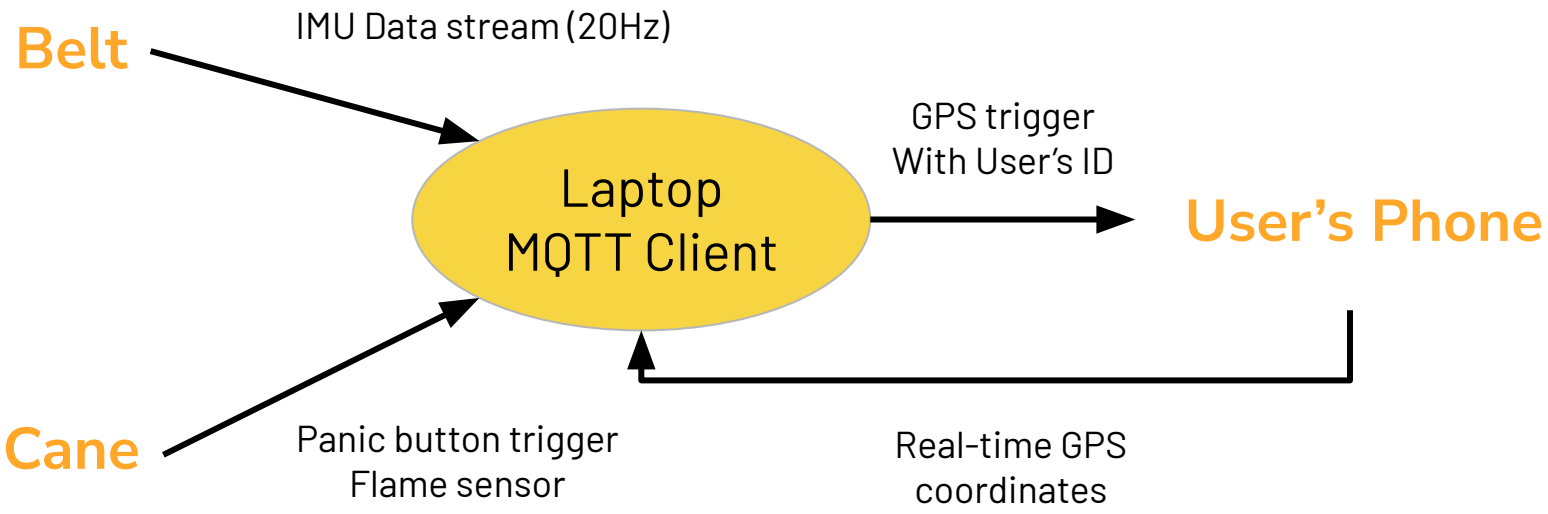
ML MODEL: MODEL TESTING

The activity detection system worked well with both CNN and Transfer learning. However, CNN showed better results while live testing and was also faster in terms of response time and hence was our final chosen model

