

Introduction to IT – COSC2196 – Assessment 3 – Autonomous Community Bus

2019



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Team Profile

Team Name

Our group has chosen the team name to be **TransForMation**. Rhys Burns is to be credited with the incredible name.

Personal Information

Let's meet the TransForMation team!

Rhys Burns (s3815633): I have an IT background; I work as a network security administrator and have a background in data centres and front-line support. In my free time I travel, spend time outdoors and play video games. My main interests in IT are in large scale networking, network security and automation. The name **TransForMation** is a combination of the words **Transport**, **Forward** (*the future*) and **Automation**, which captures the idea of our group project for an autonomous bus.

Tuan Luong (s3652729): I love all things technological and how they work around me. I have a limited working IT background; the majority of my experiences comes from troubleshooting computer hardware in various roles. My background is Vietnamese, I moved to Australia in 2002 and gained my citizenship status in 2006. My hobbies are anything water-related, swimming, diving and staying fit by going to the gym and riding my bike. My Interests in IT are software engineering, programming and network engineering.

Melissa Eder (s3414696): I am part aboriginal, a mother of four, a grandmother of two and in the past worked in the IT industry, however, I have not worked in IT since 2002. I had various roles whilst I was working IT, my main responsibilities were hardware repairs, network cabling, network software installation and programming. I have decided to return to studying IT to reignite my passion for the industry, but at this point, I am not sure if I can return to work as I suffer from chronic health issues.

Jayden Barber (s3812572): I am originally from Queensland, but moved to Melbourne to follow my dreams and pursue a career in IT. My interests stem growing up around technology, but my true passion came from playing video games. I am a naturally shy person, so having a platform that allows me to play video games whilst meeting others online enabled me to be more outgoing and engaging. My hands-on experiences with IT are limited and specifically towards video games.

Daniel Lay (s3286525): I was born in Australia from an East Timorese background. I am married and a father of two. I work as a car mechanic have been doing this for almost 10 years now. My interests in IT are cybersecurity, programming and overclocking, I also like building computers and cars in my spare time. I have no prior experience in IT but I am currently undertaking a Certificate IV in Cybersecurity and I have broadened my knowledge in networking and security.

Nickolai Sokaluk: Unfortunately, due to reason the rest of team are unaware of, Nickolai was not able to participate in or contribute to the group assignment and as such we are unable to credit him with any work done. The entire team has tried to contact Nickolai, with no success and we the rest of the team hope he is well and we wish him all the best in his future studies and/or IT career.

Group Processes

After the group was first formed for Assignment 2, Tuan put himself forward as the group leader, and everyone was happy to let him lead for the first Assignment. He acted as a group motivator and was the group representative with the academic staff. Tuan will remain the group leader for Assignment 3.

There was a lot of debate on how the team will communicate throughout Assignment 2. It was decided very early on that Facebook Messenger was the desired platform to share ideas and organise meetings, WhatsApp was used for team members unable to join group meetings in person, and this process will remain the same for Assignment 3. For our files, we uploaded them onto our canvas group folder and shared them via facebook, which was effective for our group.

From the start communication wasn't an issue for most of the team members, one team member left the Facebook Messenger early on in Assignment 2 and there were many attempts to contact them. We will be continuing as a group of 5 going into Assignment 3. We felt that despite being one short on a team member we were all able to pull it all together and get the job done.

One change that has been introduced since the completion of Assignment 2 is to organise meetings with an agenda and to have a representative taking minutes so team members who can't join can review the notes. This is also supported via video chat once per week using WhatsApp.

We also took on the advice from Assignment 2 in regards to formatting and proof-reading to ensure that we don't miss any content as well as maintaining consistency. We achieved this by having Daniel combine out individual works together, clean up the formatting and grammar check.

Overall our group worked really well, and there won't be any major changes.

The group remained unchanged from assignment 2, which allowed us to be able to keep to the same group format for assignment 3 and assignment 5. The group also looked at the feedback from the tutors at RMIT and discussed how we could improve on the other two assignments.

The first thing the group did, was an enormous amount of research into the project idea for this assignment. We first laid out rough ideas and plans for the assignment. There would be discussion when an idea was suggested, weighing up the pros and cons as well as feasibility and suitability. Once we had the bulk of the content completed, we then started working on the process of refining the report.

Using Sparkplus and feedback from assignment two, we carefully read the rubric for these assignments and went through the process to ensure we had answered every point and question in the assignment. The group was keen to improve on our score for assignment two, and taking the feedback to heart, we reviewed the rubric and the assignment to try and ensure that we had successfully met all criteria.

Test Results

Rhys Burns

Myer-Briggs Test	Learning Style Test	Gallup Strength Finder
<ul style="list-style-type: none"> - Type: Assertive Commander - Code: ENTJ-A - Roles: Analyst - Strategy: People Mastery 	<ul style="list-style-type: none"> - Auditory: 30% - Visual: 35% - Tactile: 35% 	<ul style="list-style-type: none"> - Analytical - Achiever - Focus - Includer - Maximiser

Tuan Luong

Myer-Briggs Test	Learning Styles Test	Creativity Test
<ul style="list-style-type: none"> - Code: ENTJ - Extroverted - Intuitive - Thinking - Judging 	<ul style="list-style-type: none"> - Auditory: 40% - Visual: 40% - Tactile: 20% 	Score: 52

Melissa Eder

Myer-Briggs Test	Learning Styles Test	Big Five Personality
<ul style="list-style-type: none"> - Code: ISTP - Introversion - Sensing - Thinking - Perceiving 	<ul style="list-style-type: none"> - Auditory: 35% - Visual: 35% - Tactile: 30% 	<ul style="list-style-type: none"> - Openness: 42% - Conscientiousness: 33% - Extroversion: 15% - Agreeableness: 65% - Neuroticism: 100%

Jayden Barber

Myer-Briggs Test	Learning Styles Test	Big Five Personality
<ul style="list-style-type: none"> - Code: ENTP-T - Extroverted - Intuitive - Thinking - Perceiving - Turbulent 	<ul style="list-style-type: none"> - Auditory: 30% - Visual: 50% - Tactile: 20% 	<ul style="list-style-type: none"> - Extroversion: 50% - Emotional Stability: 89% - Agreeableness: 25% - Conscientiousness: 41% - Imagination: 23%

Daniel Lay

Myer-Briggs Test	Learning Styles Test	Creativity Test
<ul style="list-style-type: none"> - Type: Turbulent Architect - Code: INTJ-T - Role: Analyst - Strategy: Constant Improvement 	<ul style="list-style-type: none"> - Kinesthetics: 36% - Visual: 35% - Tactile: 29% 	Score: 55.5

Career Plans

Rhys Burns

Reflecting on the Burning Glass data from assignment 2, my career plans as a Senior Network Engineer, Data Centre have not changed. As I continue working towards the completion of my undergraduate, I hope to major in Networking as this is my current field of expertise.

