Executive Summary

Worldwide, every 7 seconds a workplace injury occurs. Within New Zealand 63% of workplace fatalities are related to motor vehicles, 80% of which can be avoided by proper health and safety measures. In this proposal, we are outlining the implementation of wearable body cameras in the workplace to remove complacency towards safety policies and contribute to making workplaces safer. These cameras will feedback to an API which will feed to a mobile application that site managers can view. The cameras will detect breaches such as; employees wearing incorrect or lack of safety wear, jumping off or over equipment, employees in dangerous areas, incorrect handling of hardware, etc.

Requirements for this project were talked through with the client during a project brainstorming session. The requirements were split into two categories being hardware requirements (battery life of the camera, camera resolution, camera size, weight, etc) and architecture/ design requirements (sending messages through the internet, programming languages, bloc pattern, etc). These requirements make up the scope of the project.

Deliverables for this project include:

- Team contract
- Timeline
- Meeting minutes
- Proposal (written report)
- Proposal (presentation)
- Mid-term progress review
- Team poster
- Final product
- Team portfolio

These milestones have been laid out in logical order and will act as a timeline for checkpoints throughout the project.

Risks to this project include; the project schedule not being clearly defined/ understood, unplanned work going uncompleted, lack of communication between team members, loss of communication with our mentor, etc. There is also the risk of scope creep as with any large project that is being undertaken. To try to mitigate these risks and scope creep we have all agreed in the team contract to be upfront with each other and stick to the guidelines written. As the project progresses, the team contract is being updated as more risks are identified to address these.

(brief summary of the budget to be included)

1. Terms of reference (Background Information)

Background

Workplace safety practices are vital to ensuring that employees are kept well in and around work sites. Injury in the workplace worldwide occurs every 7 seconds, costing the US $250 billion worldwide annually. Within New Zealand, 63% of fatalities are related to motor vehicles, and 80% of these can be avoided by following health and safety measures correctly. Companies have many policies in place to prevent these accidents from occurring, however, over time people become complacent with these policies (https://data.worksafe.govt.nz/).

We are proposing implementing body-worn cameras in the workplace. These cameras will feedback to an API which will feed to a mobile application that site managers can view. These cameras will detect breaches such as; employees wearing incorrect or lack of safety wear, jumping off/ over hazardous surfaces/objects, employees in dangerous areas, incorrect handling of hardware, etc.

Inviol

We will be working with our client Inviol for this project (https://www.inviol.co.nz/). Inviol is a startup that is working toward creating safer working environments. This is being done through the implementation of cameras placed on worksites to remove complacency around policies that are known to keep employees safe in the workplace.

We will work with the client throughout the project to discuss and brainstorm the appropriate software and hardware to use for our project.

Project Aims / Goals

This project aims to detect accidents that;

- Vehicle incidents
- Falling from objects
- Being hit by a moving object
- Being hit by falling objects

This project will address these accidents by removing the key factor of complacency. This will be done by providing feedback to employees who are shown through the cameras to be breaking policies. Through this, a conversation will be opened with the managers to provide feedback to the employees and training where needed. This will work with Inviol's goal of creating safer workplaces and preventing workplace deaths.

2. The Rationale for the Project

Project Importance

As mentioned in the terms of reference above and in (https://data.worksafe.govt.nz/), workplace accidents occur very frequently.

Accountability for these accidents tends to fall on the directors of the companies. If they aren't able to prove that systems and policies are in place to prevent these accidents, then they are a candidate for charges of manslaughter. These policies can be shown to be in place through the use of these cameras, and with body-worn cameras, more of the workplace and employees will be able to be reviewed to determine causes and consequences. This could help prevent deaths and save companies from charges. The importance of this report to these companies is to provide a solution to these issues and to improve contact between employees and management.

