

The background of the slide is a light gray topographic map with intricate contour lines. The word 'Navipal' is prominently displayed in a large, dark blue, sans-serif font. The letter 'i' is stylized with a location pin icon as its dot. Below 'Navipal', the words 'Assistive Devices' are written in a smaller, dark blue, sans-serif font.

# Navipal

## Assistive Devices

**St. James's Hospital** Presentation  
5<sup>th</sup> of August 2021

**Katie** Software Development  
**Conall** Engineering  
**Richard** Engineering

## Richard Vaniukevich



### Engineering

Richard is a 3<sup>rd</sup> year Mechanical and Manufacturing Engineering student at Trinity College Dublin currently studying under Dr. Shuo Yin as an assistant researching laser cutting technology and direct ink 3D printing where he is developing machine learning algorithms to investigate the changes in the various parameters of the interacting materials.

## Katie Kilroy



### Software Development

Katie is a 3<sup>rd</sup> year Mechanical and Manufacturing Engineering student at Trinity College Dublin. Her interest in dementia stemmed from her late grandmother, who had severe dementia before her passing. Since then, Katie has worked on different app projects relating to people with dementia, such as an app for daily use and reminders as well as a research assistant on an app to research dementia through games called Neureka.

## Conall Daly



### Engineering

Conall is a 3<sup>rd</sup> year Mechanical and Manufacturing Engineering student at Trinity College Dublin with an interest in medical device design. He is currently working as a member of Formula Trinity's Autonomous team researching reinforcement learning algorithms using the Pytorch libraries.

# Introduction

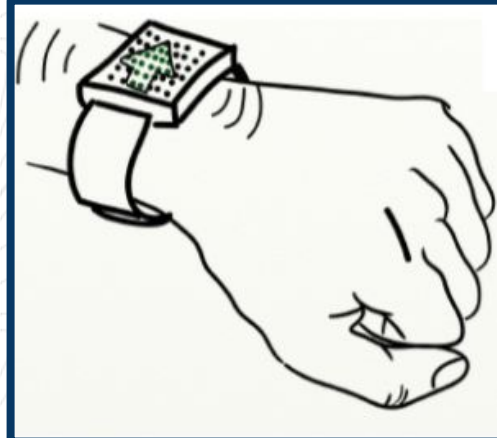
# The Origin of NaviPal

- Katie's grandmother Annie 1929 - 2015.
- She had Dementia before her passing.
- **"Annie's Gift"** an app for everyday use made in her honour.



# The Origin of NaviPal

We established a connection with the Irish Dementia Working Group to see if we could develop a product that could aide vulnerable members of our society in their daily lives.



# The Origin of NaviPal

Our Stakeholders:

- IDWG
- Dublin Bus
  - Chief inspector
  - Manager of the Control Center
  - The Travel Assistant Programme
- Iarnród Éireann
- Chime



# Feedback from IDWG



**Irish Dementia Working Group** @IrishDementiaWG · Nov 13, 2020

An interesting morning discussing transport with @tcddublin students Katie and Richard.

Thanks Sean, Kevin, Gerry and Jacinta by phone

#UnderstandTogether  
@alzheimersociarl



**Irish Dementia Working Group** @IrishDementiaWG · Feb 16

We are constantly reminded of the resilience of young people living through Covid19.

Our members are delighted to support Trinity students examining living with dementia & public transport

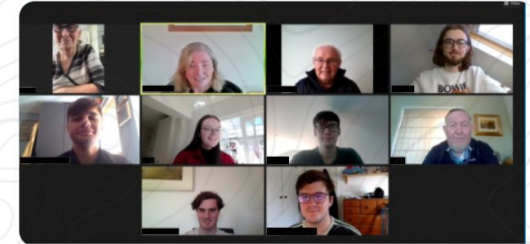
Students pictured with our Chair Sean Mackell & @alzheimersociarl  
Advocacy Officer @CloWhelan



**Irish Dementia Working Group** @IrishDementiaWG · Mar 29

Our Chair Sean Mackell was back to his advocacy today after appearing in the @VirginMedia\_One documentary #WeNeedToTalkAboutDementia yesterday