I am currently working as a Network Security Administrator for a large Cloud Solutions Provider, I've also been working in the industry for nearly 10 years in a variety of roles across 2 large companies. Whilst I complete my undergraduate, I'll also be aiming towards completing a CCNA and CCNP, a CCA-N and CCP-N (Citrix Networking) and a PCCSA and PCNSA (Palo Alto Networking). I'll also be hoping to certify my knowledge with Python, Java or C#, but this is not a priority for me.

By the time I have completed my undergraduate, I will have the relevant experience and qualifications that are required for a Senior Network Engineer.

Melissa Eder

My ideal job has changed from assignment 2, in that now my ideal job would be a part-time job working from home. Due to serious health complications, I would have difficulty in accessing full-time work out of the home.

My career plans have altered from assignment 2. My career plans are at this time to learn programming and web design in order to be in a better position to find work. I want to finish the Bachelor of Information Technology plus I also want to study subjects from other It courses and other fields. I would like to study cybersecurity and many others. Safe to say that if I look for a job, it's going to be working from home and in the distant future as I seek to improve my skills,

Only after I have improved upon my skills significantly will I be attractive to employers. I also am thinking about offering to do something free to improve my work experience.

Daniel Lay

My career plans are still directed towards cybersecurity space. I plan to finish off my Certificate IV in Cyber Security and then perhaps obtain CCNA certification to increase the likelihood of getting a job in the IT world. I am hoping to get into a junior security analyst role or similar to start building my portfolio for an IT career.

Whilst working in an IT-related job, I aim to finish my Bachelor in IT with RMIT and with that, get a more senior/advanced role. I definitely see it taking baby steps, but I am positive my motivation will get me to the dream job of a security architect.

Another career path that has also gained my interest, is in programming. I enjoyed my short time with Python, and have been enjoying the challenges in the Introduction to Programming subject learning about Java. I can also see myself leaning towards a programming career path too.

Jayden Barber

My career plan as of now is to continue with the Bachelor of IT through RMIT and branch off into either game design or software engineering sometime in the future. In terms of the games design path, I would ideally like to start at a small start-up to learn the ropes of the industry and get my feet firmly planted. After which I would like to move onto one of the big companies' design teams such as Blizzard Games, Riot Games, Square Enix, or Bethesda. These are obviously idealistic aspirations but that is the reason I am following this path.

As for the software engineering path I have connections in the online betting industry which I would take advantage of, getting a job in that industry with a mentor would be very advantageous for me later in life and the earlier I can get there the better. I am also inquiring about an internship/placement in this field to help solidify my skills here. This would require me to learn a lot of the high demand skills from the Burning Glass data which will make my skill set desirable across many jobs.

Both these paths hinge off me finishing my current degree so that will be my focus for the foreseeable future.

Tuan Luong

From assignment 2, my career plan has changed. In my opinion, I feel it's a bit early to decide what path I am going to take down the road of IT. However, having experienced the Introduction to Programming, I would like to work in programming and software development because I am able to utilise my skills a bit better with my attention to detail, high concentration and critical thinking. I am also thinking of exploring software testing where the work is in a predictable and structured routine. It would allow me to use my attention to detail to the highest standard to debug and test software. Due to my Asperger's, a task that I can just focus strongly on for long periods of time would be ideal for me. Furthermore, I would also like to do networking and gain my CCNA from Cisco to broaden my opportunities.

As for my ideal job, I would still consider helpdesk support roles, ideally as a communication and technical Services officer for the MFB, or the CFA. However, I would rather prefer an environment where there are less people because of my social anxiety disorder, which could be a problem when handling customers.

The role of a communication technical services officer involves maintaining the IT networks and databases of the emergency services department. This role appeals to me because I can still help people, but in a more technical position.

I have also considered becoming a firefighter in Queensland or Melbourne and by starting as a CTSO it will give me an insight into the fire services in how they function and work while gaining valuable experience.

Even though the fire service is tough to get in, I am willing to prepare myself mentally and physically. From the people I have met at RMIT, I believe I will overcome my social anxiety to gain the best job in the world. I want to be next Ben Southall (Winner of the best job in the world) in Queensland, with scuba diving and holidaying four days off and firefighting four days on.

Comparison of Career Plans

The obvious similarity in our career plans is the course we are all doing. Although they might differ slightly, we are all attending an IT course at RMIT to further our position in the future. Daniel and Rhys share similarities in that they both currently hold a position in the industry but are both working to increase their knowledge and skills in their respective positions.

There is not much to differentiate our career plans from each other besides the actual careers we are choosing to pursue. Mel's health requirement causing her to focus on more part-time work or working from home is the only real outlying contributor to our career plans difference. There could be a point made for the specific skills people have mentioned in their individual career plan. Some of us have a very clear plan and know exactly what skills they want to learn such as Rhys and Daniel whilst others are much more open-ended like Jayden and Tuan.

Overall our career plans are fairly diverse and cover a lot of fields in IT. From cybersecurity to game design and even customer service, there is a vast array of skills we have to cover as a group. Some of us have worked in the industry for over a decade while others are just starting to break into it. This lends the group a diverse range of viewpoints which help make our work more rounded and seems to allow us to work together quite smoothly.

Tools

- Link to group website: <https://tuanmission.github.io/GroupA2-1-vestsiders/>
- Link to group Git: <https://github.com/tuanmission/GroupA2-1-vestsiders>

Comments on the audit trail:

Most of the reporting work performed on personal computers, uploaded and shared on Canvas or Facebook messenger. The work was divided up early on after completing Assignment 2, so everyone was able to work at their own pace. Only Tuan and Rhys made edits on GitHub as they were the most familiar with the tool. Feedback was received by the other team members throughout the process. Once the assignment has been completed, Tuan and Rhys will upload all the group files to the repository since both of these members are familiar with the tool as in assignment 2. Even though Github is a part of this assignment, we are still in the early stages of learning how to use it effectively.

Project Description

Overview

Topic

What the group proposes to do with our project is provide community vehicles that are autonomous in order to serve the communities elderly, disabled, and other people who can't or do not want to drive that are isolated due to the fact they find it difficult to access public transport.

