Project Updates: 09-02-2024

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Introduction

- **Supervision Meetings:**
  Consists of a listing in table format of the supervision meetings that have occurred since the last update, including dates, attendees, and a brief description of discussions and actionable items.

- **Actionable Items Recap:**
  Consists of a listing in table format of the actionable items from the previous week, briefly discussing the progress made and pending tasks.

- **Additional Project Updates:**
  Consists of updates that weren't 'actionable items' from the previous week, such as brief overviews of experiments conducted, data collected, and research findings.

- **Next Week's Agenda:**
  Consists of a listing in table format of the actionable items to complete before the next weekly update, including task descriptions, rough timelines, and success metrics.

- **Comments & Concerns:**
  Consists of a brief analysis of comments or observations about other aspects of the project, such as facilities, work environment, and any outside interest in the project. Furthermore, outlines any concerns about the project.

1   09-02-2024

1.1   Supervision Meetings

Date	Agenda	Actionable Items	Attendees
Multiple points across the week with Ben and Paul separately.	• Started to run into a lot of software-related issues: originally installed Ubuntu Server OS for it's lightweight nature (space-wise and processing-wise since it doesn't come with a lot of features built in, which is perfect for reduced power consumption and fast processing time). However, the kernel does not support the Raspberry Pi products of cameras. For that, I'd need Raspberry Pi OS (there is a 'lite' version which is also very lightweight which is what I used), unfortunately, I had to rework a lot of the set-up steps due to various process incompatibilities (mainly networking-related and Pi Camera hardware-related) with RPi OS and Ubuntu OS.	• Once everything is set up, I need to write a script to record bubble footage using the Pi and Pi global shutter camera from the underwater testing facility so that I can fine-tune my benchmarking script.	• Sidharth Shanmugam • Paul Mitchell • Benjamin Henson

Date	Agenda	Actionable Items	Attendees
	• I researched more into the theory of real-time Linux kernels with PREEMPT-RT, I realised that this kernel patch only implements real-time functionalities in the kernel logic to replace time-bound spinlocks with real-time mutexes. This 'apparently' results in a monumental reduction in general OS latency. Normal userspace tasks such as Python scripts that the user can run are usually non-real-time, however, should be more 'snappy' due to not needing to wait for kernel logic to finish before preemption.	• It is possible to write kernel-based software to harness real-time features, but it is difficult, therefore I will stick with Python and userspace code, I will compare the effects of RT with the non-RT kernel with the benchmark script.	

Date	Agenda	Actionable Items	Attendees
	• I have completed a basic Python script that uses the Canny edge detection algorithm to detect backscatter from the GoPro underwater footage that Ben provided. OpenCV Contour detection is used for filling the closed loop edges from the Canny output so that I can overlay black holes on a white background to drive the DLP projector to eliminate backscatter. I have added logic to track real-time metrics such as the time it takes to process each frame, etc. The test footage isn't very good since it has a lot of artifacting, this drastically reduces the Canny's performance and increases the frame processing time.	• I need to focus on perfecting Canny before working on the Contour detection logic. For this, I'd need better test footage, which is what I will be making the recording script for. After that I can look into other types of Contour detection algorithms, perhaps research into segmentation algorithms.	

Date	Agenda	Actionable Items	Attendees
	• I need to start work on the initial report. I have logged a lot of information in my project journal so it shouldn't be too difficult to summarise in a report.	• I will need to create a basic plan on document structure. List out section and summarise the information that will need to go in it. Bring this basic plan to the next supervision meeting and we can refine it further. Will also need to consider the tasks and timelines, can make a simple plan of the overall tasks and we can discuss breaking this down into smaller chunks and giving each an timeline. Paul mentioned to take into account of situations when things don't go to plan by adding sufficient buffers.	

1.2 Actionable Items Recap

Actionable Item	Progress Report	Pending Tasks
More research into PREEMPT-RT and reading into how the bubble region was determined and filled with white from the paper.	• All progress complete for this item, and logged into the proejct journal. • The paper doesn't go into much detail on how the bubble region was segmented after applying Canny.	-
Write benchmark script.	• A simple script with bubble detection with Canny and segmentation with contour detection is complete, albeit very inaccurate.	• I will need to record better test footage to work with for fine-tuning the script before I can improve the bubble segmentation logic and implement bubble tracking and position predictions.
Plan initial report & plan schedule.	• No progress on this.	• Due to running to a lot of software and hardware issues, I ended up with this task in backlog. The software and hardwre problems have been mostly resolved, so I can make an effort on this next week.
Email CoBoS and academic supervisor reg. India visit.	• Done	• The department has acknowledged and approved this visit.

1.3   Additional Project Updates

Additional Update	Description
No additional updates	-

1.4 Next Week's Agenda

Actionable Item	Description	Success Metrics	Target
Script to record footage from RPi and Pi GS camera.	• Write script, test that it works before deployment.	• Make notes in project journal if needed. • Commit code updates to GitHub repository.	Wednesday
Improve bubble segmentation performance in benchmark script	• With the better testing footage, fine-tune the Canny parameters and research into bubble segmentation.	• Log progress in the Project Journal. • Commit code updates to GitHub repository.	Friday
Plan initial report & schedule	• Summarise report sections and outline roughly what content needs to go in each.	• Log progress in the Project Journal.	Tuesday

1.5 Comments & Concerns

No comments or concerns at the moment.