# **Status Report**

# **for**

# **Inviol Body Camera Project**

**Team Members:**

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**Mentor:**

Roopak Sinha

**Moderator:**

Edmund Lai

**Executive Summary**

This status report’s aim is to provide a current update for the Inviol Body Camera Project. This will include an explanation of all the work completed from week 7 of the project (11/04/2022) to the end of week 11 of the semester (27/05/2022), as well as the relevant documents worked on during this time and each team member's individual work log. It will also outline the deliverables of the project and the knowledge that has been gained and applied during the project's current duration.

Since the project proposal, our team has worked towards better communication and structure in the project. By focusing on these goals, we have gained a strong momentum towards the project, and are working more efficiently as a team. As a team, as well as individually, we have spent the time since the start of week seven researching the ideal camera models to fit the requirements provided by the client, upskilling on model training, and have begun practicing training a YOLOv4 model with researched data sets.

**Project Description**

Inviol is a start-up company that aims to identify complacency in the workplace by implementing cameras running AI vision (<https://www.inviol.co.nz/>). Workplace incidents occur worldwide every 7 seconds, costing the world annually equivalent to USD $250 billion. Inviol aims to reduce the number of workplace accidents by providing a way of removing complacency and stopping dangerous practices before they become fatal.

Our project is to create a prototype of a body-worn camera to assist inviol in detecting a lack of PPE (personal protective equipment) from a first-person perspective. We are also training a model in YOLOv4 to detect these breaches in policies.

**Overview of Project**

**Objectives**

The first objective of this project is to create a body-worn camera prototype. This is being done with a Raspberry Pi, and a Raspberry Pi Camera Module 2. The second objective of this project is to train a YOLOv4 model to detect a lack of PPE being worn. The PPE (personal protective equipment) wanting to be detected by the client includes; hi-vis vests, helmets, and face masks. As a part of this objective research is also being conducted into data sets and data collection to aid our team in the model training, while also allowing us to include our own data to make the model more accurate for the scenarios we are wanting to capture.

**Scope**

Our project scope has been narrowed down from the original proposal following feedback from our mentor and moderator. Our scope now includes the camera prototype, the model being trained in YOLOv4 for the detections, the research and upskilling requirements, and the collection of data sets (both open source repositories and from the Pi Module 2 Camera).

**Approach**

We have adopted an agile scrum methodology approach to our project. This approach includes weekly meetings with our mentor, as well as weekly communication and meetings with the client. As a team, we also send weekly schedules and reports, as well as individual schedules that detail what is being accomplished in that given week to the mentor each week. The agile methodology is also applied to our team meetings where we spend the first minutes updating each other on the progress that each individual has made. This ensures that everyone has made progress and is also up to date with what others are doing to gain a good understanding of the current status of the project.

During the beginning of the project, while an agile scrum methodology was agreed upon, this was not followed correctly by the team. Following the feedback and the adoption of the weekly reports and schedules and the beginning of discussions during team meetings, a noticeable shift occurred to adopt this method, which has contributed to the increase in momentum of the project.

Adopting sprints for the agile method allows us to focus on certain parts of the project that are vital at the given time. During sprint one we focused on individual upskilling and research, as well as obtaining the hardware of the camera. Through focusing on individual upskilling and research, our team adopted a divide and conquer approach for research and upskilling, which allowed individual members to become more knowledgeable in certain areas, and allows all of us to help each other out when it comes to applying this knowledge collectively to the project.

**Summary of Client and Mentor Meetings**

Following feedback given by our mentor at the beginning of week 7, we have weekly half-hour mentor meetings to update the mentor on our team’s progress, as well as show the mentor what we have each achieved individually. Since these meetings have been implemented, a noticeable improvement in the work contributed as well as team morale and application of the chosen PM methodology has been seen.

Weekly meetings with the client have also been carried out during this time. Through the team's product owner, questions have also been able to be answered outside of meeting times by the client, allowing upskilling tasks to be completed in a timely manner.

**Major Milestones for Sprint One**

Below details the milestones that were planned to be completed during the time for sprint one (11/04/2022) to (27/05/2022)