Existing Systems

Body cameras are currently being used in the workplaces of security, law enforcement, emergency services, etc (https://peoplesafe.co.uk/blogs/body-worn-cameras-and-lone-working/). This helps provide safety for the employees and allows managers and other parties to review events that have occurred through the employee's view. The purpose of the cameras in most of these workplaces, especially emergency services is to ensure employee safety and can also be used as a prosecution tool against any violence that may occur towards the wearer. As we begin and move through this project, we will be looking to research the current implications of using body-worn cameras in these workplaces.

In comparison to the current cameras that have been deployed in workplaces, our proposed camera will not only provide insight into the safety practices of the employees but will also through the app allow communication between the employees and their managers to quickly discuss what incidents have been detected by the camera.

Key Issues

The issues we will face when finding the optimal camera for our project will be ensuring that the battery life of the camera is long enough to sustain a full workday, as well as the camera API compatibility and wifi compatibility. We will also need to research existing algorithms and systems to better optimize our project so that the API can better detect aggression and behavior. These issues were outlined during a brainstorming session with the client, and with the client and the client's team, we agreed that these issues were ones to note and to keep in mind when researching options for the hardware and software for this project.

3. Project objective and scope

Project Goal

The objective of this project is to implement wearable body cameras in workplaces. These cameras will provide feedback through an API to an application. This application will allow employee managers to view potentially dangerous actions taken by their employees while on site. These actions will be viewable through the application, and both the employee and manager will be able to communicate with each other about the incident.
Key stakeholders in this project are Inviol and AUT.

Scope

We would deem the project successful when;

- A hardware prototype has been selected
- The hardware prototype has software installed
- The hardware prototype can detect incorrect employee behavior
- The software has been created for the hardware prototype
- Web/mobile application has been designed for connection with the hardware prototype

To achieve these success criteria we have outlined some hardware and architecture/ design requirements that have been discussed with the client during a brainstorming session.

Hardware Requirements

1. Camera resolution (pixel resolution): The resolution of the camera will need to be high enough quality to detect employees, their surroundings, and both of these objects moving, but also be at a quality that will not drain the battery.
2. 8-hour battery life: the camera will need to be operational for an average of 8 hours, or a full working day. We will need to take into account the amount of battery capacity a camera has when it comes to selecting the camera for the project so that the camera can run for the amount of time specified, as well as have the computing power for WIFI, GPS and the internal processor.
3. Camera Size and weight: the camera needs to be an appropriate size and weight to be wearable for employees for an entire day, this has been decided with the client to be 500g or less.
4. Minimum performance models: these models for the hardware could include; jetson, raspberry pi, object detector, position estimation, etc. These are options that were discussed with the client and will be in accompaniment with the camera itself.
5. Onboard and post-processing, processing will either be done onboard or in post-processing, this will be determined by the requirement of how much battery power the processing takes, and how much more weight onboard processing will require.

Architecture / Design Requirements

1. Send messages through the internet: the camera will need software that will send messages/ videos from the hardware to the API and in turn the application.

2. BLOC diagram: code for the hardware and application will follow the guidelines of the BLOC (Business Logic Components) pattern, as requested by the client, following their current coding requirements. This will also ensure that the project is as efficient as it can be.
3. Detect objects: the software that will be installed onto the hardware prototype will need to be able to have an object detection element to identify the employee's actions and views.
4. Framework/programming language: these will be required for the application and the hardware prototype.
5. Hardware restraints: described above in the hardware requirements, these requirements will determine some of the software that will need to be used, and what programs are runnable on the devices.
6. Open source repos: as advised by the client, we will resource open source repositories for model training.
7. Application: the application will require; product design, UX design, and graphic design.

Derived from our definition of success and the hardware and architecture/design requirements stated above, our project deliverables are formed. These deliverables consist of;

1. Wearable body cameras
2. Software to be installed on the cameras
3. API software (either modify the current API or the new one)
4. Mobile / Web Application

As seen in the requirements stated in the scope, our team will need several resources to complete this project defined by our definition of success. These resources include; the cameras (lens, battery, camera harness, camera processor, etc) that will be selected after the research phase of the project, the software API which is to be provided by the client, the azure development software which is to be provided by the client. The client has the azure software and during the brainstorming meeting agreed-upon allowing us to use it. By using the client's azure software they are also able to check in on our progress as we update it.

