Project Updates: 02-02-2024

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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 02-02-2024

1.1 Supervision Meetings

Date	Agenda	Actionable Items	Attendees
30-01-2024	• Discussed information on the intial report - two main/overall aims have been identified: (a) a reliable backscatter detection program, and (b) real-time compliancy ensuring efficient and reliable processing and operation. • I will be visiting India from the 18th of March to the 5th of April and will return once Easter finishes. This means I will be working remotely from India during term time between the 18th to the 22nd of March.	• I need to research on exactly how the PREEMPT-RT Linux kernel patch works to implement real-time functionality. Especially with what pre-emption means in this context, and whether interpreted programs, such as Python scripts will continue to function, since programs may have to be compiled for real-time compliancy depending on the context of pre-emption. • There is a figure in this paper which shows the Canny edge detection detecting a bubble, the bubble is filled with white on a black background. How was the bubble region calculated and filled with white? A Python script can be written as a benchmark employing the basic methodologies explored in this paper. Try to retrieve some more of the metrics and statistics outlines in the paper to achieve a better understanding.	• Sidharth Shanmugam • Paul Mitchell • Benjamin Henson

Continuation 1/2			
Date	Agenda	Actionable Items	Attendees
30-01-2024	• Discussed real-time aspects, Docker/Jailhouse reserves hardware on time-basis and does not manage the scheduling and priority of tasks so jitter will still be a problem. To reduce jitter, a real-time OS needs to be looked into, however, there aren't many RTOSes with Raspberry Pi support, so a real-time kernel can be explored. • Discussed literature on using basic algorithms such as Canny and the least distance rule to detect and track underwater rising bubbles for environmental analysis. Using basic algorithms and rules such as these will form the best foundation which can act as a benchmark when comparing real-time and hardwre aspects.	• I was planning to reach out to the electronics store to enquire about the ordered components after allowing a week's time if I didn't hear anything from them, however, the components arrived surprisingly fast and I've collected them.	• Sidharth Shanmugam • Paul Mitchell • Benjamin Henson

Continuation 2/2			
Date	Agenda	Actionable Items	Attendees
30-01-2024	• Discussed the steps I took to get the development Raspberry Pi connected to the internet and accessible via SSH from my laptop. The uni network prevents cross-device communication, so I set up W-Fi for internet, and ethernet for SSH comms with my laptop. Easier said than done - this system took an entire evening to get working. • Ordered components on the day of the supervision meeting (new gen Pi, case and PSU for Pi, global shutter camera, HDMI cable, and USB drive to boot OS from). Components arrived on 01-02-2024.	• I need to start laying out an overall plan to how the initial report needs to be structured, I also need to plan out a schedule (with a Gantt chart for example) to create an outline of what needs to be completed and the timeframes. • Paul and Ben are happy with me working remotely from India, as long as my work output is the same quality as me working on-site, however, I do need to let the department know by emailing the Chair of the Board of Studies and my academic supervisor.	• Sidharth Shanmugam • Paul Mitchell • Benjamin Henson

1.2 Actionable Items Recap

1.3 Additional Project Updates

1.4 Next Week's Agenda

1.5 Comments & Concerns

No comments or concerns at the moment.

Actionable Item	Progress Report	Pending Tasks
Expand research and make notes.	• My plan to read the paper that discusses the technical aspects of using Canny to detect bubbles has been read and reviewed. • I think I've collated enough information on bubble detection, however, all the paper's I have read on this are related to the environmental analysis of quantifying bubbles released from sea-floor gas seepages. Gas escaping and rising to the surface of the ocean is very different to the backscatter experienced when recording video from a constantly moving UUV, where debris also forms backscatter alongside bubbles.	• Since I struggled to find papers on detecting and eliminating underwater backscatter, I had to assume that bubbles form most of the backscatter, and if I can build a system that effectively detects bubbles, then I can easily expand it to detect other forms of backscatter. I should develop a benchmarks script that uses the fundamental and basic technologies such as Canny to detect bubbles and the least distance method to track bubbles. This benchmark can help test how effective the bubble detection idea works with detecting other forms of backscatter such as debris.
Compare differences between hypervisors: Jailhouse and Docker.	• I have outlined the differences between the two, use-cases of the two, and their effectiveness in reducing jitter to ensure better real-time complicance in the journal. The main idea was to use one of these tools to reserve hard resources in order to ensure that task latency is as little as possible. • Unfortunately, my research showed that these tools only reserve hardware on a time-basis and cannot isolate hardware completely, furthermore, it cannot manage the scheduling or priority of the tasks, so jitter will be unchanged. • Best option is to implement an RTOS, however, there aren't many that are well documented and support the family of Raspberry Pi boards that I am using for this project, so the next best thing is to apply a real-time patch to the Linux kernel (PREEMPT-RT).	• I need to research more into the PREEMPT-RT patch to understand how it works, its benefits, drawbacks, etc. • I can use the benchmark script (that I need to write) to compare performance differences between the real-time patched kernel and the normal kernel.

Continuation 1/1		
Actionable Item	Progress Report	Pending Tasks
Compare differences between hypervisors: Jailhouse and Docker.	• Best option is to implement an RTOS, however, there aren't many that are well documented and support the family of Raspberry Pi boards that I am using for this project, so the next best thing is to apply a real-time patch to the Linux kernel (PREEMPT-RT).	
Experiment with Canny edge detection for bubble detection	• I have started writing the Python script, taking extra care into the consideration of implementing logic to calculate real-time metrics of the script.	• I need to finish this off.

Additional Update	Description
No additional updates	-

Actionable Item	Description	Success Metrics	Target
More research into PREEMPT-RT and reading into how the bubble region was determined and filled with white from the paper.	• I have collected some literature that should be explored.	• Log details in the project journal.	Monday
Write benchmark script.	• Use basic algorithms such as Canny, least distance method to detect and track bubbles. • Prioritise fast performance over bubble detection/tracking accuracy. • Use underwater GoPro footage provided by Ben.	• Make notes in project journal. • Commit code updates to repository.	Friday
Plan initial report.	• Create an overall plan of report layout.	• Log progress in the Project Journal. • Perhaps create a new document for this report.	Friday
Plan schedule.	• Make an initial draft of the schedule, outlined by a Gantt chart.	• Show Paul and Ben, refine until perfection.	Tuesday
Email CoBoS and academic supervisor reg. India visit.	• Send email.	• If the email has been sent or not.	Monday