



Research Project (IT 4010)
4th year

Research Logbook

TeaBot

Tea Plantation Preservation Using an Intelligent Robot

2023-044

IT20382476

Perera P.V.Y

In partial fulfillment of the requirements for the
Bachelor of Science Special Honors Degree in Information Technology
Specializing in Data Science

30.10.2023

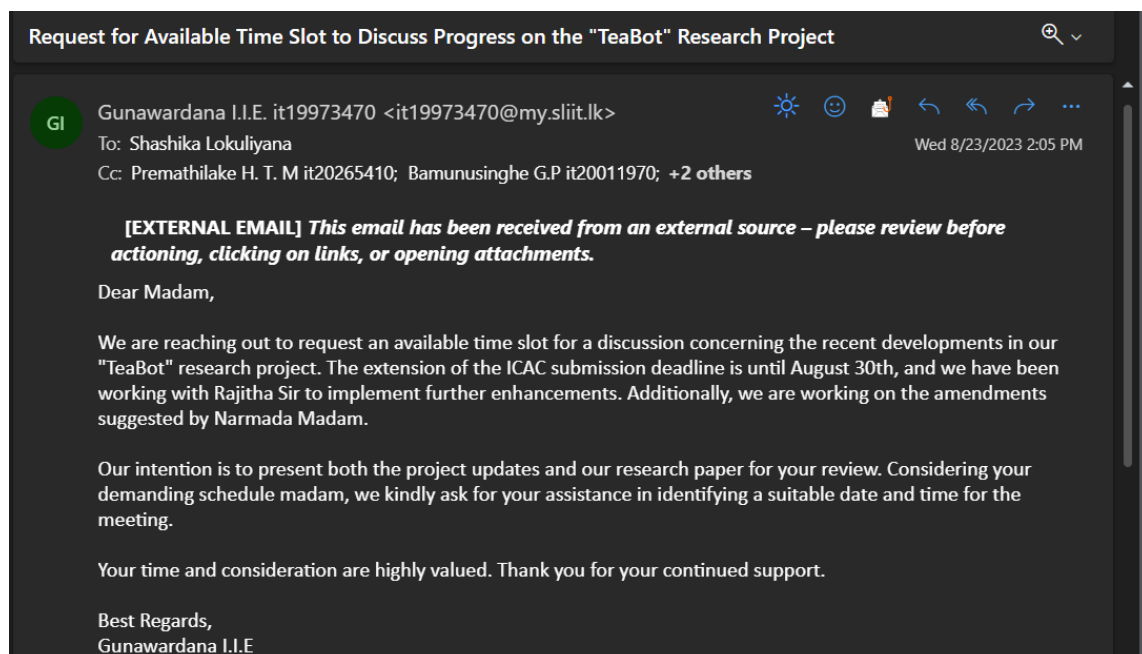
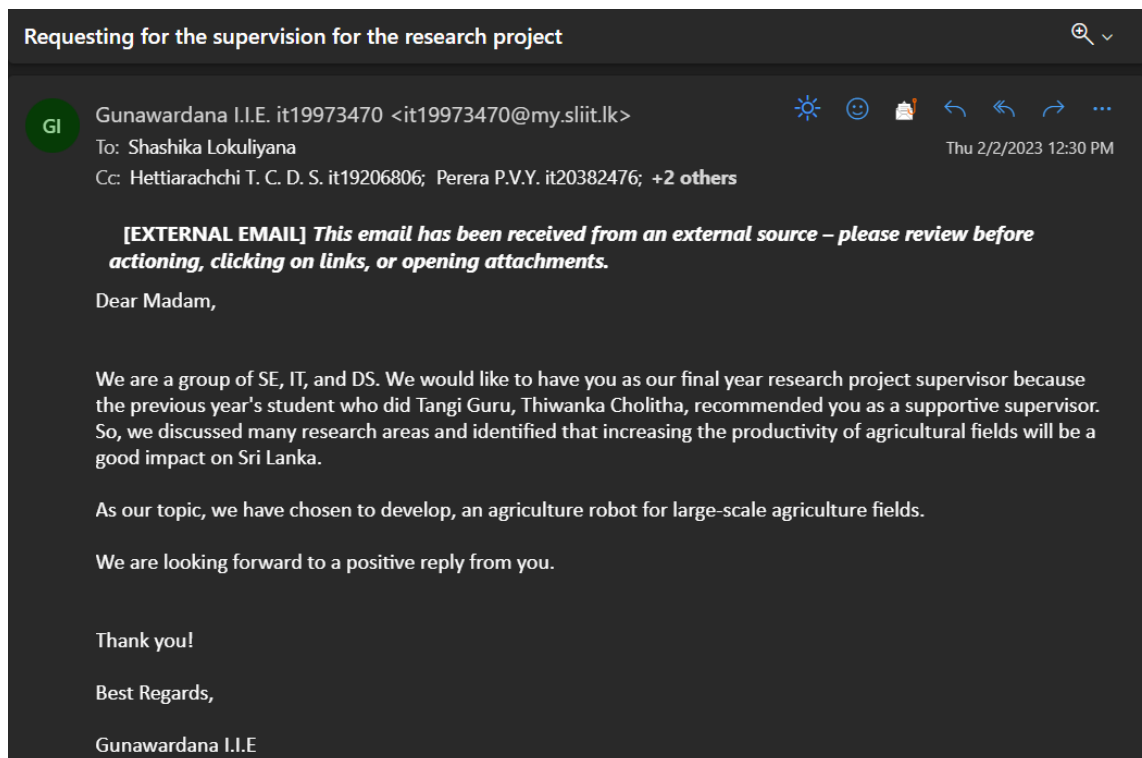
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1 Supervisor, Co-Supervisor, External Supervisor Meetings, Emails, and Messages

