



CITYU GEF PROJECT  
**ELDERLY FALL  
DETECTION SYSTEM**

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# Introduction

Hong Kong being an aging country has a large portion of their population made up of elderly people. To combat this we wanted to create an elderly fall detection system to ensure that our elderly population can maintain safe and healthy lives.

Our system will function in the form of a wearable watch and or necklace to optimise efficiency. Additionally, both these accessories are often favoured by the elderly, making it an attractive product for them.





# The problem



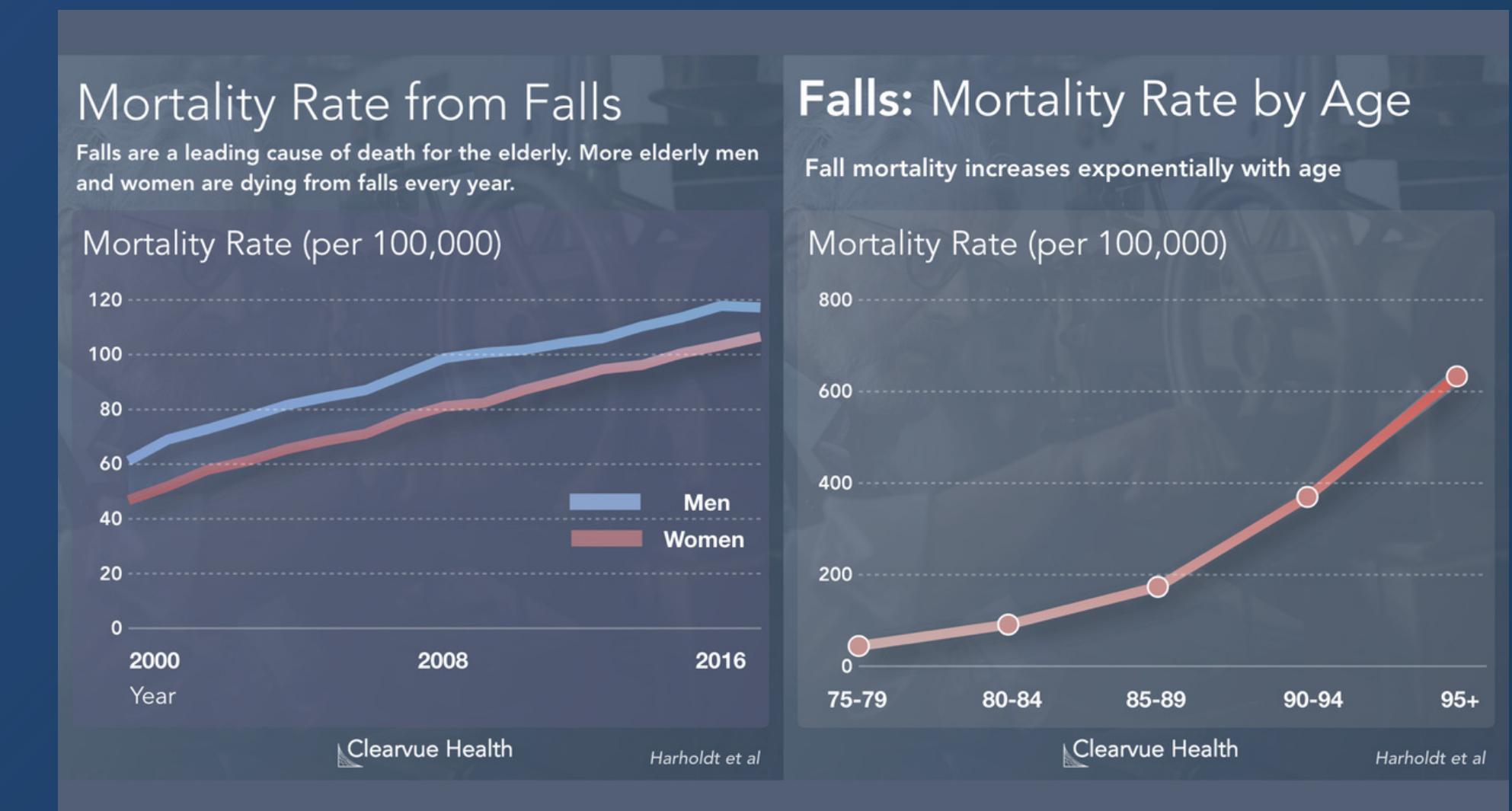
## 3 MILLION

elderly people are treated in the hospital due to fall accidents yearly.