To achieve the requirements set up above, our team will be required and responsible for undertaking some upskilling in model training and detecting for the software to be implemented for the body cameras. This was discussed with the client and they are happy to run workshops in upskilling these areas, so we can learn how to train models correctly and in the way that suits the client and how they currently train models themselves.

4. Project methodology- project phases and practices

Planning

1. Our main goal as a team was to take a real-world topic and conduct an in-depth investigation focusing on the type of accidents that usually occur around trucks in order to assist inviol in removing complacency from workplaces thus making workplaces safer.
2. As a team, we will be working with the clients from the very beginning of the project to brainstorm and discuss the appropriate software and hardware to use for the project that will help create a safer workplace with body worn cameras
3. We receive information and instructions from our clients on how to set up a body worn camera that connects to an API and feeds data to a mobile application that is assessed by site managers who can view accidental actions by the employees.
4. While on the process of creating the product for inviol as a whole team we will be composing a draft proposal noting down all the requirements for the project which is signed individually to all the team members to be completed.
5. Once the draft proposal is completed and handed over to receive feedback. We will contact our client and plan meeting in order to start with creating our product for the company as a part of our main project.
6. Identifying the features that our camera needs to detect would be the first step in creating a safer work environment for employees.This would include Location, positioning rules that enables to have wifi, Bluetooth, GPS which detects in advance regarding the accidents that can occur. This will also include a behavior of a human that can detect any unsafe behavior such as jumping, Smoking, bad posture that can cause injury.
7. Once the necessary detection is completed, Hardware requirements need to be noted down. This would include Camera resolution (pixel resolution), 8 hour battery life: ensuring that the camera has plenty of power to run for as long as stated, as well as be equipped with WIFI, GPS, and an internal processor, Camera size and weight: employees need to be able to wear the camera for a long time, Minimum performance model, Onboard processing or post processing, depending on how much battery power the processing takes and how much weight onboard processing requires.
8. The next step would be setting up Architecture / Design Requirements for sending messages from the hardware to the API, and from there to the application, a BLOC diagram will be generated showing the hardware and application code in accordance with the BLOC (Business Logic Components) pattern, as requested by the client, Object detection feature the software that will be installed onto the hardware prototype should be able to detect employee actions, Framework / programming language to be installed, Hardware limitations: described in the hardware requirements.
9. The next step of planning would be creating open source repos: a recommendation from the client will allow us to use open source repositories for model training. The application will require product design, UX design, and graphic design which will be inbuilt and designed on the body worn camera training mode.

10. The most important planning step is the building process of the model camera product with having all the hardware and Architecture / Design Requirements.This includes AGILe, Sprints, Azure Devops, GIT Repos, Kanban/Trello Boards, Prioritization, Break Down Work into User Stories, Workload, Estimated Time Of Completion, Description of the model created, Team Member(s) Assigned to User Story, Exceptions/Criteria, Set Sprint Goals of completing the product on time.
11. Testing would be a very crucial step that involves the client to test the product we have created and make sure all the application related to the product and up and running which will help with creating the workplace safer for the employees
12. Passing all these steps we have planned would create a successful body worn camera model which will complete our project work and helps creating a safer workplace for the employees and causing less accidents at work.