Initially, we do not want to replace person driven vehicles, but have an additional service that provides support especially to the more vulnerable members of the community. If the project gets to the point where drivers might be in danger of losing jobs, then we will also implement retraining and upskilling for all drivers, plus a guarantee of another job even if it was not driving.

We feel that having a range of autonomous vehicles would help the community, as many members of our community are isolated due to the fact that they live too far from public transport. This range would include, buses, cars, trams, trains with expansion into the trucking area after that. We see this as the big picture of having a service that will benefit the community as a whole by providing an on-demand, public transport service.

We also allow ourselves to dream of a range of small autonomous flying vehicles in our future, however, we firstly want the autonomous buses and cars, being tested and used for our community first.

Motivation

The motivation for this project for our group is to step into the future and also keep up with Information Technology trends in addition to the vital goal of wanting to provide a service to those members of our community who are vulnerable and isolated due to the fact they can't drive and have difficulty accessing public transport.

People with disabilities, those that suffer from chronic severe illness, the elderly often are unable to drive, and find it hard to access the public transport system the ways it stands currently. This might be due to the fact the person is wheelchair-bound, or in a mobility scooter, or has some other walking aids.

While some of our public transport buses use suspension to lower themselves down for wheelchairs, by no means are all of them like that. Our hope is to have smaller autonomous community buses capable of lowering themselves down, using their suspension and a retractable ramp that can be used anywhere.

This project has hit home for several members of our group who have direct knowledge, understanding and experience of accessing public transport with disabilities. Due to this direct experience, our group has a good understanding of how difficult it can be in using public transport with a disability.

Additionally, our group are very future-focused and can see the trends in Information Technology that are important now, but are also going to be very important in the near and distant future.

Autonomous vehicles have been judged by many different sources to be one of the vital technologies that will come and need to be provided for now and in the near distant future.

Working towards these technologies, will help future proof us, but also hopefully provide employment for group members. At the very least working towards these goals will make us more attractive to future employers. It's safe to say having some understanding of future technologies will make employers look on us with a more favourable eye.

Additionally, the group can see that many autonomous vehicles are starting to come onto the market and the technology to achieve our project is already there, we feel by providing this service we would be in the forefront of technology and in the forefront of many other countries.

Landscape

At this moment in time, there are already autonomous vehicles starting to be used in Australia by many companies and government companies. One example is the Olli which is being trialled in holdfast bay in Adelaide (Nott,2019). While no autonomous level 5 vehicles yet exists in Australia, there is a push by many companies to get that level of autonomous car into the testing phase. This is our main point of difference of our project compared to the other autonomous vehicles out on the market is to achieve level 5 automation within a couple of years using state of the art, sophisticated technologies to be competitive in the future.

The Australian and New Zealand Driverless Vehicle Initiative (ADVI) is an industry advisory body, that hopes to help the industry with achieving the aims of autonomous vehicles. ADVI states that its mission is to “accelerate the safe and successful introduction of driverless vehicles to Australia”. (ADVI, 2019)

ADVI are supported by 120 partners, who are from the automotive, insurance, transport, motoring, parking, communications, banking, logistics, defence, technology and research sectors. ADVI is also supported by many local and state governments, including the federal government.

Currently, our roads system is not set up with autonomous vehicles in mind. Importantly our group will need to look how current and future roads are constructed and the architecture of the roads and the design, how then roads are manufactured, and how other vehicles would interact with autonomous vehicles, and what services might be needed if the autonomous vehicles breakdown.

New laws are starting to be introduced in federal and state parliaments regarding autonomous vehicles, and ADVI, plus many other industry groups are been asked as to what laws and legislation needs to be in place for autonomous vehicles to start being used.

“The National Transport Commission (NTC), an independent body that develops regulation for Australia's roads and other transport systems, will be tasked to establish a uniform law around the technology.” (Lieu, 2018)

“The NTC has proposed the national regulation will:

- Allow an automated driving system (rather than a human) to perform the dynamic driving task when it is engaged
- Ensure that there is always a legal entity responsible for driving

- Set out any obligations on relevant entities, including the ADS entity, and users of automated vehicles
- Provide flexible compliance and enforcement options.” (Lieu, 2018)

Detailed Description

Aims

To have an effective autonomous transport solution that caters to the need of people of various needs and requirements in the community. As many people are unable to access effective transportation due to disability or other circumstances, we've decided to do an autonomous bus that can be booked on demand.

Plans and Progress

The motivation for this project has come from the motivation to help the community while using our passion for information technology to do so. Our ideas for an autonomous bus system have come from the input of two project ideas, Tuan Luong's automated railway and Melissa Eder's idea for disabilities. We are at the initial stages of our project, determining the technologies required for the autonomous bus and recruiting people required to develop the project.

We have determined the required technologies for the project. After being researching the on-market and the off-market solutions currently out there, we have found these technologies particularly useful in delivering the required objectives in our scope. However, these technologies require adaption of infrastructure and systems of the road systems in the area before it is deployed.

We will need to use on-board sensors, cameras, GPS and telecommunications to obtain and analyse information using computer algorithms, and then respond appropriately by controlling the vehicle in safety-critical situations. We are aiming for level 5 automation with these technologies. Level 5 (Full Automation) negates the need for pedals and a steering wheel, completely removing the driver from the driving task under all conditions. These vehicles will need to be capable of autonomously communicating with each other, with roadside infrastructure, such as traffic control signals, or with other devices, such as mobile phones.

The autonomous bus by TransForMation will be powered by Nvidia's deep learning accelerator named Jetson AGX Xavier. It is an SoC (System-on-chip) with very high processing power at 32 TOPs (trillion operations per second) on a small package of 10 watts. (NVIDIA Developer, 2019a)

Development of the system will be done using the Jetson AGX Xavier development kit (NVIDIA Developer, 2019b), utilising the open-source NVDLA deep learning compiler. (Mukund, Gaikwad and Harwell, 2019)

By utilising a specially designed SoC on a small form factor, it will be suitable in automotive use as it allows easy integration into the vehicles systems, provide a low power consumption solution while being very efficient at its job.

The hardware to provide the data for the Xavier SoC includes Texas Instruments' mmWave sensors and Continental automotive cameras.

