

SMART-RAMP

DESIGN PORTFOLIO
BY KINSON HOU



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Bibliography



image source: [https://www.abc.net.au/news/2018-08-29/
the-unconscionable-state-of-australias-train-stations/10147174](https://www.abc.net.au/news/2018-08-29/the-unconscionable-state-of-australias-train-stations/10147174)

INTRODUCTION

Problem Statement

Wheelchair and mobility scooter users [WMSU] encounter difficulties when boarding and alighting Sydney trains. Typically they need assistance to deploy a folding ramp to both bridge the gap and the variance of elevation between platform and train doorway entry, when boarding and alighting. Human assistants presently fill the role, but they are costly to provide for the process at scale throughout the network. Smart city innovations should be able to assist with implementing solutions which apply universal design principles and make the journey as seamless as possible for this user group.

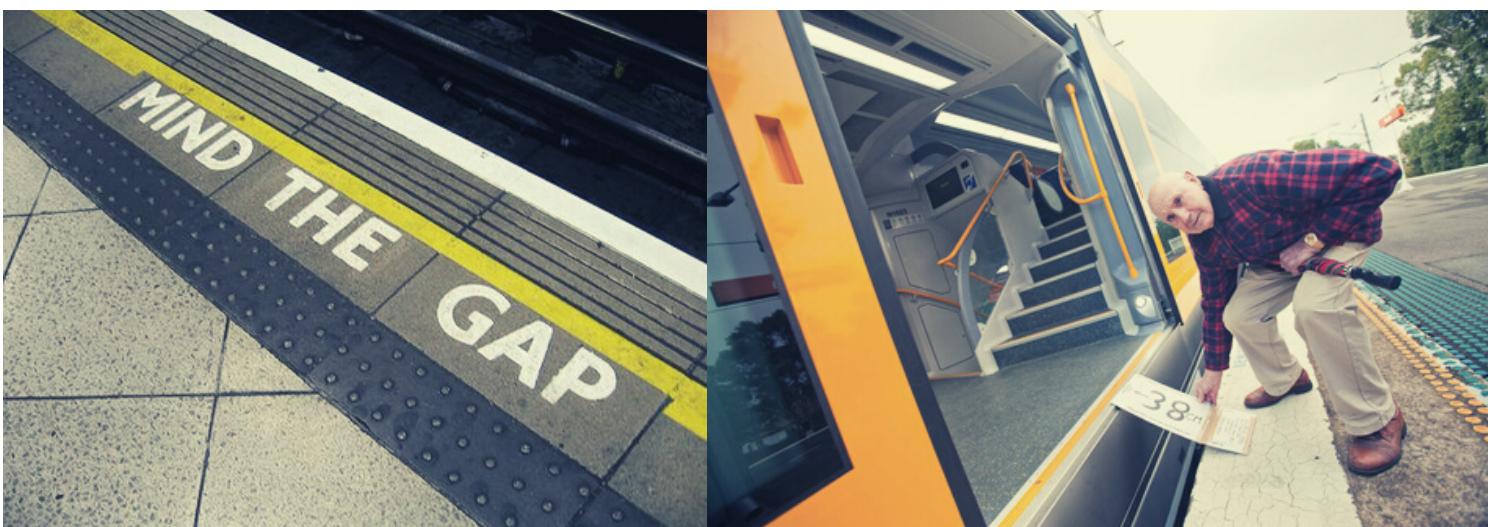


image source: <https://www.pinterest.com.mx/pin/291959988336000929/>

image source: <https://www.localnewsplus.com.au/?p=7583>

Final Concept/Prototype

Smart-Ramp consists of an automatically deployable ramp embedded below the doorways on rail carriages, a camera to detect users on the platform and in the carriage vestibule, an interactive screen on platform and button in the vestibule to request the ramp. Additionally, on the platform the Ready Zone is defined by painted and lighted markings on the pavement, which interact with the user. The Movement Zone between the Ready Zone and the train doorways also has markings and lighting to alert mobile passengers of the potential movement by a WMSU on and off the train.