He joined colleagues Gerry & Jacinta to continue their collaboration with @tcddublin students on Transport & Dementia  
#UnderstandTogether



The Alzheimer Society of Ireland



# NaviPal Device

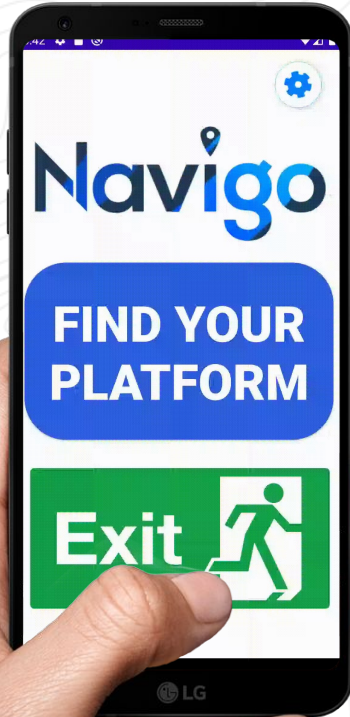




# Navipal

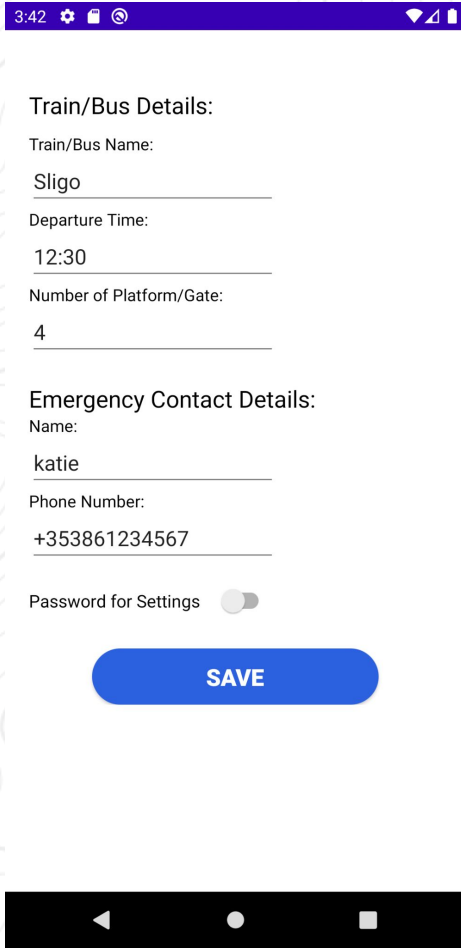
**Navigo**

# The Navigo App



The Navipal watch will be used in conjunction with the Navigo App.

The user or carer inputs a destination through the app settings or by voice.



A mobile application settings screen with a purple status bar at the top showing the time 3:42 and various icons. The screen is divided into two main sections: 'Train/Bus Details' and 'Emergency Contact Details'. Each section has a label, a text input field, and a numeric input field. At the bottom, there is a blue 'SAVE' button and a toggle switch for 'Password for Settings'. The background of the app is white with a subtle topographic map pattern.

3:42

Train/Bus Details:

Train/Bus Name:

Sligo

Departure Time:

12:30

Number of Platform/Gate:

4

Emergency Contact Details:

Name:

katie

Phone Number:

+353861234567

Password for Settings ☐

SAVE

# User Input

All the necessary information is entered through the app settings, which is accessed through the homescreen.

This includes:

- Train/bus Name
- Platform Number
- Departure Time
- Emergency Contact Details



## Navigation

The user selects to be directed to either the platform or exit on the home screen.