The Xavier SoC will be trained using machine learning to recognise obstacles, roadside infrastructure, traffic control signals and people using the camera's situated at the front, rear and side of the bus. It

can then apply the electronically controlled brakes as necessary. The Continental MFL400 automotive camera can also provide lane keep assist functions if the bus is drifting out of the lane which can be easily corrected via an electrical steering system. (Continental-automotive.com, 2019a) As for the side, rearview and additional front camera monitoring, the autonomous bus will utilise the Continental SVS220 Surround View System. (Continental-automotive.com, 2019b)

Texas Instruments makes a variety of millimetre wave sensors for different ranges of distances. These millimetre wave sensors are currently used in modern automotive vehicles today such as all-speed radar cruise, pre-crash safety systems, cross-traffic monitoring and blind-spot monitoring. (Lexus, 2014)

For the autonomous bus application, TransFormaTion have identified that a short-medium millimetre wave sensor (AWR1843) would be appropriate for a bus as the development and trial will involve slow to medium speeds. Even at normal road speeds, a detection range of 150 metres is a sufficient amount of distance to allow the SoC to analyse the data and respond accordingly. (training.ti.com, 2019)

We have described the first few technologies needed for our bus; however, they need to work hand in hand together with infrastructure changes as well to ensure that the autonomous bus has an effective environment to operate safely in.

The first issue is human drivers can respond appropriately to changes in road layout as a result of roadworks or vehicle crashes, however, autonomous control vehicles such as our bus may have difficulty responding to changing road conditions. Therefore, consideration needs to be given to machine learning of the Xavier SoC for any future changes in traffic management.

This could take the form of a connected roadworks warning system that communicates the details of the work, including the location of workers, configuration of the work site, and speed of vehicles around the site of the road work and providing appropriate algorithms for the AI in response to this. However, this is only feasible for planned roadworks; unplanned traffic incidents will still require special sensing and developing appropriate response measures for the AI of the autonomous bus.

The sensory technologies on our autonomous bus which are the Texas Instruments millimetre wave scanners and the continental automotive cameras may require good road conditions and road conditions and signage in order for the Xavier SoC AI to navigate effectively and safely. When there are long cracks in roads or markings are faded, the system may have difficulty staying in the correct lane. This may be mitigated in the future by implementation of digital road marking and signage infrastructure, but until then, road markings and signage will require regular maintenance in the area where the bus will be deployed to support it. However, even with regular maintenance, traditional road signs and markings may become difficult for the bus to recognise in bad weather. To mitigate this, we could use digital waypoints on specific road signs to remind the bus to stop or the Xavier SoC machine learning can be programmed to remember the locations of specific signs and update itself regularly.

CAN-bus communication is currently used in automotive systems to interconnect the ECUs and allows multiplexing, reducing the amount of wiring. However, CAN bus doesn't have great bandwidth capabilities, only at 1 Mbit/s. Due to the increased demand for bandwidth from the autonomous bus system, it would be wise to invest in newer CAN technology, known as CAN FD. CAN FD increases transmission speeds considerably, from 1 Mbit/s to 8 Mbit/s; it also increases the

packet size from 8 bytes to 64 bytes so the efficiency of the protocol is further improved. (CSS Electronics, 2019)

During the development and testing cycle, security will be a main overarching goal blanketing the system. In the current society, cyber-attacks are a real threat. With the proposal of TransForMation's autonomous bus, there are various safety aspects to consider.

An important aspect that TransForMation has identified is the potential for the system to be hacked or tampered with. It is a serious issue as there is no dedicated driver as a backup; to combat this issue, machine learning using hardware attached to the OBD-II port of the vehicle can "learn and protect" the integrity of the system. The anti-hacking device would be able to shut down systems if it detects any attacks/abnormalities, putting the bus into a "limp" mode. It is also possible to implement software analytics to carry out similar functions. (Causevic, 2019)

Furthermore, the GPS receiver in the bus will be able to pinpoint the location of the bus if any issues or attacks occur and the system can send out SOS messages to a central depot to deploy teams to rectify the issue. For this reason, the successful roll-out of automated vehicles that are capable of functioning at the highest level will require mobile internet coverage combined with a strong GPS signal across the whole road network.

Onto the testing, we have outlined how we would test the vehicle in the scope of limits and the test plan. The first step is to test our vehicle once a working prototype is developed. We would test our vehicle in a controlled and small environment such as a university campus or an industrial estate as outlined in the scope of limits. As stated in the scope and limits we would incorporate trial feedback for improvement before deployment into the community. Once government approval has been sought, it would be deployed into the trial community such as St Albans. This means the first time that our vehicle would be integrated into the public space and roadways.

After the trial period, we would gradually roll out the buses to more communities as stated in our scope of limits. We would roll this out to more communities where there is a high demand for transport for special needs such as Dandenong, Cranbourne and Frankston where there is high dependency and special needs. From this, we would then become gradually commercialised with our technology once the final design of our autonomous bus has been developed with the feedback from the trial periods and the gradual community roll out.

From this, we would use the feedback to implement this into our final design of the autonomous bus.

The final design would take approximately a few more years to finalise. The final design of our autonomous bus is the bus that will be implemented if we were to win tenders for implementing our autonomous bus solution. This is because the technologies we currently have are currently premature and the gradual roll-out of the autonomous bus will happen in stages to ensure that adequate feedback can be taken on board and the current on the market technologies will need to be refined more to meet the needs of different communities and environments that the autonomous bus will encounter. Once the final design of the autonomous bus has been finalised, we can start commercialising our technology and putting it out on the market for shareholders and potential investors to see. However even though that is the final design, it is not the final design. This is because there is no final design since our autonomous bus will continue to improve and we will continue to refine our technology throughout its lifespan.

We would declare our project a commercial success if it meets the required outcomes below:

- Able to transport passengers in a safe and effective manner
- Able to respond to the ever-changing and growing needs of a community
- Meets the current legislative requirements and standards for autonomous vehicles
- Operates autonomously and safely in the public space.
- Community places trust in our project
- We can negotiate with stakeholders to invest in our project and return dividends to the stakeholders. However, with this comes commercial responsibility, where we put people safety first over profits.
- Our products become recognised worldwide and we can start getting tenders to implement autonomous bus solutions worldwide.

However, to get to this stage, we would need to pass through many milestones of development and testing. The biggest hurdles for this project to be declared a success is government approval of our autonomous bus to be deployed on public roads and placing the trust in the community that we will transport them to where they need to be, reliably and safely.

Throughout the development of this autonomous bus, we would need to negotiate with government agencies to ensure that our autonomous bus meets the required standard for autonomous vehicles and can meet the legislative requirements to be deployed on the public road. This is a big hurdle because we need to develop our technology according to the standards and that we put public safety first in order to seek approval from the government to be deployed on public roads. Government approval needs to be sought first before we can try it into a community environment.