The request is validated by camera and AI object detection, to also negate non-WMSU deployment. Within the train the vestibule area is a Ready Zone and due to its confined space passengers act on good will to facilitate the WMUS easy movement off the train. There is a simple interactive meme added to facial capture on the screen which facilitates user engagement while waiting for the train. Smart-Ramp deploys after the train stops, then doors open and passengers alight.



TEAM RHINOS



BEN CROSER

Role:

Documentation and research
Quality Assurance
Experienced physical prototyper



KINSON HOU

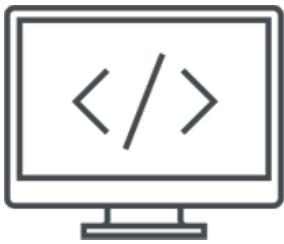
Role:

Graphic Designer
Programmer
UX Designer
Video Editor

Responsibilities

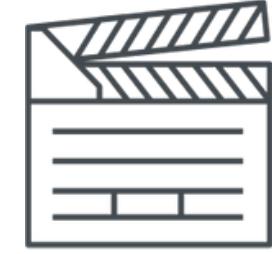
PROGRAMMING

1. Program for the GUI of interactive screen on raspberry pi platform.
2. Program for the meme play on interactive screen which can engage users.
3. Program for the interactive light strip which can response to the judgement of AI detection system.



VIDEO EDITOR

1. Prepare and shoot the footage for product video.
2. Produce and final edit the video.



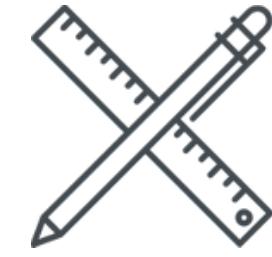
AI TRAINER

1. Train the deep learning object detection model to detect and recognize "wheelchair-user".
2. Use YOLO pre-trained model to detect and recognize "person" as pedestrian.
3. Implement 2 AI models on Raspberry Pi/iOS platform.