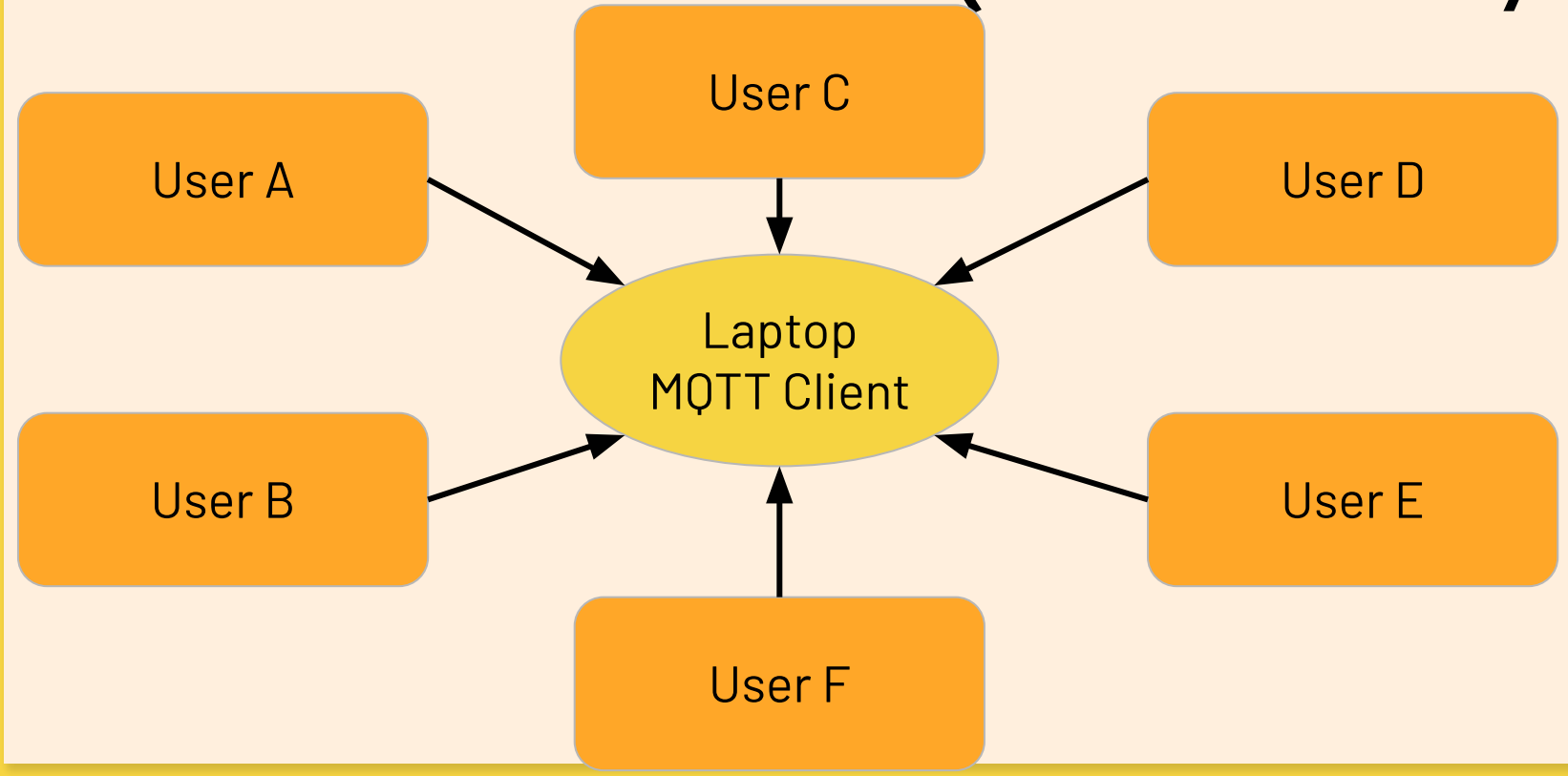


The best performing model for fall types detection was CNN.