## MORTALITY RATE

depicted on the right is how much more prone the elderly are to falling and how damaging these falls can be to their health.

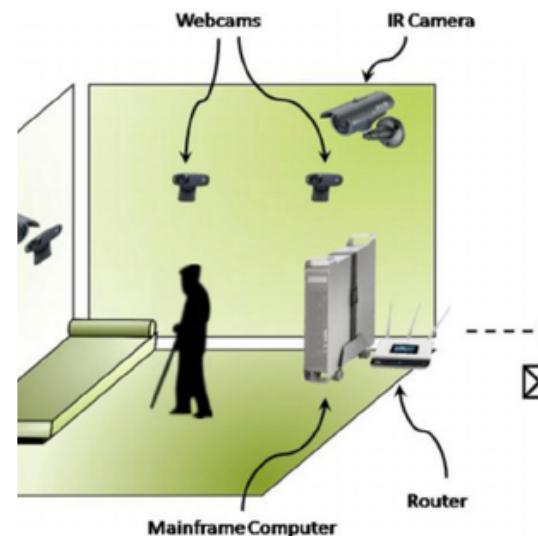


# Competitor Analysis



## Wearable Watches

- Too expensive: High-tech features make the product expensive
- Unnecessary features: Unnecessary features on apple watches and wearable watches are often overwhelming and useless to the elderly



## Camera Systems

- High set up costs: Often inconvenient to install
- Places of high hazard inaccessible: the toilet can be slippery and therefore the elderly are more prone to falling, however, installing camera's can be invasive and impractical in the toilet



## Other small chips

- Unreliable and are easily damaged: Small bluetooth chips are often prone to breaking easily and getting lost



## **Convinient**

The system takes only a handful of minutes to put on and take off.

01

## Why our solution works

02

## **Affordable**

By removing several unnecessary features the cost of manufacturing significantly decreases, making it more affordable for the elderly who may not have a large disposable income.