1.1 Meetings with Supervisor and co-supervisor



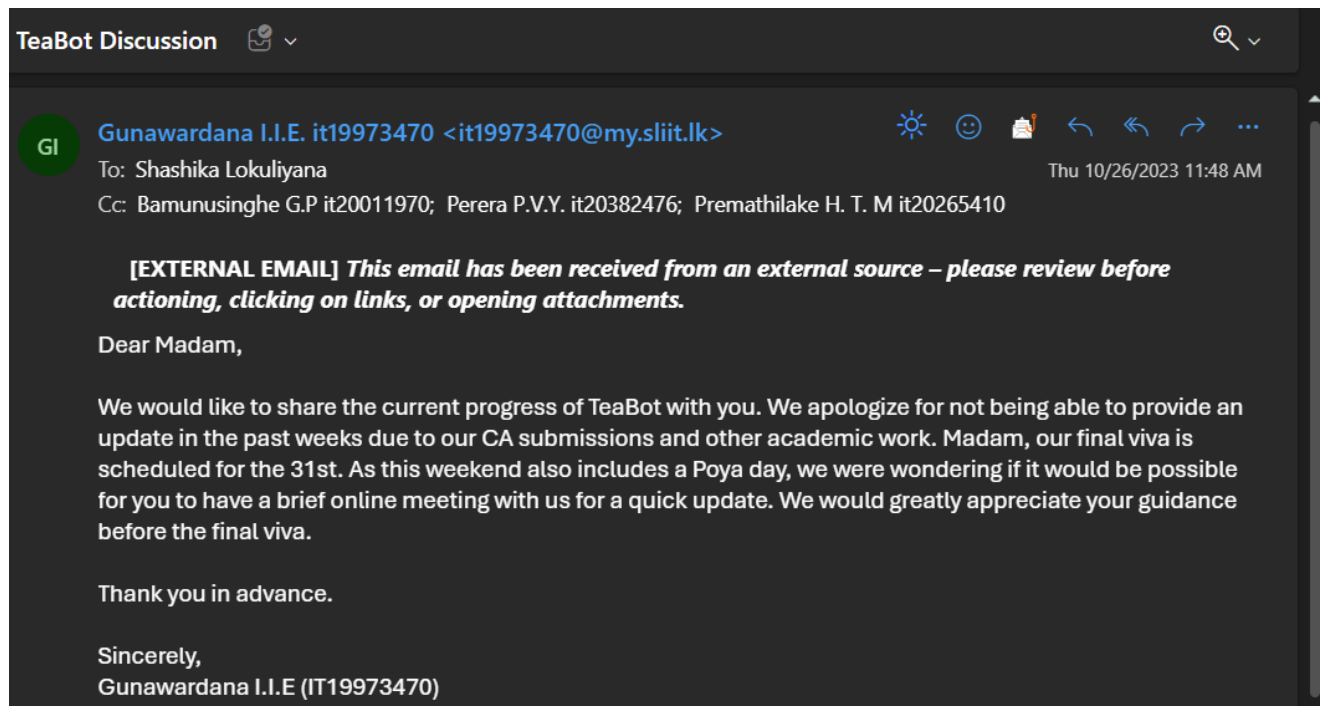


Figure 1.1.1: Final Viva discussion

- In this section, we have included the emails that were sent to our supervisor and co-supervisor, where we requested available time slots for upcoming meetings.