Learning

Learning is a very essential part of the project in every step to lead to a great successful teamwork.Our teams main focus was to learn to develop body worn cameras implementing in the workplace. An API will feed the video data to a mobile application, which site managers can use to access the feed. By using such cameras, you will be able to detect items such as employees wearing the incorrect clothing, jumping off and over hazardous surfaces, employees working in potentially dangerous areas, incorrect handling of equipment, etc.In this process we will be learning how cameras work how the API will feed the video data to a mobile application. First we will mainly be focusing on creating the camera with hardware, software and Architecture / Design Requirements. We will be learning to create online website and mobile application through coding language that allows to use API model. We will also be learning the best fit camera for the creation accordance with its weight, size, battery life, resolution of picturization. Will be learning to install software in the body worn cameras which would have included features such a wifi, bluetooth, GPS. Product design, UX design, and graphic design are to be thought by the client to us. Most importantly will be learning Block diagram of the body worn camera code for the hardware and application will follow the guidelines of the BLOC (Business Logic Components) pattern, as requested by the client.

Project work

Our main project work is based on working with our client Inviol for this project. Inviol is a New Zealand based startup developing company AI-driven hardware & software solutions to assist in detecting workplace hazards as well as implementing workplace health & safety strategies to prevent accidents from occuring. Worksite cameras are being installed in an effort to weed out complacency surrounding policies that are known to keep employees safe around the workplace and decrease the possibility of accidents. It takes a considerable amount of effort for agencies to get body cameras into place. Implementing body-worn cameras has some challenges, including monetary and personnel resources. Keeping all this in mind our team has collaborated with Inviol for this project work of creating a body worn camera product to provide employees with the feeling of safety at work with the camera serving as a safeguard against accidents occurring with members of the public and providing evidence should an incident occur.

5. Team roles and expected work behavior & practices

Team Contract

- Communication with team members: team members will speak politely and respect each other, will not lower their voice or their opinions. All the team members will be positive in recognizing and thanking one another's thoughts on the team project and will not be speaking down to each other. Team members should acknowledge and thank each other for the contributions they make for the team project.

- Seeking help from team members: Be honest with ourselves when we are stuck and accept help from other team members. Allow members to provide assistance when we are stuck.

- Team meetings: All team members must listen attentively without interjecting while an individual team member is sharing their thoughts and ideas. During conversations, there should be no disagreements. All team members must attend all the meetings and adhere to the rules that govern effective meetings. Attending meetings prepared by members of the meeting group should be punctual.

- Interpersonal Disputes within Team Members: Team members will ensure they all understand what to communicate and when. Any complaints regarding other team members will be addressed first within the team, if a solution can not be found, we will communicate our issues with the teacher for assistance.

- Team problem solving, conflict resolution and decision making: disputes among teammates will be handled directly with the disputants. It is important to not hold grudges against one another and work together as a group leading to achieve success.

- Team leadership: We are a team of 5 members and treat all team members equally hence leadership will rotate weekly as per the work done that has been provided to the individual by the group.

Team Roles:

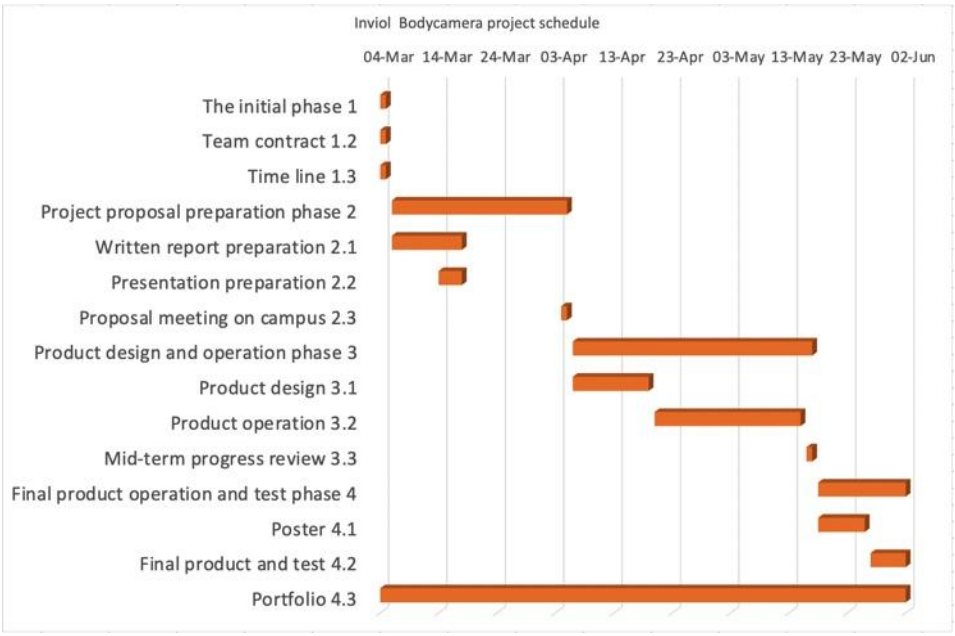
Member	**Roles**
Julia	Front end App design API
Ray	Developer Wanting to learn AI Model Training
Gamana	Hardware installment Creating a website