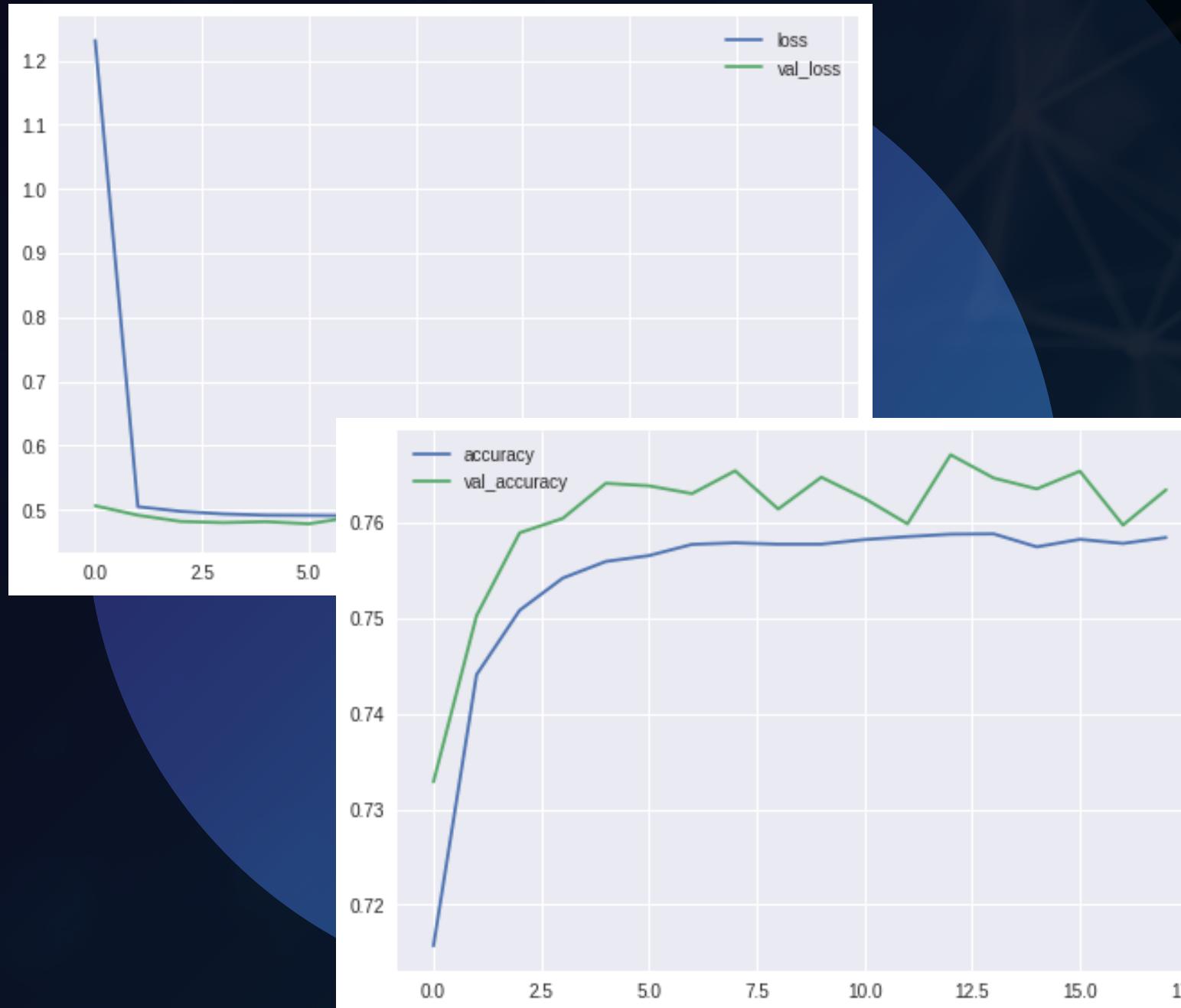
## **Catered towards elderly**

The system is catered strictly to the elderly. It is programmed for their needs. Additionally, overwhelming features that may not be of use to the elderly have been removed making it customised for this niche market.





# How our product works



## Software

We trained a machine learning model using over 2,000,000 data points of fall data split in to 85:15 training to testing ratio. This DNN model is further integrated with one-hot encoding, Adam optimizer and regularizers.