1.2 Meetings with External Supervisor

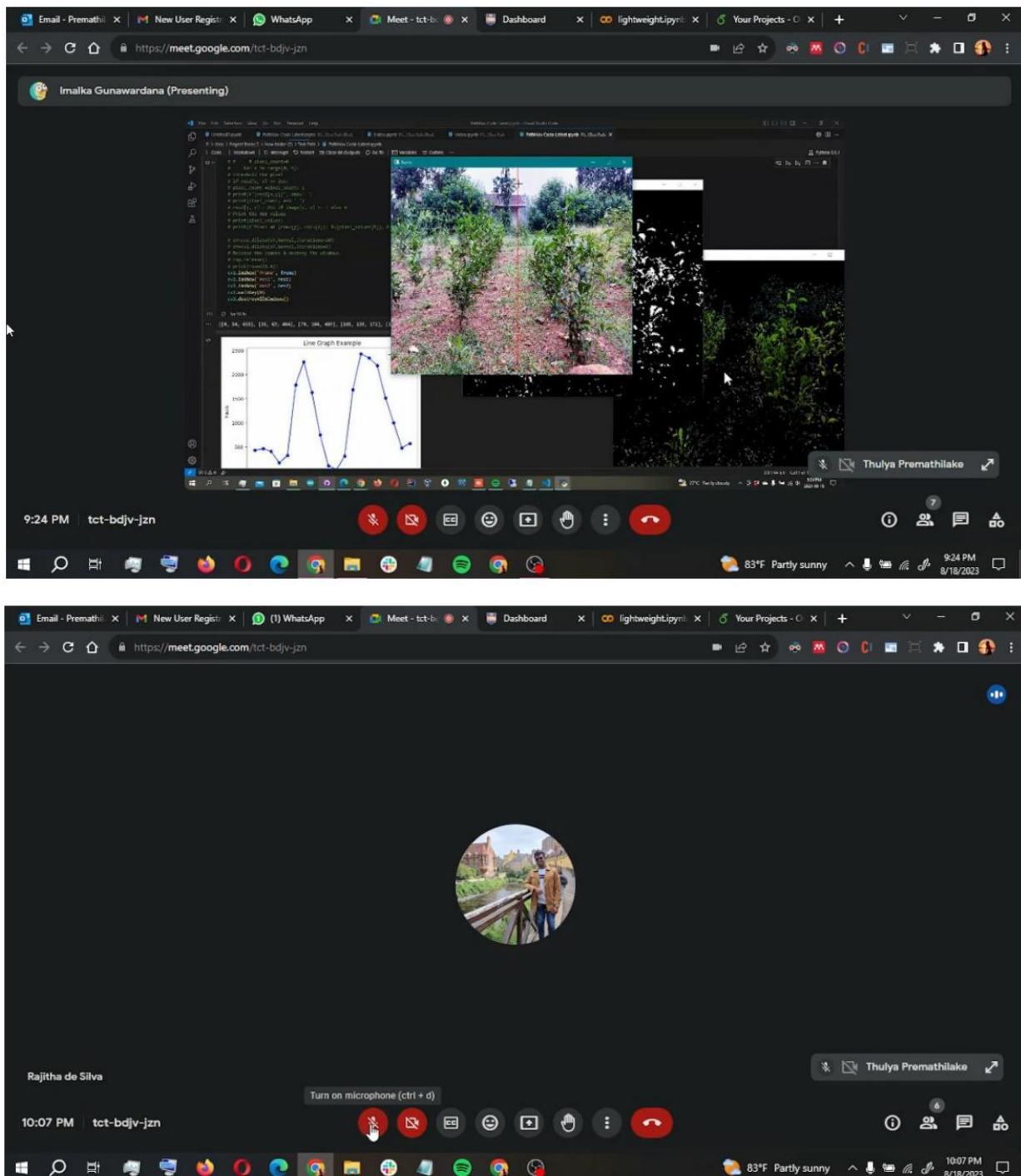
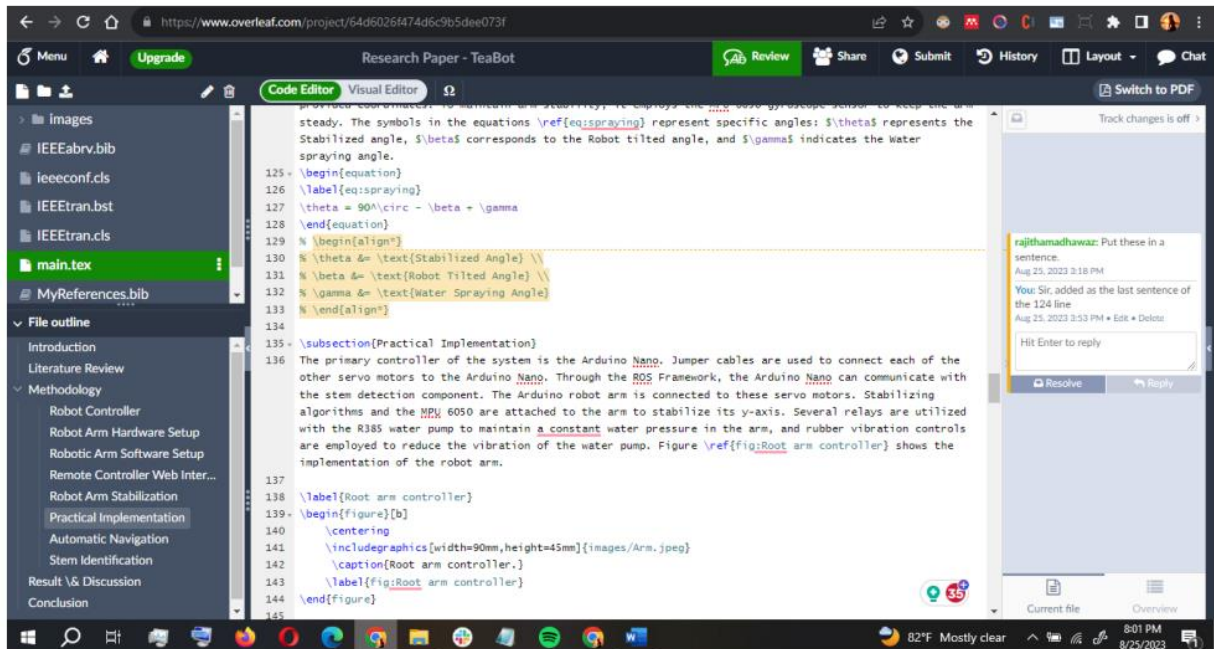