# Navigation

**Follow the  
arrows on your  
watch to go to  
your platform  
to get the  
12:30 train to  
Sligo**



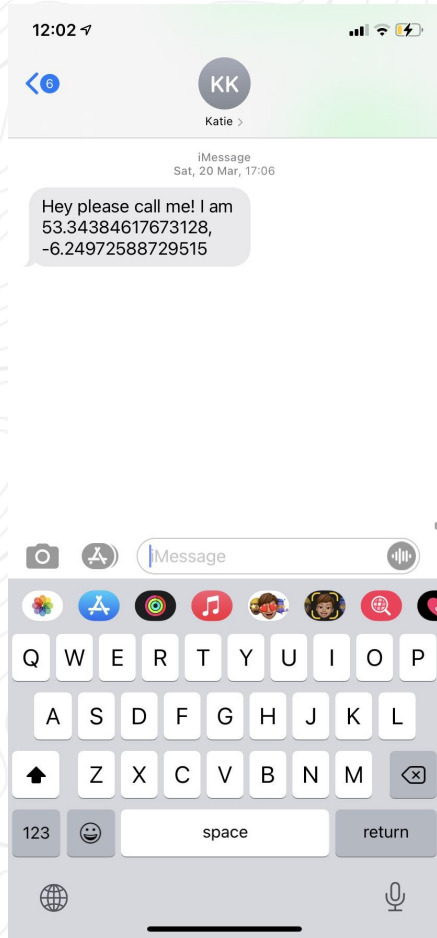
**Follow the  
arrows on your  
watch to go to  
the Exit**



The user selects to be directed to either the platform or exit on the home screen.

This brings up a screen telling the user to follow the arrows on their watch to their selected destination.





# The Emergency Feature

An automated message will be sent to a trusted contact when the user is in need of assistance.

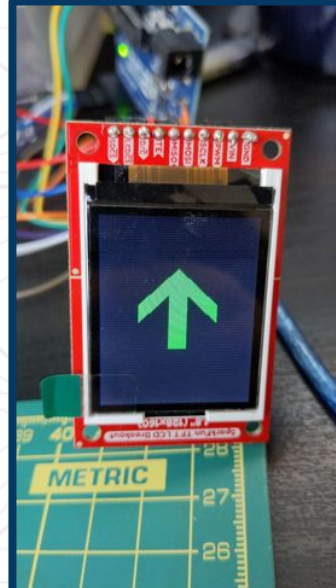
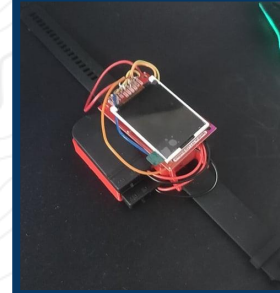
The contact details will be inputted and stored in the app settings.

Activated once the user holds down the button on the side of the watch.

# Technical Aspects

# NaviPal Watch

- Runs on an Arduino Nano 33 BLE Sense.
- Connects via Bluetooth to Navigo app receiving destination information from it.
- Powered by simple watch batteries.
- Components primarily chosen based on ease of prototyping.

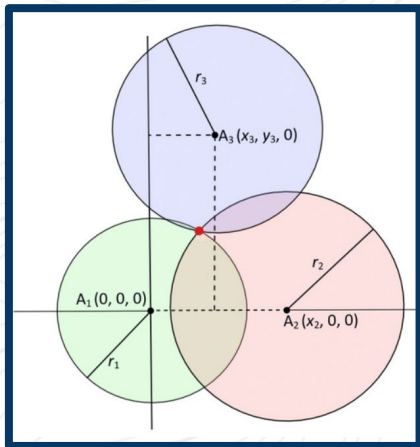


# Bluetooth Beacons

- Navigation is ultra accurate ( $\pm 10\text{cm}$ ) with Bluetooth Low Energy beacons (BLE).
- Uses Received Signal Strength Indicator (RSSI) which is the same technology used by COVID contact tracing apps.
- Act as the “rulers” so to speak (a big area of improvement).