Lingze Meng	Information collection Programming Language Testing
Haoge Ming	Project schedule making Information collection Testing

Meeting Schedule:
Team Meetings - Wednesday/Friday 4:00pm - 5:00pm
Mentor Meetings - Tuesday
Client Meetings - Tuesday

6. Schedule and Milestone Report

Project schedule (Gantt chart):



Project success factors:

1: Methodical Approach
The selection of an appropriate project management technique is critical to success. Follow the patterns and approaches of the framework selected to make sure the process is clear, dependable, and efficient. All stakeholders should be aware of the need of devoting time to defining a clear project goal and agree to do so.

2: Proper Planning
Developing a detailed schedule can help the team know the exact progress of their projects. Relying on this schedule allows the team to reasonably allocate sufficient time for each task to complete. This ensures the efficiency of the entire project.

3: Effective Communication
Effective communication can drive the enthusiasm of each team member, and can accelerate the development progress of the entire project.

4:Sense of responsibility
Each team member has their own value. In the process of teamwork, everyone should be clear about his own task and be responsible for it. The sense of responsibility from everyone is the key to the achievement of a team, only in this way can guarantee the quality of every part of the project.

Milestone report and Risk register are in the document.

7. Estimate all costs incurred.

Mentor Labour Estimate - $142 (incl. GST) per hour
Team Labour Estimate -
Hardware Costs Estimate -

Inviol Body Camera Cost Estimate

	# Units/Hrs.	Cost/Unit/Hr.	Subtotals	WBS Level 1 Totals	% of Total
WBS Items					
1. Project Management					
1.1 Project mentor					
1.2 Project team members					
1.3 Client company (Inviol)					
2. Hardware					
2.1 Body Cameras					
2.2 Servers					
3. Software					
3.1 Licensed software					
3.2 Software development*					
4. Testing (10% of total hardware and software costs)					
5. Training and Support					
Upskilling					
6. Reserves (20% of total estimate)					
Total project cost estimate				**Unkown**	

* See software development estimate

Appendix: Disclaimer

Disclaimer:
Clients should note the general basis upon which the Auckland University of Technology undertakes its student projects on behalf of external sponsors:

While all due care and diligence will be expected to be taken by the students, (acting in software development, research or other IT professional capacities), and the Auckland University of Technology, and student efforts will be supervised by experienced AUT lecturers, it must be recognised that these projects are undertaken in the course of student instruction. There is therefore no guarantee that students will succeed in their efforts.

This inherently means that the client assumes a degree of risk. This is part of an arrangement, which is intended to be of mutual benefit. On completion of the project it is hoped that the client will receive a professionally documented and soundly constructed working software application, some part thereof, or other appropriate set of IT artifacts, while the students are exposed to live external environments and problems, in a realistic project and customer context.

In consequence of the above, the students, acting in their assigned professional capacities and the Auckland University of Technology, disclaim responsibility and offer no warranty in respect of the "technology solution" or services delivered, (e.g. a "software application" and its associated documentation),both in relation to their use and results from their use.