| **Milestone** | **Who Worked on This** | **Status** |
| --- | --- | --- |
| Hardware Research | Julia Borlase  Sai | Completed |
| Selection and Acquirement of Hardware | Sai | Completed, after completion and selection of the hardware, the client was emailed the list that was compiled and purchased the hardware. The initial hardware setup of the Raspberry Pi module 2 has been completed also. |
| Upskilling in Model Training | Lingze Meng | In Progress - upskilling in model training we decide to use google collab to do the practice and we completed creating all required folders and upload to the darknet, and the model training part, but there is some issues during the performance checking, it still needs to be completed |
| Dataset Collection | Haoge Ming | In Progress - From now on, images for face masks have already been collected and 400-500 images for hardhat and High-Vis are also being collected. However, the suggestion from the moderator is that we should collect more video mode data for detection. Because YOLOv4 is a good object detector for video data. |
| Initiate setting up of the Raspberry Pi camera | Ray Crescent Garcia | The Raspberry Pi is now set up to take photos and is in the process of being set up to take videos and to store the outputs appropriately. |
| Test Footage |  | Not Completed - after upskilling in the model training and researching data sets, we have decided as a team to move this milestone to the second sprint, as we yet don't know the accuracy of our model, and what data would be needed in order to improve the accuracy of this at this point in time. |
| Mid-term progress review | All team members worked on the mid-term report and the presentation | Completed |

**Deliverables**

Below details an update on the two deliverables of the project.

| **Deliverable** | **Status** |
| --- | --- |
| **Camera Prototype**  The camera prototype made includes   * Raspberry Pi 4 8GB * Raspberry Pi Camera Board V2 * Raspberry Pi single cooling fan * Associated cables, casing, heatsink, and SD cards | Camera parts have been ordered by the client and arrived.  The camera prototype is currently being put together and the camera is being tested. |
| **AI Model (in YOLOv4)**  By the end of the project the model will have been trained to detect people wearing hi-vis vests, helmets, and face masks. | Upskilling in AI models has been undertaken by the team, as well as research and upskilling into open-source data sets to use for our model and data labeling tools.  Training of our model is being commenced and will be carried out on a computer at the client's workplace. |

**Response to Feedback**

After submitting our project proposal, our mentor gave us ideas on how to better improve it. The main improvements included numbering our pages so that our table of contents was easier to use and using rough estimates and a range of values for our ‘Cost Estimate’ document as it didn’t give a very clear idea of how much budget was required for the project. As for our Gantt chart (seen in figure one), it originally only contained milestones relevant to part one, but after receiving mentor feedback, it is now extended all the way through to the end of part 2 in November.

Our mentor was also concerned that some of our team members were not putting in the 12-15 hours of work required to work on the project every week. To remedy this, we began making weekly schedules that show what each individual in the group will work on throughout the week as well as fill out a weekly status report that we show to our mentor every week. The report goes over whether or not an individual’s tasks were complete, what went well, and if there had been any changes to tasks planned in the schedule. We repeat this process every week to ensure that all members are putting in the required effort and that our mentor stays in the loop.

Additionally, after presenting our project proposal to our mentor and moderator, we were given feedback on narrowing the scope. The scope of our project then was too ambitious and concerns were raised regarding whether we would be able to complete all of the milestones, so we decided as a team to narrow the scope to just researching which camera to use and to use already existing software on the hardware of our choice. We originally had the idea of creating an app or website to monitor the data gathered by our cameras but have since removed that from our plans going forward. The narrowing of the scope allowed our team to focus on what was important to the project and allowed us to have a clear vision of what the end product would look like, and how we will achieve this.

**New Variations from the Original Proposal**

Following feedback from our original proposal and the second submitted proposal, the following changes have been made.

* Feedback stated to provide a clear list of deliverables identifying what you must deliver and what would be nice to deliver. Based on feedback from the mentor, moderator, and client, our project deliverables and narrowed down to the prototype of the camera - Raspberry Pi Camera Module 2 and having the YOLOv4 model trained to detect incorrect wearing of PPE- hi-vis, helmets, and facemasks.
* The plan that we had implemented for the proposal was very risky and also has no details that allow monitoring of progress, or how this progress was going to be made. The plan was updated to two semesters' worth of work to reflect the plan of the project timeline.
* As mentioned in the response to feedback, the scope was narrowed to ensure the completion of the project.
* Build a clear project-relevant risk register. Given the feedback, the risk register was updated to include the time crunch that the project could face, given that we had not allocated appropriate time for tasks, as well as accommodate scope creep.
* Each milestone or deliverable has its own risks, the current risk register is very generic and some more details are required. We would be adjusting the upskilling plan by adding more time to upskilling.We found the time allocated to each skill is not enough due to the complexity of each task required and the need for upskilling on the go. Tasks have been allocated to individual members of the team to upskill. By dividing the tasks, progress can be made on the project collectively as our team helps each other.

**Summary of Current Project Status**

The project is currently undergoing the hardware setup of the Raspberry Pi Camera Module 2 and having the YOLOv4 model trained and data understanding phase. A consultation with the client revealed that more time needed to be spent on adapting and clarifying the data set's purpose, as well as investigating YOLOv4 training and individual upskilling.