If this project would be successful, it would make a significant improvement into the daily lives of many people and will lead the way in robotics and autonomous vehicles research which will have an impact not only on people, but on technology as well because our technology will be at the forefront of ground-breaking innovation that would inspire people to challenge the status quo and encourage more people about engineering and how it can make a wonderful impact on the community that we intend to serve.

Roles

For this project to be successful in the end, there are certain roles that are required with the expertise inside it for the project to function and deliver the key expectations that are required. The roles that will be required for this project are:

Software Developers and Engineers - Software developers will be required for the automation to occur. Because automation depends on reliable software in order to run, software developers are needed to develop effective software for the automated bus to run. Also, the software developers are required to develop effective artificial intelligence and machine learning programs and algorithms because automation depends on effective machine learning combined with artificial intelligence due to the dynamic nature of the roads and how rapidly the environment can literally change. (GTI Media, 2014)

Robotics and Mechatronics Engineers - Robotics and mechatronics engineers are also required for this project to occur successfully. Because this is an automated bus, the robotic and mechatronic engineers are required to develop the automation systems inside the bus that can respond to the dynamic road environment while being able to transport passengers safely. Mechatronic engineers will also integrate existing mechanical knowledge of vehicle and systems into automation so that the vehicle can be controlled automatically without human intervention. (University of New South Wales Engineering, 2019)

Data and Systems Analyst - The automated bus has a lot of data that needs to be processed such as passenger numbers, road information, bookings, and timetabling, an effective data management system or database is required to manage this amount of data. Also, artificial intelligence requires the data in order to function with machine learning generating more data. In order to manage the ever-growing and changing data a data and systems analyst will develop an effective database to store large amounts of data that will be required for the autonomous bus run while storing the data effectively and efficiently. (GTI Media, 2014)

Cybersecurity Experts - As with any automated system, it is prone to security threats and cyber-attacks. Throughout the lifetime of this automated system, there is a need for cybersecurity professionals to patch vulnerabilities in the automated system and keep the system up to date with the latest security threats. If a cyber-attack occurs in the automated bus system, it can cause disruption such as a breakdown or a major accident if a hacker was able to take control of the vehicle. Not to mention the loss of public trust and data of customers being lost and stolen which can put the project into disrepute. (GTI Media, 2019)

Ethic Analysts and Lawyers - The automated bus has a lot of ethical issues not to mention legal issues in the public sphere and the government. An ethics analyst or a lawyer would be required to analyse the ethical and legal issues about autonomous vehicles and ensure that all the legal requirements have been met regarding autonomous vehicles and to resolve legal and ethical issues if they occur such as an accident which can lead to litigation. (Belot, Piper & Kesper, 2018)

Scope and Limits

The outcomes that would be expected out of this project in order to be successful is to have an efficient and effective autonomous community transport solution, however it is important to have several outcomes and objectives that are well planned in order for the ultimate goal to be achieved which is to have an up and running autonomous community bus.

The first goal to be achieved is the design and development of the autonomous community bus and hardware. This is the first step, because the bus wouldn't exist if it hasn't been developed yet. The second outcome to be achieved is to begin testing after development in a controlled testing environment on a test track to identify bugs and issues that could affect the operation of the autonomous community bus in the public. The third outcome to be achieved after testing in the controlled environment is to begin testing and trials in a small public space such as a large university campus or a large industrial estate. Before this can occur successfully, legal issues need to be sorted first and approval needs to be sought from the government for trials to begin.

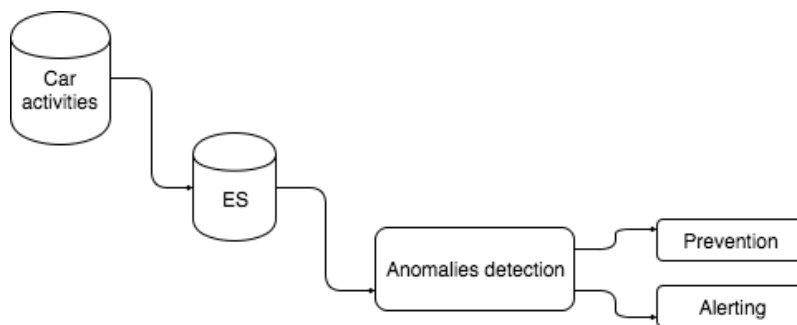
During the trial period, feedback from users can be incorporated to improve the autonomous bus before being deployed into the general community. Furthermore, this is an opportunity to assess the performance of the community bus in general use and how it performs with passengers responding to the vehicle such as the ramps and interface. The fourth outcome is for deployment into the general community once final approval has been sought from the government. Initially, we plan to deploy the autonomous bus within a community that has high levels of special needs.

A community we plan on deploying the bus into is the suburb of St Albans, Victoria in Melbourne. St Albans has the highest level of special needs including a large ageing population and disabilities. If the project is successful in this community, we plan to roll the autonomous bus to more suburbs gradually. In short at this point, we would say our project would be successful. However, the success of the project all depends if we are able to make our project commercialised and able to have tendered for autonomous bus solutions as outlined in the plans and progress.

Tools and Technologies

Software

- NVIDIA Deep Learning Inference Compiler (Open source)
- CAN (Controller Area Network) FD standard/protocol to allow multiplexing of electrical wiring and communication between the systems.
- Ethernet bus for image processing
- Elasticsearch analytics



Hardware

- Texas Instruments mmWave sensor (AWR1843)
- Blind-spot monitoring (AWR1843)



- Camera (front/rear/side)

Continental MFL400 for front with incorporated use for Lane Keep Assist.

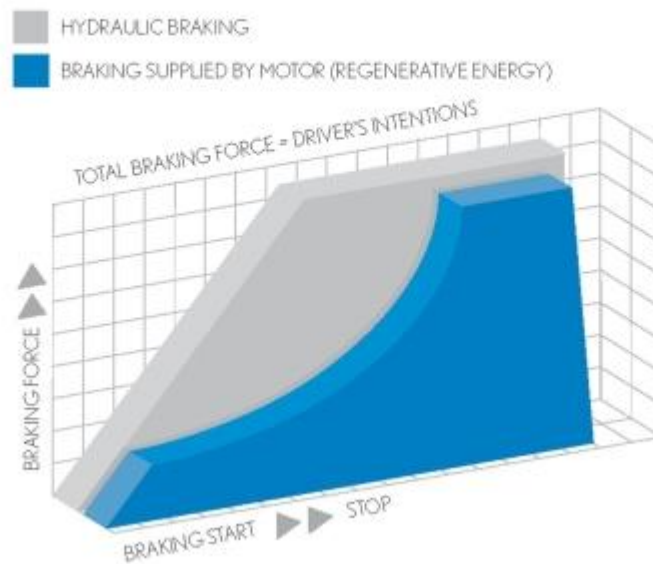


Surround View System SVS220 for front, rear and side view



- Electric brakes – Lexus ECB (electronically controlled brakes)

ECB - ELECTRONICALLY CONTROLLED BRAKE SYSTEM



- Nvidia Deep Learning Accelerator, Jetson AGX Xavier SoC (System-on-chip) to provide the processing power for the AI-driven bus



- Jetson AGX Xavier Developer Kit for developing the system via machine learning.