Figure 1.2.1: Components Modification



Research Paper - TeaBot
ICAC
3

I like you to correct before submission. Due to limited time, I will limit my feedback to the most important bits although I think there's more to be fixed if we had more time. Please find the below comments I have grouped section-wise.

- Authors:** Change my affiliation to: Lincoln Agri-Robotics, University of Lincoln, United Kingdom
- Abstract:**
 - Avoid referring too much to Sri Lanka and ceylon tea because it takes away the generality of the paper. Your paper should read like a scientific document and hence, significance of tea in SL could be limited to one sentence with statistical relevance (1st sentence does this job). Remove all the other bits about how good ceylon tea is because they are scientifically irrelevant for the goal of this paper.
 - The abstract also lacks the technicality. Talk about what you have done, your key novelty contributions of this paper.
- Keywords:** Limit to 5 keywords. My suggestion: precision agriculture, computer vision, robotics, machine learning, autonomous navigation
- Introduction:**
 - Avoid repetition of sentences from abstract. Rephrase the 1st sentence.
 - Add a few references in introduction when you talk about GDP, ceylon tea and labour.
 - The last part of introduction reveals too much of your system. The introduction should explain the significance of your research, motivation for doing it, your key outcomes and how you achieved it in generic terms. The system overview, dimensions and other technical bits must be introduced in your methodology section.
 - Add a few bullet points at the end of introduction highlighting your key deliverables of this research. See attached example image.
- Lit. Review:**
 - Remove first sentence. No need to clarify that.
 - The lit. review talks about multiple aspects of your research: navigation, tea plantations, stem detection and etc. Break the lit. review into paragraphs based on these themes.
- Methodology:**
 - In section B: 1800 and 3800? What are these numbers. Add units to these numbers.
 - Equation 2 refers to Excess Green Index (ExG). Mention this and add the corresponding reference.
- Result:** Merge with discussion section and change title to "Results and Discussion"
 - In the discussion, add some examples of good and bad stem detection images and talk about why those bad examples are bad. What environmental challenges may have caused to false detection and how would you improve them in the future.
- Conclusion:**
 - Remove 1st sentence. No need to introduce what conclusion is.
 - The paper lacks a future works section. It is advisable to add a small future works section highlighting the potential improvements to your system. Separate this from conclusion. Future works must come before the conclusion.