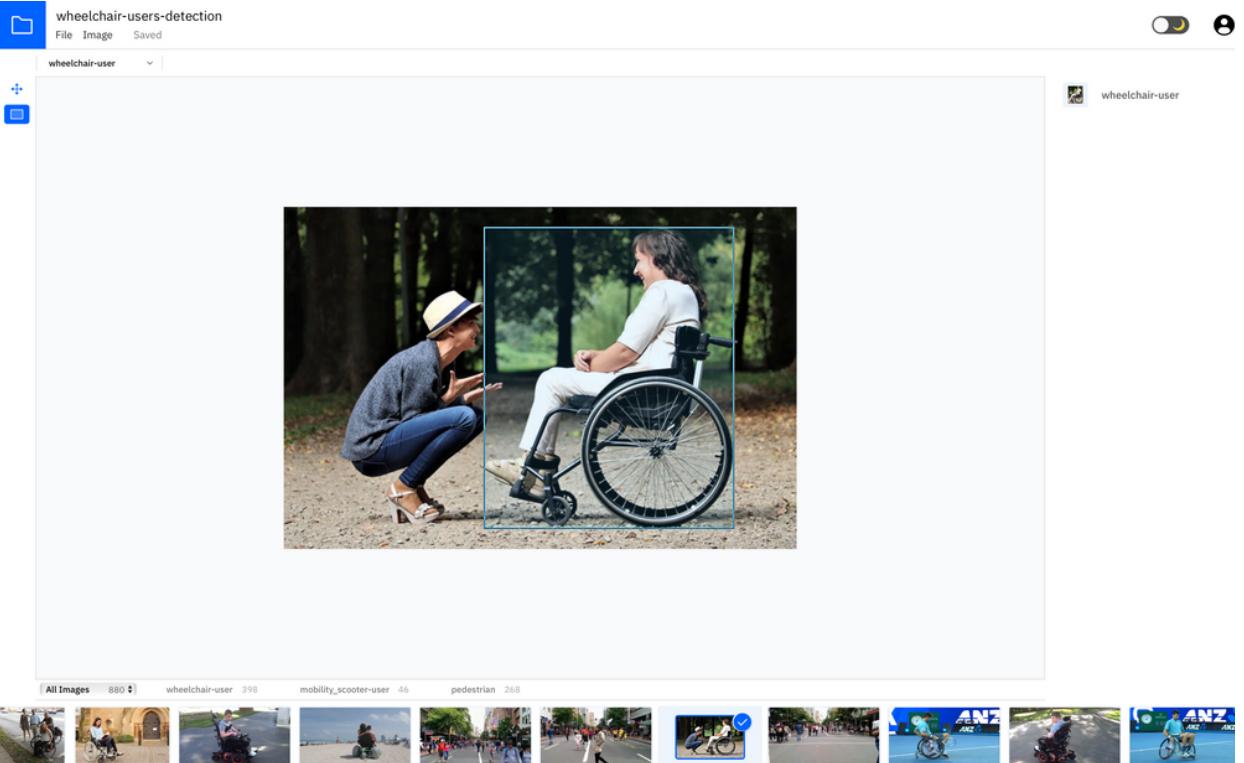


GRAPHIC DESIGNER

1. Make concept arts for our proposal during Assignment two.
2. Make infographics and format the visual report to ensure the high visual representation.



CONTRIBUTION



LABLING WHEELCHAIR-USER FROM IMAGES

I searched wheelchair-user images from google, pick around 350 