- NXP microcontroller-based device plugged into OBD-II port



- Electronic throttle (drive-by-wire)

Our group member Daniel, who works at Lexus as an automotive tech has experience working with hardware and software relating to vehicle safety features and systems.

Daniel has installed, configured, diagnosed and repaired system using millimetre wave sensors and cameras in his job. He has also worked with electronic braking systems, both in repair and maintenance.

Testing

As outlined in the scope of limits, the first stage of testing would begin during the development stage of our project. We would test the technologies for our project including the software and hardware throughout the developmental stage of our project. If there are faults with any hardware or software during the development stage of our project, we would rectify it before we would have a working prototype.

The second stage of testing, once a working prototype has been developed is to test our working prototype in a small test track in a controlled environment as outlined in our scope and limits.

The third stage of testing after faults and bugs has identified in the second stage is to deploy the bus in a small environment such as a University Campus or an Industrial estate. In this environment, we would use public feedback as outlined in the scope and limits to improve our bus and take on feedback before we deploy it into the community. We would also use this opportunity to showcase our project to potential investors and to the public as well, hence we will make our bus open to the public to use as well.

The fourth stage of our project is to deploy our bus into the general community such as St Albans as outlined in the scope and limits. For this to happen, we would need to seek government approval for this to occur and to ensure that our autonomous bus is safe in the general community and on the public roadways.

After the fourth stage of testing, we would then use the feedback from the general public and identify any further bugs before we come up with our final design.

Timeframe

Week	Tuan	Rhys	Jayden	Daniel	Melissa
7	Increase knowledge about machine learning.	Research in automotive security.	Learn more about programming ECU communication language.	Research into laws and legislation relating to the project.	Begin planning for marketing strategy. Plan for recruitment phase.
8	Learn more about AI technology in depth.	Carry out a risk assessment on the design of the automated bus.	Develop a plan for utilising CAN FD to connect resources together.	Develop company policies and procedures.	Start the recruitment phase – initial interview.
9	Start to learn how to use the NVDLA open-source software.	Research Cyber-Security Issues with the project	Put plan into place	Research similar companies' policies and procedures	Continue recruitment phase – shortlisting.
10	Acquire Jetson developer kit and begin practising with the resource	Provide feedback into all security and risk issues	Test that all technologies are working and can be used in the project	Compare policies and procedures.	Finalising recruitment – make selection.
11	Begin to implement technologies and software	Begin implementing security technology and procedures	Provide any training needed	Have the policies and procedures typed up.	Training – Company policies/ requirements/ technologies used
12	Provide training for all software and hardware	Begin training on all security issues	Have plan and procedures into using technologies and resources	Begin training on policies and procedures	Training – hands-on with hardware and software
13	Monitor resources used	Assess understanding of security concerns	Continue monitoring that all resources are working correctly	Assess understanding and compliance with policies and procedures	Training – assess skills
14	Continue research into new and relevant technologies	Begin writing up security policies	Fix any issues with connecting of resources	Train any new personnel and retrain those who need it	Divide recruits into teams based on skills and areas of interest

15	Implement any new technologies and monitor project performance	Continue research into new and ongoing security risks	Provide ongoing support for any relevant issues	Provide policies and procedures to all governing bodies	Continue monitoring employee for understanding of all training and policies and procedures.
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For this timeframe, this is only a short time timeframe to achieve the project to a point where it can be showcased to shareholders and foundations in order to secure funding or a research grant. Our long term timeframe will be described below.

After we have secured funding and a few stakeholders, we would start testing and development of our project would take 1-3 years depending on the engineering and research required.

After development and research, we would then begin field testing in a controlled environment such as a controlled test track. This should take several months to a year to identify and remove any bugs before public trials begin.

Once controlled environment testing has concluded, we would then begin initial public testing which is the third stage of testing. This would take approximately 1-2 years before general community deployment.

After the third stage of testing, the bus would then begin general community testing which is the fourth stage of testing once approval from the government has been sought. This would be the longest phase of testing, 2-3 years combined with the gradual rollout into more communities. Development of the final design would occur during this timeframe.

Once the final design has been developed, we intend to reach further with our project and commercialise it even further with the aim of winning tenders and contracts across Australia and the world to implement autonomous bus solutions.

Risks

When evaluating the risks of this project there are many things that need to be taken into consideration.

We have identified a few key areas of risk specific to our autonomous bus.

The first risk to this project is the hardware not performing properly or the software not being developed correctly. This could result in the system not working, behaving strangely and have the potential of causing serious harm. Systems controlling the steering, acceleration and braking need to have pin-perfect reliability to certify that the vehicle is safe. Thorough testing is a must! We would mitigate this risk by ensuring that we would identify any bugs during development and thoroughly test along the way during development.

The second risk to our project is not being able to secure funding for our project, running out of funds or running above the budget for development. This is a continual the risk throughout the development and it can be mitigated by determining a roadmap for our project, setting clearly defined goals and using our resources carefully including time. Conducting periodic cost-benefit analyses as well as risk assessments can help catch abnormalities in development cycles and assist in producing the best product.

The third risk to our project is being able to negotiate government approval and ensuring that our vehicles meet government regulations and standards. This risk is very large because if we are not able to meet the legislative requirements for autonomous vehicles or we are unable to seek government approval, then the project will not be able to progress forward developmentally and we can't deploy our bus into the general community. Ensuring that we plan correctly, and submit our intentions for the project before expensive development begins will help mitigate this. By implementing a strong quality control culture, a focus on meeting laws and legislation will be a priority.