Our team decided to start upskilling in YOLOv4. This upskilling was completed on Google Collab, and guidance as to how to do this was given from resources sent from the client. A labeled custom dataset for facemasks was used to practice training this model (<https://github.com/AlexeyAB/darknet>).

This led our team to focus on making the folders and some datasets for the data training (Photos for PPE have been collected, and videos collection for other scenarios is still progressing) then we connect it to the darknet on the google collab, and our custom detector training is done. Our project Dataset will include some search and collection of data as well as identifying the essential elements which need to be detected from each scenario and looking at images and videos to make sure the model can detect the right thing in the right way. The images for the face masks have already been collected, and 400-500 images are being gathered for the hardhat and hi-vis garments. We are collecting datasets in image formats. The client has recommended training the detector with images, then turning the videos we will get from the Raspberry Pi Camera into frames and training from those images.

We have decided as a team that we will use CVAT for data labeling due to its ease of use and ability to download and convert to YOLOv4 data. After comparing a couple of different data labeling tools, it has been decided that the software CVAT will be the best choice for labeling the data that we capture. This is due to the fact that is runnable via a web browser and the data sets are easily able to be exported into an obj.data file in YOLOv4 format.

Following the hardware list being compiled and sent to the client, the hardware for the camera prototype was acquired. The camera prototype was initially being put together and the camera was being tested on a computer. This did not provide us with success. Later, the team upskilled using a monitor, and now the Raspberry Pi module 2 is set up and connected to a monitor which is up and running and is able to capture pictures with the help of Python programming.

As of now, all of the project's basic research has been completed. Every member of the team is clear about what this project is about and how we plan to accomplish it. The documents related to the academic field are also completed, and the team will further refine and update those documents. In addition, All the project-related documents are written and up to date.

Later in the semester, the team will work on initializing the Raspberry Pi as well as researching possible ways of integrating work done on our personal computers to the Pi. Additionally, the research into how the camera will be worn will be conducted, as well as the collection of data from the Raspberry Pi Camera to increase the accuracy of the model. Before the beginning of part two, more data will be selected for the dataset as preparation, data model training, and hardware setup is planned to be completed before the training time. The team will also individually upskill in Python as it is the most used language on the Raspberry Pi and can be easily used to control its camera module.

In the project we are having issues with the following:

* As of now, we are supposed to finish upskilling in model training. We decided to use Google Collab for the practice, and we have already created all the required folders and uploaded them to the darknet, but there have been some issues during the performance checking, so more work remains.
* We have chosen as a team to defer this milestone to the second sprint after improving our model training skills and studying data sets because we do not yet know the quality of our model and what data would be required to increase its accuracy at this time.
* Considering some of the upskilling topics are extensive and complex, as well as our other commitments affecting our ability to complete the upskilling within the time, we have re-evaluated this and updated it with new deadlines.
* Initially, we had issues with the team with tracking the work progress which have been resolved when our team was given feedback by the mentor to create weekly schedules and weekly reports which had all the progress of the work and the goals being achieved by the individuals. Now, these issues do not exist due to some infrastructure of weekly schedules and weekly reports being set up and collaboration to improve these issues.

**Individual Hours Contributed**

Hours from (11/04/2022) to (27/05/2022)

| **Team Member** | **Hours** | **Skills Gained** |
| --- | --- | --- |
| Julia Borlase | **61** | * Becoming and upskilling about being a product owner * A gained understanding of the raspberry pi * Data labeling for data sets * Proposal and reflective report writing * Organizational skills (with constant updating of team minutes and communicating information between client and team) |
| Sai Gamana Putta | **63** | * Basic understanding of the hardware of the Raspberry pi * Selecting the required hardware for installing the Raspberry Pi and camera setup * Upskilling in setting up the Raspberry Pi to a Monitor then to a Computer. |
| Ray Crescent Garcia | **61** | * Basic Understanding of Raspberry Pi and its Camera Module * Basic upskilling on Python |
| Lingze Meng | **68.5** | * Upskilling model training * Understanding of the principle of model training * Improvement of summarizing and solving problems ability * Writing skills(working, proposal, mid-term review) |
| Haoge Ming | **66** | * Upskilling on dataset collection * More understanding and analysis of detected data for each scenario * Ability to predict the data that might need to be detected for each scenario. * texting ability to summarize and record everything by typing. * A simple understanding of the working principle for RPi lenses. |

**Recommendations for Team**

Project team performance improvement recommendations are based on team issues and challenges. In this project, our team encountered many challenges and problems.

Taking into account the feedback given to us by the mentor, our team discussed the following suggestions:

* We need to learn about the overall plan of our project and not just parts of it.
* Make a complete plan for the entire project cycle.
* The expectations for the project need to be controlled within our achievable range.
* If a member of the team encounters problems, communicate and solve them in time without delay.