I don't expect you to correct all the above suggestions given the limited time. But I strongly advise you to fix as much as you can for a positive outcome. Good luck with the submission!

Best Regards,
Rajitha

Figure 1.2.2: Research Paper Writing

1.3 Meetings with the team

General

Posts

Files

Tasks

+

Meet

Wednesday, June 21, 2023

PI

Premathilake H. T. M it20265410 6/21 10:08 PM

https://drive.google.com/drive/folders/1rKJn0XN3R-nJN6H_Z0FXxVsrBd-3HVL3?usp=sharing

Reply

PI

Premathilake H. T. M it20265410 6/21 10:15 PM

Task	2022	2023											
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Topic Selection													
Requirement Gathering													
Project Charter													
Project Proposal Document													
Project Proposal Presentation													
System Designing													
Implementation													
Progress Presentation 1													
Research Paper													
Testing													
Final Report													
Progress Presentation 2													
Logbook & Website													
Final Presentation													
Final Report													

Reply

Thursday, June 29, 2023

Meeting in "General" ended:

PI

Reply

General

Posts

Files

Tasks

+

Meet

PP2 Slide Deck ended: 1h 16m

Reply

PP2 Slides started

Collapse all

PI

Perera P.V.Y. it20382476 8/27 4:41 PM

Mobile-UNet employs depth-wise separable convolutions and skip-connectors to efficiently capture features in the given inputs. Mobile-UNet's decoder network uses up-sampling feature maps and concatenation with skip connectors to reconstruct high-resolution segmentation maps from the compact feature representations generated by the encoder, ensuring precise navigation path prediction.

See less

Meeting ended: 1h 32m

PI

Reply

General

Posts
Files
Tasks
+

Meet

PI

Premathilake H. T. M it20265410 9/2 6:52 PM
PP2 Slides.pptx

PI

Perera P.V.Y. it20382476 9/2 7:00 PM
Algorithm development for stem identification
calculating the position of the end of the stem
capturing a frame from the video through the webcam

Meeting ended: 3h 56m

Reply

Sunday, September 3, 2023

General started

Collapse all

Recording has started

Recording has stopped. Saving recording...

Meeting
Recorded by: Perera P.V.Y. it203...
3h 9m

This recording is set to expire. View or change the expiration date [here](#). [Learn more](#)