The fourth risk to this project is having a major accident which can lead to the project's reputation being damaged. This is another big risk and it presents a lot of ethical challenges when it comes to deciding who is at fault and it can cause the public to lose trust in the autonomous bus. Loss of public confidence can have a significant impact on this project because if the public is not confident on an autonomous bus, then it can lead to loss of revenue for our project, not to mention the fallout if the project fails. The ethical and legal challenges would be litigation where our company could be at fault for the accident and the liability for our company would be very high if there was legal action taken. Even though we develop the technologies for this well, accidents can occur and will always occur as on the roadways since technology is not always perfect. Mitigating this risk presents several challenges, but it can be mitigated by having processes in place to resolve legal disputes if accidents occur and keeping our trust in the public by ensuring that our technology is safe and having a response team if an accident does occur.

Skills and Jobs

Mechanical Engineer-Position Description

Transformations is an exciting start-up that is pioneering the development of an autonomous bus solution that is tailored to serving the diverse communities of Melbourne. We are focused on three things, **Transport**-Which is our purpose, **Forward**-In which we see the future and **AutoMation**, the moving parts of this technology. TransForMation is in the process of using cutting edge research and technologies to develop an autonomous bus capable of achieving level 5 automation sometime in the future. We are currently searching for a passionate Robotics and Mechatronics engineer to join our team to develop our project.

The Mechatronics/ Robotics engineer will be responsible for:

- Analysing plans to develop mechanical and electronic systems for the autonomous bus
- Develop effective solutions and systems architecture for the autonomous bus
- Integrate mechanical knowledge and skills into the robotic systems of the autonomous bus
- Produce drafting drawings
- Research latest technologies and adapting them to the bus design
- Liaise with the project manager on the progress of development
- Test the systems on the autonomous bus.

What are we looking for?

To be successful in this position you should possess the following:

- Degree in Mechatronics or Electronic Engineering
- Experience in dealing with programming languages (C++)
- Experience in handling sensory equipment such as millimetre wave scanners
- Experience in using AI for engineering tasks and AI to drive automation.
- Passionate about automation
- Previous use of CAD software
- Industrial or automotive experience will be highly regarded
- Effective problem solving and analytical skills
- Knowledge about robotic electronics, mechanical and power control systems.
- Machine learning experience
- Strong mechanical reasoning skills
- Drafting experience will also be regarded
- Also, most importantly excellent interpersonal, communication and teamwork skills.

Interested, click apply now.

For further enquiries Please contact Tuan Luong-Project Manager of TransForMation.

Note Only shortlisted applicants will be contacted.

Software Engineer-Position Description

Transformations is an exciting start-up that is pioneering the development of an autonomous bus solution that is tailored to serving the diverse communities of Melbourne. We are focused on three things, **Transport** -Which is our purpose, **Forward**-In which we see the future and **AutoMation**, the moving parts of this technology. TransForMation is in the process of using cutting edge research and technologies to develop an autonomous bus capable of achieving level 5 automation sometime in the future. We are currently searching for a passionate Software engineer to join our team to develop our project.

The Software engineer will be responsible for:

- Programming the software required for the autonomous bus.
- Developing software solutions that can integrate with the mechanical hardware of the autonomous bus.
- Developing an effective program required to control the artificial intelligence required for the autonomous OR develop artificial intelligence algorithms required.
- Debugging and performing software tests
- Managing machine learning for the autonomous bus
- Updating software on the autonomous bus.

What are we looking for?

To be successful in this position you should possess the following:

- Degree in Computer Science or Information Technology
- Experience in dealing with programming languages (C++, C)
- Experience in use of low-level programming languages such as assembly
- Experience in data management and AI
- Debugging experience
- Previous experience in developing enterprise-class applications.
- Machine learning experience will be highly regarded.
- Development experience across multiple platforms.
- Knowledge of operating systems
- Driver development experience will also be highly regarded
- Previous experience with robotic software development will also be highly regarded
- Effective problem solving and analytical skills.
- Also, most importantly excellent interpersonal, communication and teamwork skills.

Interested, click apply now.

For further enquiries Please contact Tuan Luong-Project Manager of TransForMation.

Note Only shortlisted applicants will be contacted.

Position Description-Data Analyst

Transformations is an exciting start-up that is pioneering the development of an autonomous bus solution that is tailored to serving the diverse communities of Melbourne. We are focused on three things, **Transport**-Which is our purpose, **Forward** -In which we see the future and **AutoMation**, the moving parts of this technology. TransForMation is in the process of using cutting edge research and technologies to develop an autonomous bus capable of achieving level 5 automation sometime in the future. We are currently searching for a passionate Data Analyst to join our team to develop our project.

The Data Analyst will be responsible for:

- Developing and maintaining an effective database required for the data management of the autonomous bus.
- Analysing and developing effective data models that can encapsulate the data that is ingested and obtained.
- Create data frameworks
- Integrating data into artificial intelligence and machine learning
- Supervising machine learning and creation of training data
- Compiling data from existing infrastructure into the project
- Develop effective data mining algorithms for the artificial intelligence of the project

What are we looking for?

To be successful in this position you should possess the following:

- Degree in Computer Science or Information Technology
- Experience in dealing with SQL.
- Experience in relation database management systems.
- Experience in the management of networks and databases
- Previous experience in data mining for AI and Machine learning
- Ability to analyse large data sets and develop effective data frameworks for managing big data.
- Knowledge of storage formats and storage networking
- Proven experience in data management software such as CRM systems.
- Experience in large scale data systems.
- Passionate about continual development.
- Effective problem solving and analytical skills.
- Also, most importantly excellent interpersonal, communication and teamwork skills.

Interested, click apply now.

For further enquiries Please contact Tuan Luong-Project Manager of TransForMation.

Note Only shortlisted applicants will be contacted.

Position Description-Cybersecurity Specialist

Transformations is an exciting start-up that is pioneering the development of an autonomous bus solution that is tailored to serving the diverse communities of Melbourne. We are focused on three things, **Transport**-Which is our purpose, **Forward**-In which we see the future and **autoMation**, the moving parts of this technology. TransForMation is in the process of using cutting edge research and technologies to develop an autonomous bus capable of achieving level 5 automation sometime in the future. We are currently searching for a passionate cybersecurity specialist to join our team to help develop our project.

The role of the Cybersecurity specialist will be to:

- Assist management in the development of policies, particularly in security topics.
- Maintain and keep policy up to date database.
- Carry out penetration testing on systems of the vehicle.
- Identifying vulnerabilities in systems.
- Protecting intellectual property.
- Handling encryption of confidential data.
- Strong sense of ethical handling of sensible data.
- Assist software engineer in security-focused programming.

What are we looking for?