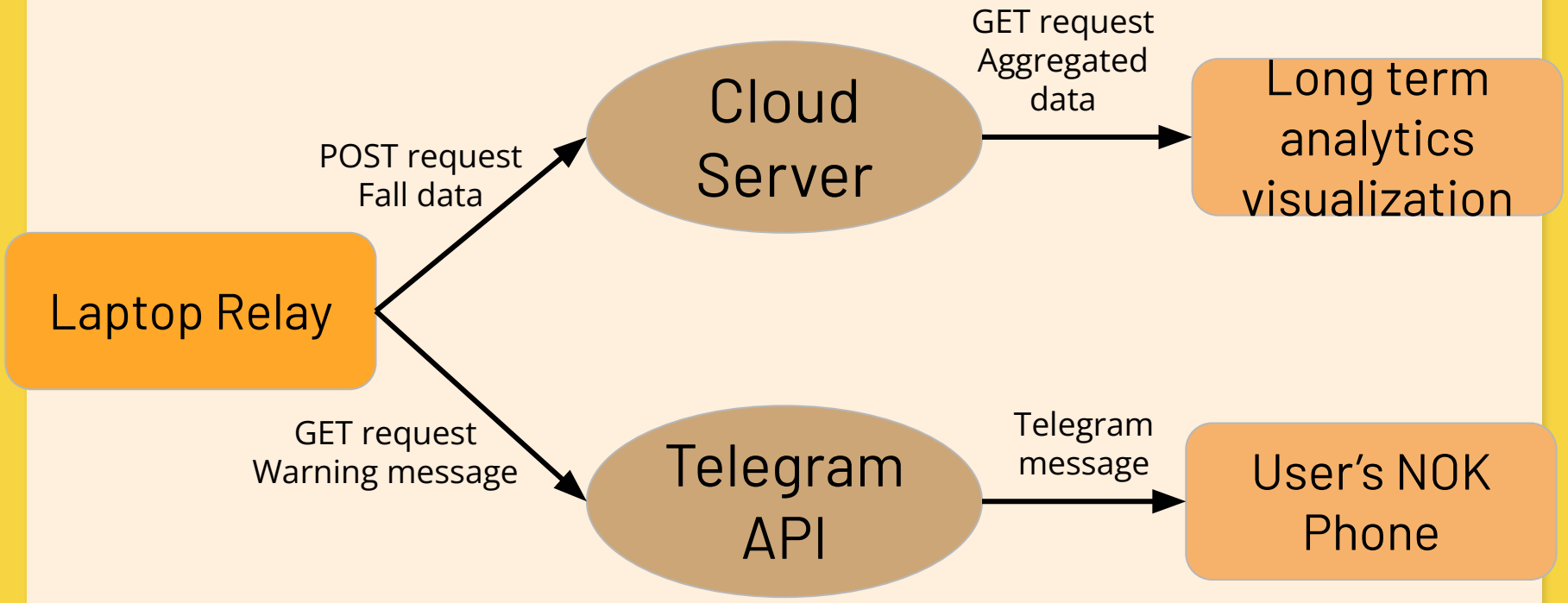
Communications - MQTT



Communications - MQTT- Scalability



Communications - RESTful API

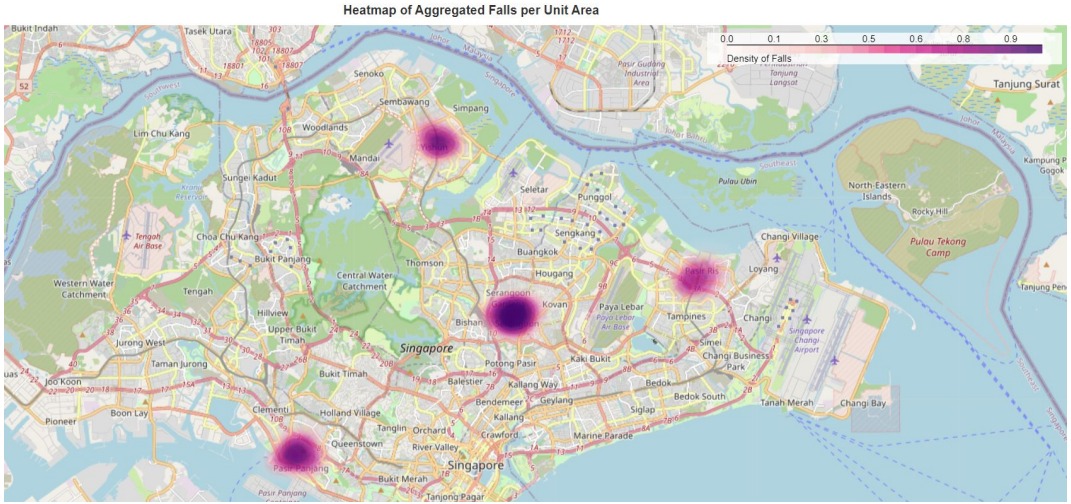


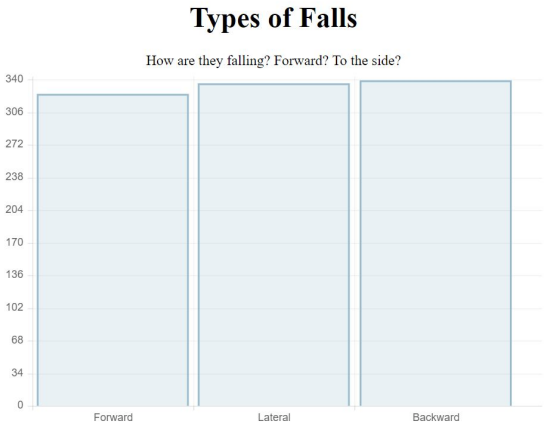
ANDROID GPS & GOOGLE MAPS INTEGRATION

CLOUD

Target user: Urban planners

1. Where
2. Why





Panic or Flame?

TECHNICAL ACHIEVEMENTS

01

Data Processing

02

Uses SQLite 3 integrated with Flask

03

User-Friendly Visualization

04

MQTT Integrated GPS Tracker

05

Telegram Messaging

06

GitHub Version Control

CONSIDERATIONS

01

POWER CONSIDERATIONS

Sending GPS data only when needed instead of continuously

Sampling Rate of 20Hz following Nyquist Rate (98% of human actions capped under 10Hz)[1]

02

SECURITY

Credentials are removed when data is sent to cloud

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3859040/

CHALLENGES

01

PAINS OF DATA COLLECTION

02

POWER DELIVERY AFFECTING IMU

03

TROUBLESHOOTING HARDWARE VS SOFTWARE

FUTURE IMPROVEMENTS

01

Collect more data for better ML prediction

02

Continual Learning

03

Optimize Database Schema

04

GPS Tracker to run in background of phone

05

Camera for object detection

06

Text to speech

CONCLUSION

01

SUBCOMPONENTS ARE CHALLENGING ON THEIR OWN

02

INTEGRATING COMPONENTS INCREASES COMPLEXITY

03

IOT SYSTEMS CAN HAVE HUGE POSITIVE IMPACTS ON THE SOCIETY IF IMPLEMENTED CORRECTLY

THANKS!

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