of them and download. Then put them in IBM Watson Annotation cloud, label the wheelchair-user in the image

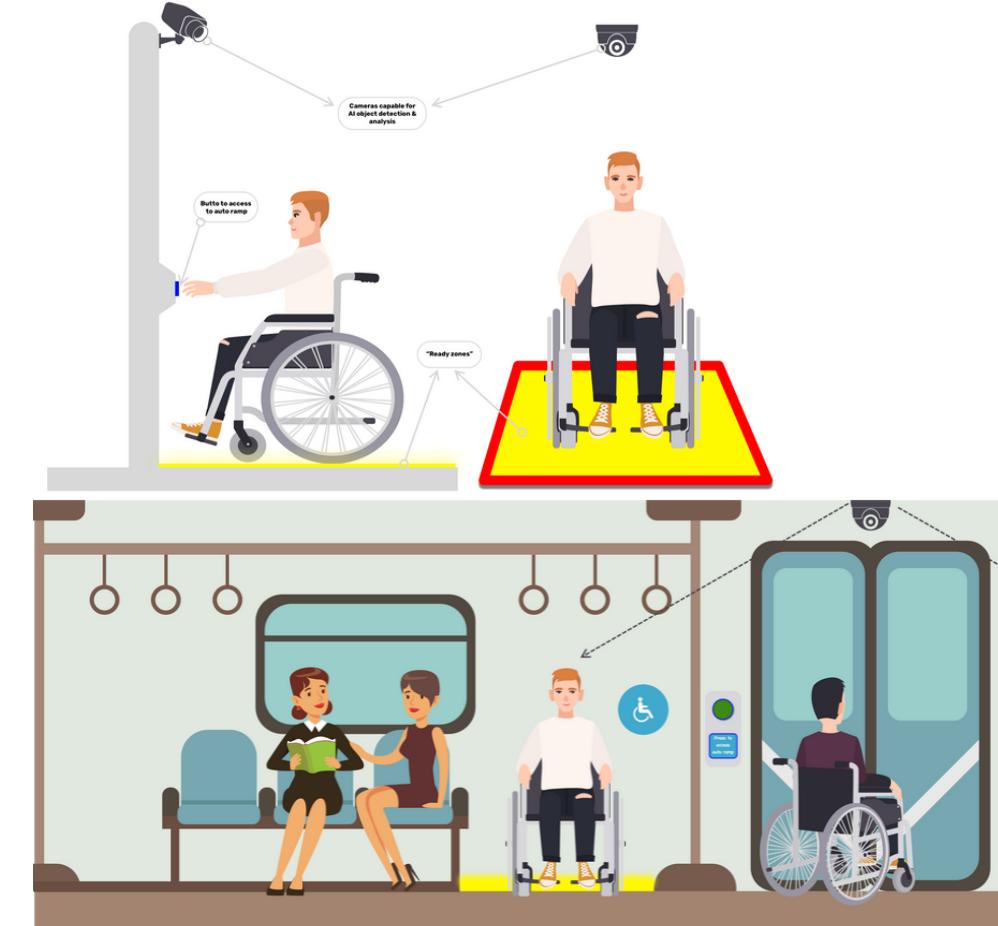
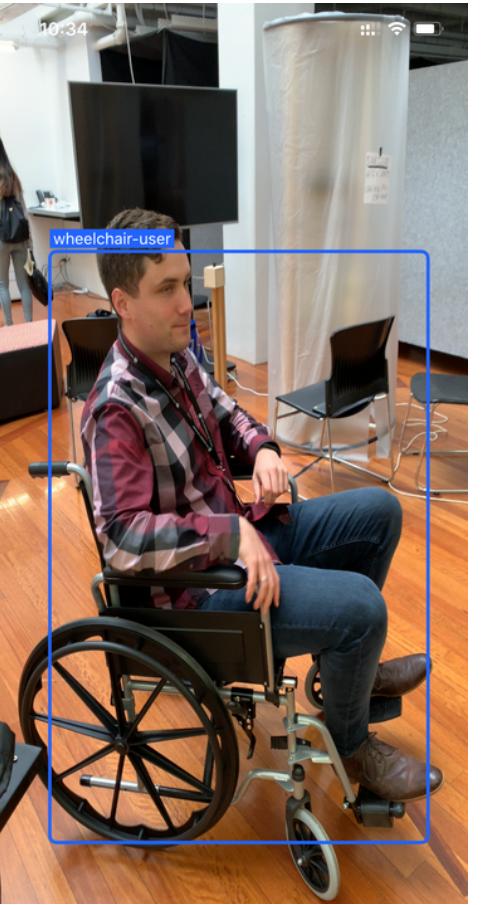
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wheelch...	model-js2s26fr	completed	21 days ago
wheelch...	model-mq1w7egh	error	8 days ago