To be successful in this position you should possess the following:

- Degree in Cyber Security or Information Technology.
- At least 2 years' experience working in the field.
- Experience in dealing with programming languages (C++, C, Python).
- CCNA Security or CyberOps certification preferred.
- Have an expert understanding of security concepts and procedures.
- Very high level of understanding Linux OS and CLI.
- Ability to use monitoring software.
- Strong analytical skills.
- Knowledge of cryptography (AES, Hash)
- Expert-level knowledge of ethics in technology.
- Ability to work in a team. Excellent interpersonal and communication skills.

Interested, click apply now.

For further enquiries Please contact Tuan Luong-Project Manager of TransForMations.

Note Only shortlisted applicants will be contacted.

Position Description-Lawyer

Transformations is an exciting start-up that is pioneering the development of an autonomous bus solution that is tailored to serving the diverse communities of Melbourne. We are focused on three things, **Transport**-Which is our purpose, **Forward**-In which we see the future and **autoMation**, the moving parts of this technology. TransForMation is in the process of using cutting edge research and technologies to develop an autonomous bus capable of achieving level 5 automation sometime in the future. We are currently searching for a passionate Lawyer to join our team to help develop our project.

The Lawyer will bear the responsibilities of:

- Providing legal advice to TransForMation.
- Assisting management in developing new policies.
- Drafting legal documents.
- Ensuring that all operations are legal. Carry out internal auditing of processes and providing feedback as well as advice.
- Being the legal representative for TransForMation.

What are we looking for?

To be successful in this position you should possess the following:

- Degree in Law and/or Cyber Security
- At least 5 years' experience in the legal field.
- Expert level of knowledge in IP (intellectual property) laws.
- Experience in IT law.
- Excellent interpersonal and communication skills.
- Strong reasoning skills.
- Prior experience in drafting automation legal tenders a bonus.
- Ability to work in a team as well as alone when necessary.
- Ability to work under pressure.
- Analytical mind.
- Have a very high level of attention to detail.
- Good judgement.

Interested, click apply now.

For further enquiries Please contact Tuan Luong-Project Manager of TransForMations.

Note Only shortlisted applicants will be contacted.

Group Reflection

Tuan Luong-Group Leader

Throughout the group, I feel that the group worked extremely well and very effectively. The group members have clearly understood their roles and what they had to do to. As the group leader, I ensured that each group member has received a fair share of work in their area and expertise. For example, one member was quite proficient at making videos, so other team members made rough videos, while the third helped make the official one and helped the other two put the draft video and storyboard up onto RMIT Canvas.

The group's communication was excellent, the group continued to be very supportive and positive in their interactions with each other. The group used a variety of means of communication, such as Facebook Messenger, WhatsApp, messaging each other, group chats, individual or two to three people chats. The group helped each other with assignment parts given out, with positive suggestions made, contributions given, and ideas exchanged. As a leader, I offered help to group members that are struggling with the workload and lending a hand each way. At no time was there any tension in the group, and the group made sure every voice and opinion was heard.

One thing that could be improved is using GitHub or other processes of sharing files, because as a group we mainly uploaded the files via facebook messenger and it was hard to track changes as the assignment. However, we did mitigate this somewhat, as Daniel Lay has stated by using the Canvas A3 group folder.

One thing that was surprising to me was the amount of work the group had put it even though we had very chaotic and busy lives. One thing that I have learnt about working in groups is that if a group is productive and understands their roles and what needs to be done, then a project can lead to success and I am very fortunate to have a team that works really well. I have made some new friends from this group.

Melissa Eder

My perception of the group is that every member tried their hardest to ensure that this assignment and assignment 5 the video was done and completed on time, fulfilled the assignment's requirements and that work was distributed as evenly as possible.

The group met up about twice a week or more depending on when we could, We talked over Facebook messenger all the time, we would ask each other questions, put upload work for the group to examine or just talk about the assignment, about where we were at, about how the assignment was going and so for.

Individual members would also talk to each other asking about the assignment or getting feedback about their part of the assignment. I thought the group was extremely supportive of each other and they all helped me enormously.

Daniel Lay

I thought our group worked well. Communication was the main factor to our success as there was consistent conversation about planning, ideas and updates on progress. The work was done on a good schedule to allow for improvements and proof-reading by all the team members.

I think the main improvement that I can think of is more use of GitHub or perhaps a different form of communication. Reason for this is that sometimes, parts of the assignment were uploaded to Facebook messenger and it does get lost in the chat. We did circumvent this somewhat by utilising the Canvas A3 group file sharing board.

One thing that I found surprising was the amount of work everyone can do in a small timeframe and produce good quality work. It has been a joyful ride as it scooted by rather quickly.

While my experience with this group has been excellent, I can definitely see why I had feared groupwork before. However, I have been gifted a great team and produced, in my opinion, a very decent report. Well done all.

Rhys Burns

Everyone was able to complete their portion of the assignment in a timely manner and produce some high-quality work. Communication was a driving force of our previous success and it played a pivotal role again for assignment 3.

In the previous assignment, I mentioned that having a single medium of communication and a platform for idea sharing/document uploads would've been ideal. I think using something like Microsoft Teams would've provided a good platform to work with, but it would've been difficult to introduce this change and learn the platform considering the size and scope of the assignment. As mentioned previously, using a combination of Canvas File Share for document sharing and Facebook Messenger to discuss ideas worked for this assignment.

The team took on board the feedback from the previous assignment and was able to turn what we'd already start producing into what we'll end up presenting. I believe that the quality of work that is being presented for this assignment is considerably better than what we produced for the previous one. So the surprising factor here was the energy and enthusiasm everyone showed to make the best work possible.

I learnt that even though we might not all be in the same city, have the same abilities, are as confident in ourselves as others, we can still overcome these hurdles and produce something we can be proud of.

Jayden Barber

This assignment has gone relatively smoothly throughout the whole process although there have been a few hiccups. The beginning went very smoothly as we established roles and task early allowing us to get a head start on the assignment. We had regular meetings to check where other members were at and if they needed any assistance with what they were doing. We were lucky enough to have conceptualised a project idea swiftly as this, I feel, might be the hardest part for some groups. However getting closer to the due date communication became a bit more difficult with people being busy, the stress of other classes and impending exams may have put some of the

group on edge. In the end, it is not a real issue but is worth mentioning in a group reflection setting. Overall I think we, as a group, work together well and support each other where needs be. This makes our assignments go extremely smoothly and we get the bulk of the work done far prior to the due date allowing us to edit and add parts where needed.

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