In our first few drafts of the proposal, we only planned the part that we needed to complete in front of us, which revealed our lack of understanding of the project. According to the feedback from the mentor, our team concluded that we need to have a complete plan for the project from start to end. In this way, we can clarify what will be achieved in this project.

We adjusted our goal of the projects within our capabilities, during our planning phase, we had too many ideas for the project, which resulted in most of them being included in our project proposal. These ideas were beyond our capabilities and would’ve taken too long to implement. To change this, based on the clients, mentors, and moderators' suggestions and from our team discussions, we choose two achievable deliverables that we are capable of completing.

Previously we would focus on just one task as a group, which greatly reduced our work efficiency. Based on our mentor's advice we began to assign individual work to all the members based on each individual's strengths. By doing so we combined everybody’s strengths together, which increased the productivity of our group, and ensured that everyone has the same contribution to the team.

From our experience, we found that when we had some questions it was best that we record these questions first and then bring them to the team meetings. After summarizing and discussing the questions, they would then be sent to the mentor or client for advice. This proved to be more efficient than asking them directly individually. This can save everyone's time; speed up the progress of our project and also improve our problem-solving ability, because many problems have already been solved during our team discussions.

Suggestions for the problems we face in terms of teamwork:

* Understand what the team needs to do and why.
* Use each person's strengths reasonably to assign work that is suitable for everyone
* Handle conflicts in a timely manner such as disagreements or whether there are two people doing the same job without them knowing

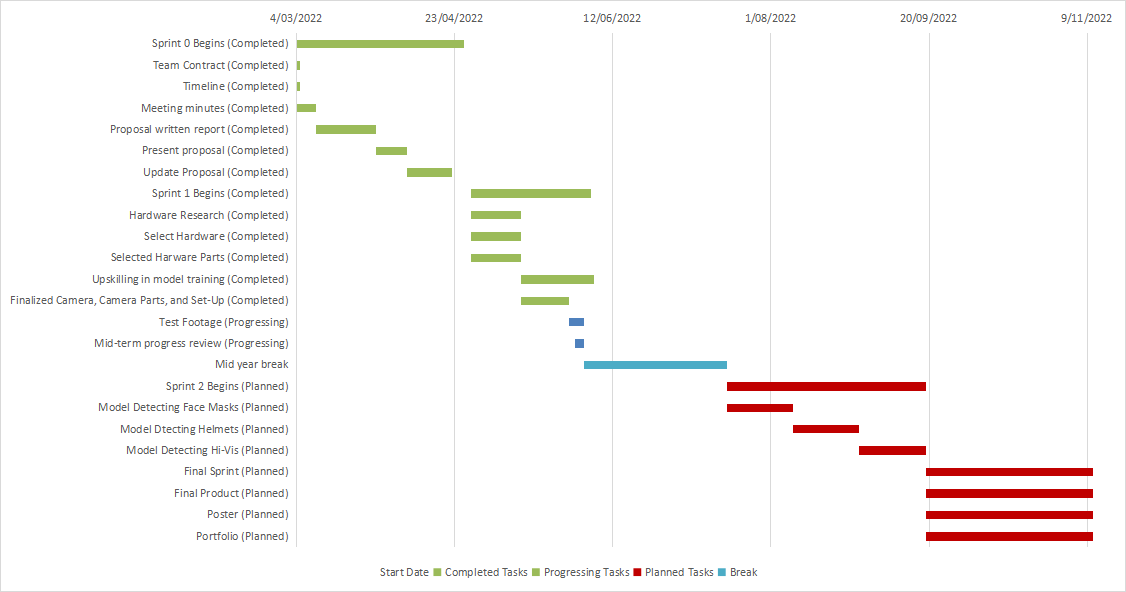
Suggestions for improvement at the technical level:

* Make good use of the school's resources and previous knowledge to help us complete this project.
* Use online resources to learn independently.
* When encountering problems, discuss them with members and record them. After summarizing, ask questions to customers or mentors.

**Updated Schedule**

**Figure 1**

*Project Milestone Gantt Chart*

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*Note:*

* Completed tasks (Green coloured bar)
* Processing tasks (Blue coloured bar)
* Planned tasks in Part 2 (Red-coloured bar)
* Mid-year break (Sky Blue-coloured bar)

As of now, we have already completed the tasks in Sprint 0 & 1. During the previous term, we completed tasks following the timeline strictly. This ensured that we completed the appropriate tasks at the midterm as planned. In this updated schedule, all the completed tasks are displayed as a green coloured bar while the processing tasks are displayed as blue. The planned tasks which will be completed in Part 2 are also listed in the schedule as a red coloured bar. The whole project is expected to end on 9 November assuming our progress strictly follows the timeline on the schedule.