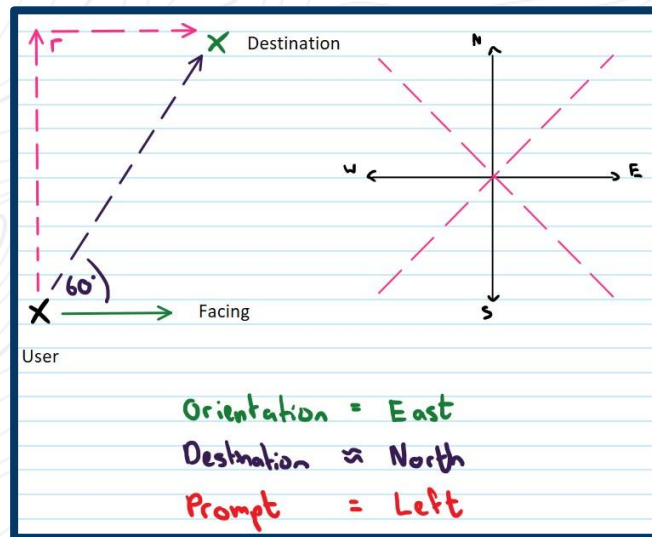


# Navigation Software



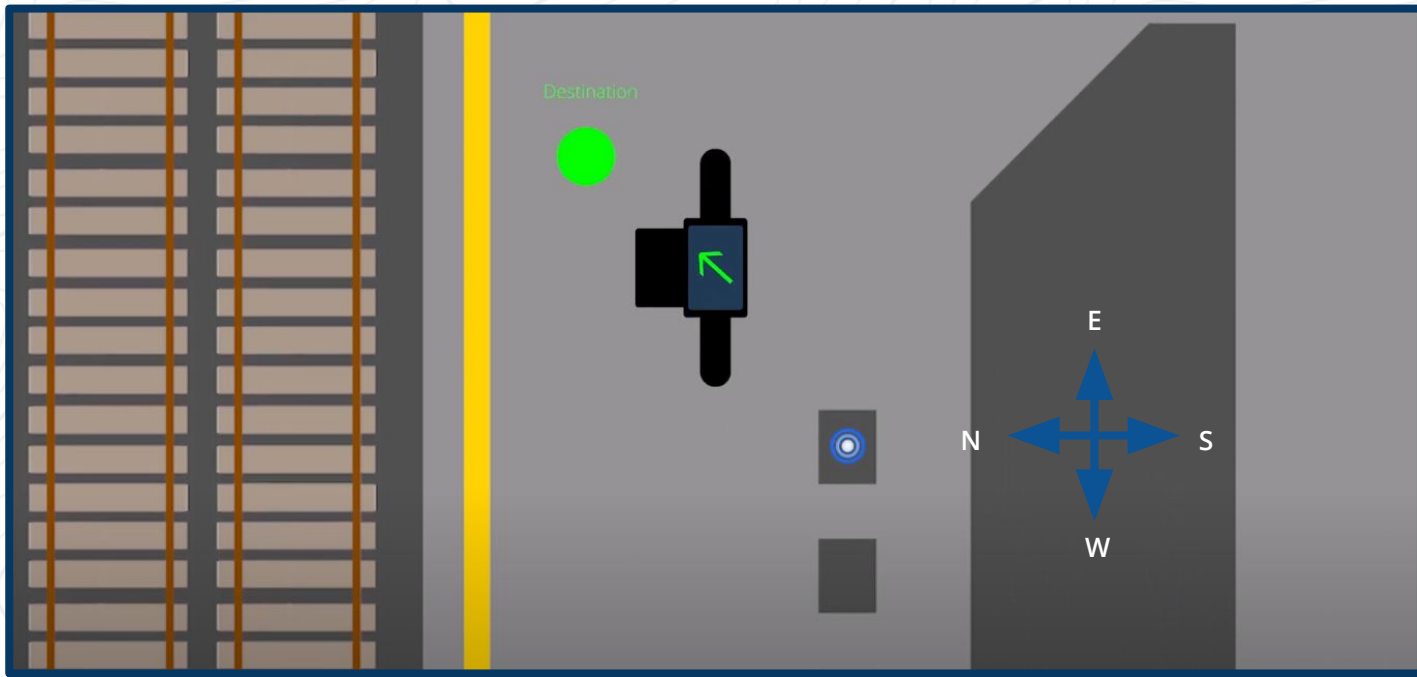
$A_1 (0, 0, 0)$	$r_1^2 = x^2 + y^2 + z^2$	$x = \frac{r_1^2 - r_2^2 + x_2^2}{2x_2}$
$A_2 (x_2, 0, 0)$	$r_2^2 = (x - x_2)^2 + y^2 + z^2$	$y = \frac{r_1^2 - r_2^2 + x_2^2 + y_2^2 - (2x_2 x)}{2y_2}$
$A_3 (x_3, y_3, 0)$	$r_3^2 = (x - x_3)^2 + (y - y_3)^2 + z^2$	$z = \sqrt{r_1^2 - x^2 - y^2}$

Trilateration



Vector Operations and  
Path Finding

# Navigation Software



Use watch frame of reference (magnetic field) to figure out which way user is facing and display arrow correctly.