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TRAINING THE OBJECT DETETCTION MODELS

Tensorflow python scripts for Model were trained using IBM Watson Cloud Machine learning service and trained 500 epochs per model.

CONTRIBUTION



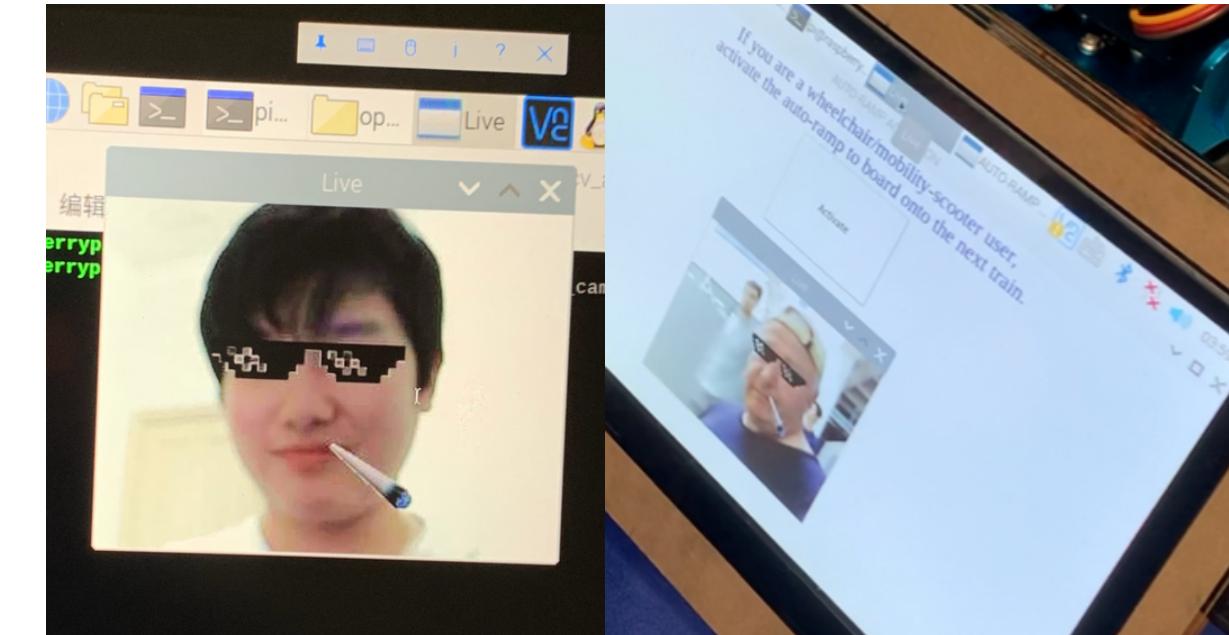
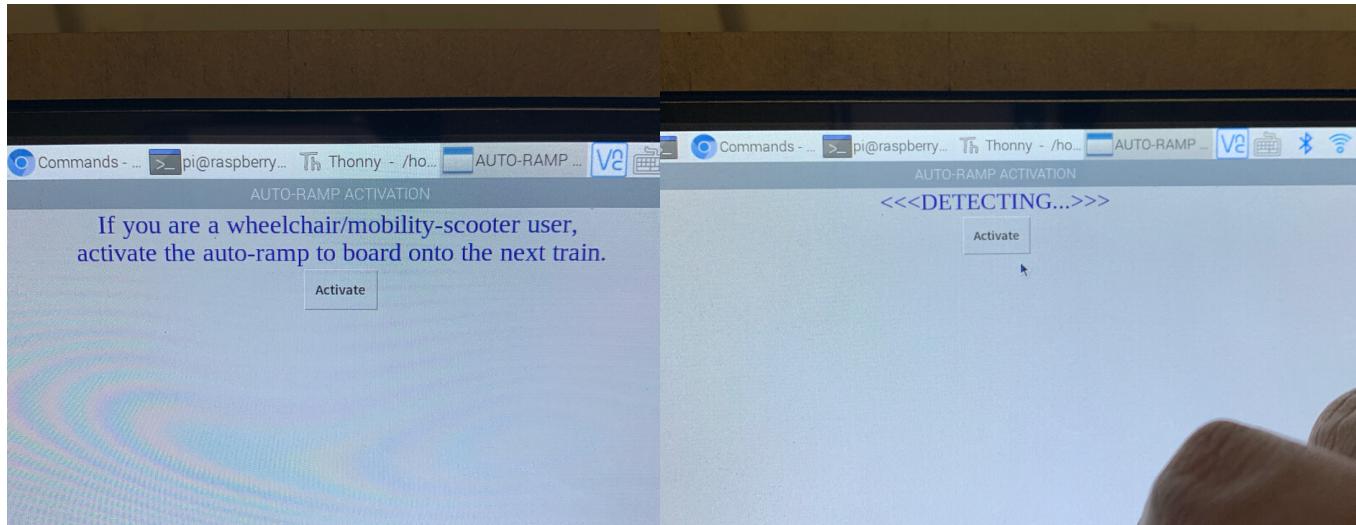
DETECTION MODEL IMPLEMENTATION ON IOS PLATFORM

I wrote 2 iOS programs which used the models to recognize wheelchair-user and "person" as "pedestrian"

CONCEPT ARTS

I Prepared and drew the assets which can be used in Adobe illustrator and make them into concept arts in photoshop.

CONTRIBUTION



GUI PROGRAMMING

I programmed a simple graphic user interface in raspberry pi platform which users can press the button to request ramp and keep users informed of detection status and action instruction after button pressed.