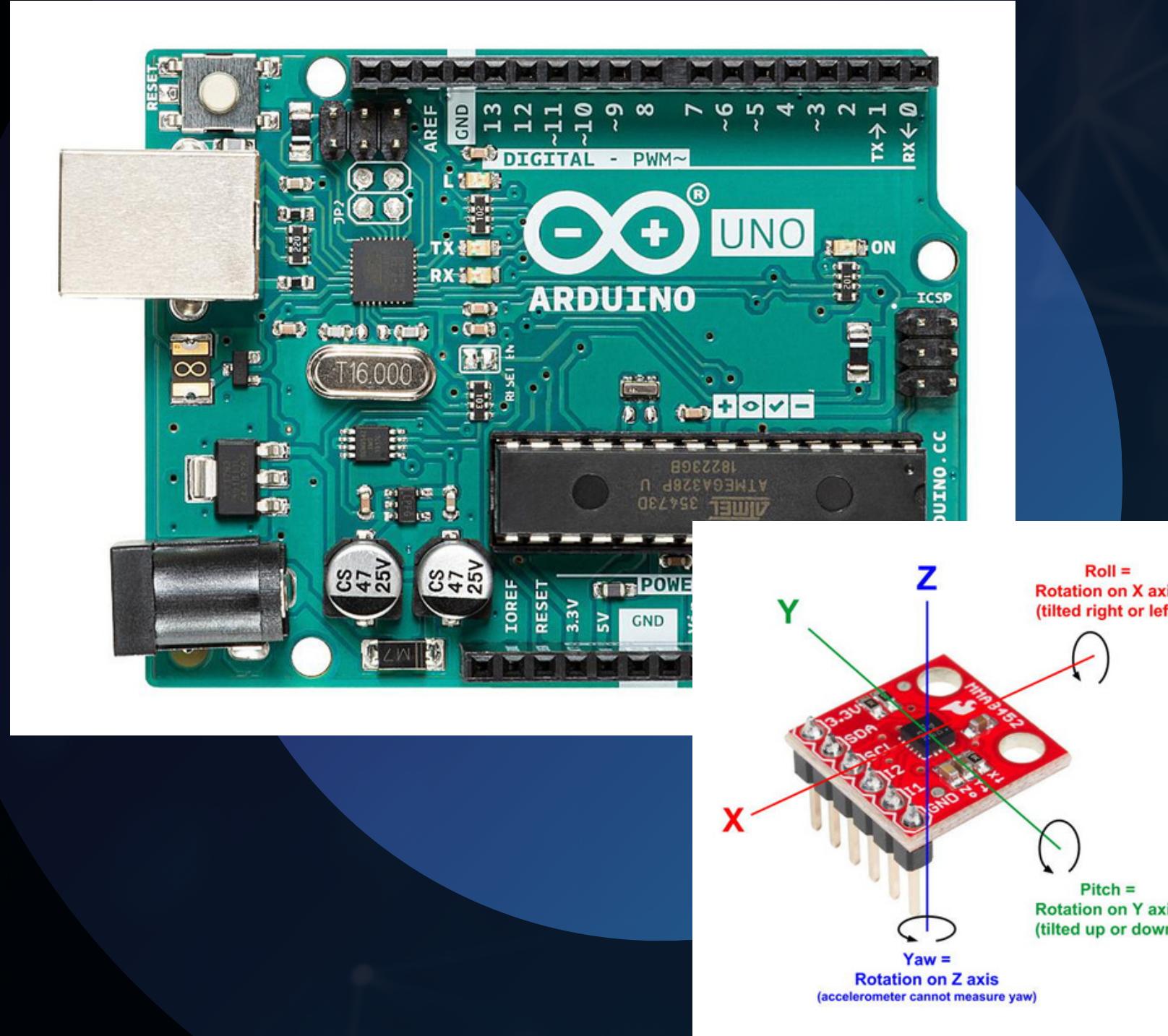
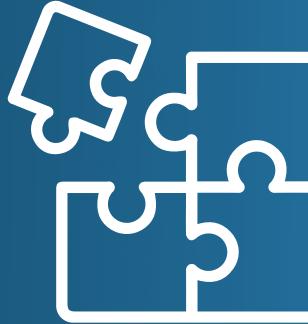
### Libraries used:

- TensorFlow 2.0
- NumPy
- Pandas
- Matplot Lib





# How our product works



## Hardware

We used an accelerometer to measure the acceleration of the elderly person, and we then connected this to an Arduino Uno.





# How our product works



## Results

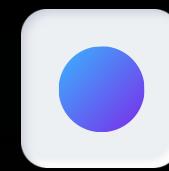
Through integrating software and hardware output values from Grove - IMU 10DOF and Arduino Uno and the trained DNN model, we attempted to predict a fall.

```
✓ 1s   prediction = model.predict(inputset_test[11:15])
      prediction
      1/1 [=====] - 0s 445ms/step
      array([[0.7013496 , 0.29865038],
              [0.00252119, 0.9974788 ],
              [0.0515999 , 0.9484001 ],
              [0.10453029, 0.8954697 ]], dtype=float32)

✓ 0s   [37]  test_one_hot [11:15]
      array([[1., 0.],
              [0., 1.],
              [0., 1.],
              [0., 1.]], dtype=float32)
```



# Summary



## Purpose

Our project aims to ensure that the elderly can maintain a safe and healthy life by creating a system to notify the hospital or their family if they have fallen.



## Methodology

Using machine learning models, accelerometers and an Arduino Uno board we developed our fall detection system.



## Success

At the moment our product has 77% success rate. However, in the future we are looking to add new sensors that can hopefully increase its accuracy.