**Looking to the Future**

# Our Plans for the Future

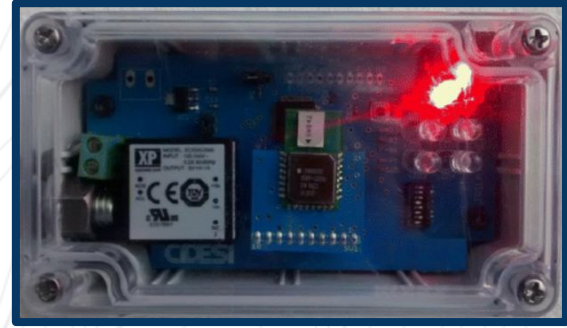
Continue testing our prototype.

- More secure software.
- Further develop the prototype.
- Different environments:
  - Train stations
  - Outside
  - Hospitals
  - Schools

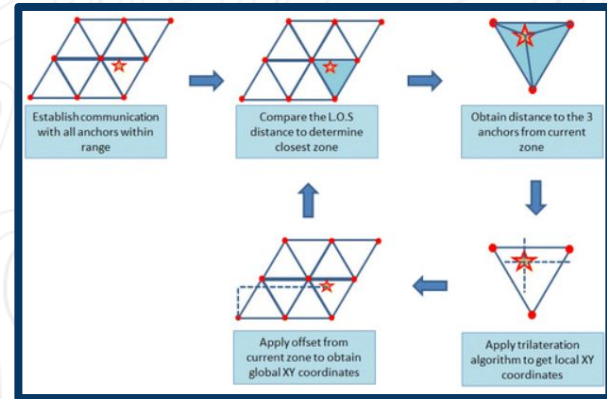


# Technical Improvements

- Creation of custom Smart Beacons would speed up system setup for transport providers (in this case Iarnrod Éireann).
- Knitting together a mesh of beacons is also another big step we want to take to develop a fully featured capable navigation system.
- Set up a robust test bed for development of the device and general troubleshooting.



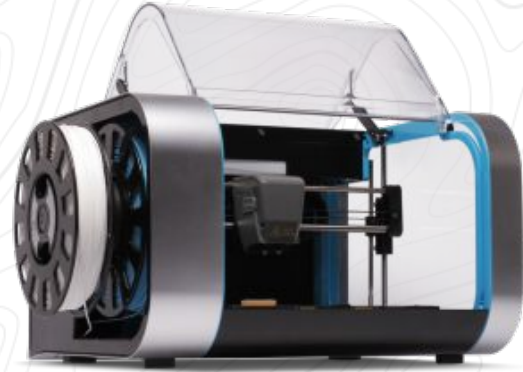
**Smart Beacon (Raspberry Pi B+)**



**Zone Detection and Global Positioning**

# Manufacturing Considerations

- 3D printing will primarily be used for production allowing for open source development and easy prototyping.
- Similar to the way it democratised development prosthetics.
- Open source software repo's.



# Applications

- While in make or break development stage we want to focus on our initial niche of navigating a train station.
- However the technology's scope can be widened to further fields.
- Perhaps on hospital wards and in nursing homes.
- People with other disabilities.



# GDPR and Safeguarding Measures

## Current

- No name input.
- No external storage of data other than transferring the code to the watch.

## Future Improvements

- More secure connection between app and watch.
- More secure connection between watch and BLE beacons.



# Our Timeline



Concept



Stakeholder Feedback



Concept Refinement



Initial Prototype



Further Development

# NaviPal

Assistive Devices