INTERACTIVE MEME PLAY PROGRAMMING

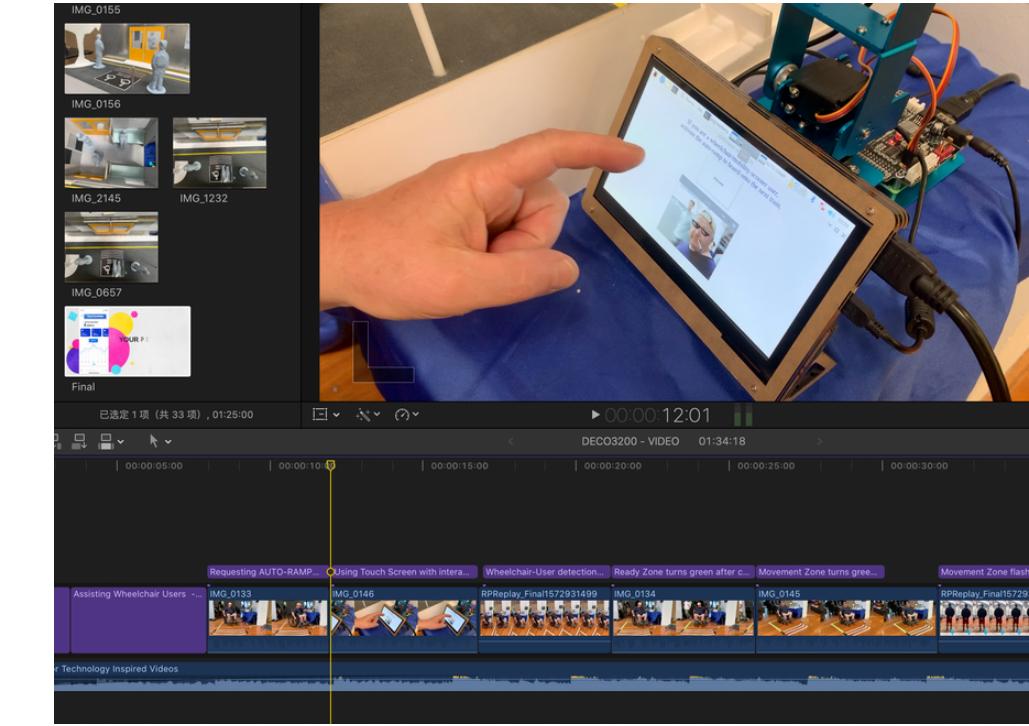
I modified code from Shenzhen Yahboom Tech in Github which sun-glasses appear overlaid on the face(s) captured by the camera, after the successful request for the ramp.

CONTRIBUTION



LIGHTING PROGRAMMING

I programmed the light strip green to inform wheelchair users to board onto the train and flashes when blocked to alert pedestrian in the path of the wheelchair. The lighting states are controlled by the judgement of ios detection software.



VIDEO EDITING

I modified code from Shenzhen Yahboom Tech in Github which sun-glasses appear overlaid on the face(s) captured by the camera, after the successful request for the ramp.

CHALLENGE

CHALLENGE1

- IMPLEMENT OBJECT DETECTION ON RASPBERRY PI HARDWARE

I implement object detection model on raspberry pi 4B computer at first but it delivered low frequency which the fps(frame per second) was only about 1-2.

SOLUTION

I wrote a iOS program using the trained model and the AI model performed great which gave decent accuracy whilst remained high fluency (fps).



CHALLENGE2

- SERVO TO DRIVE FOR MODEL RAMP

In our action plan, we need to use the servo connected to raspberry pi 4B computer to drive the model ramp in order to deliver enough strength, but the 12v power battery pack died during our first implement test because of short circuit.

REASON

I ordered an alternate pack on AMAZON but unfortunately it couldn't be delivered on time. So this challenge was still remain unsolved.



FINAL REFLECTION

HOW WELL DID I WORK ?

To my perspective, I did a good job. I finished 90% on implementation tasks of my part on our plan. And most exciting part is that AI models performed pretty good which gave decent accuracy whilst remained high fluency (fps).

WHAT COULD'VE DONE DIFFERENTLY

In our original prototype plan, there should be a servo driving the small model ramp after the recognition of wheelchair user activation. The 12v lithium power batter pack is needed to delivery enough power.

It's a pity that the battery died during the first test run and the alternate one couldn't be delivered before the demo day. So if we have a god battery, the demo should delivery a more complete user experience.

WILL OUR TEAM KEEP WORKING ON THE PROTOTYPE FURTHER?

Yes. Smart-Ramp has a future in fully designed cities from scratch, but also in cities which are willing to repurpose infrastructure for a growing population, so we do see some to government market opportunities here. So we will make the servo driving functioning after the battery pack delivery.

1.image source:

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