Meeting ended: 12h 20m

Reply

General

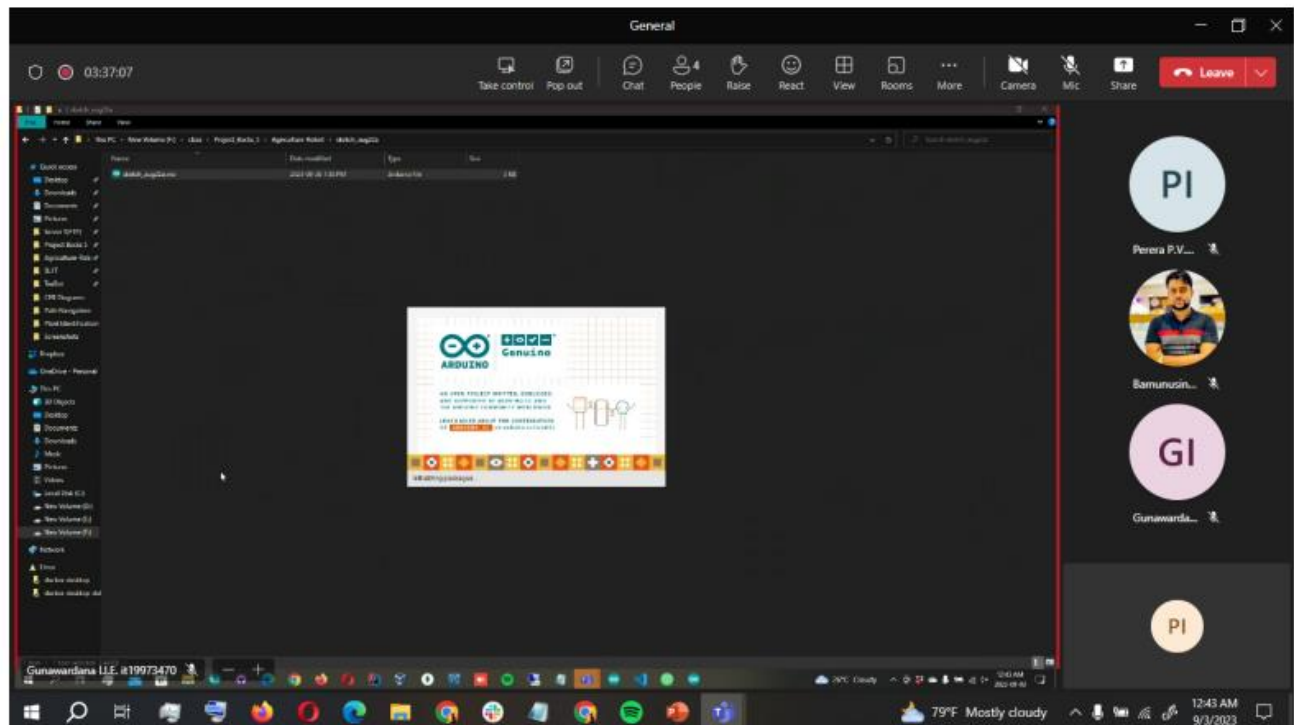
Posts
Files
Tasks
+

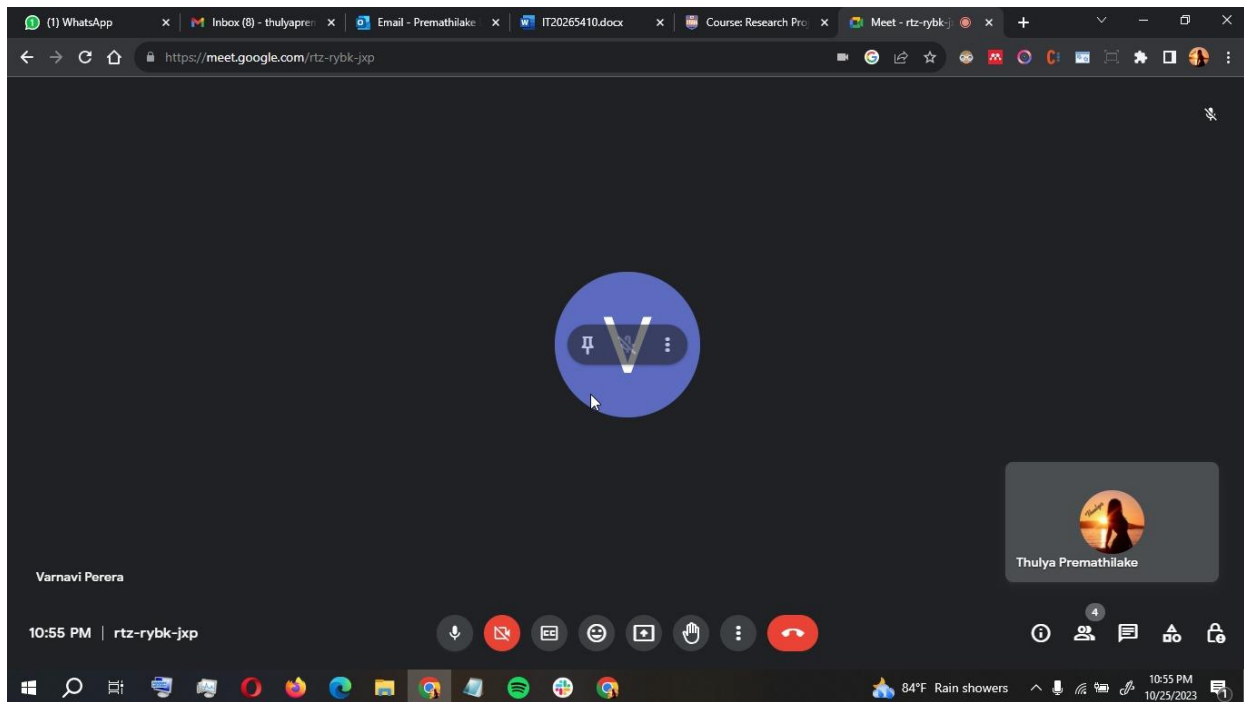
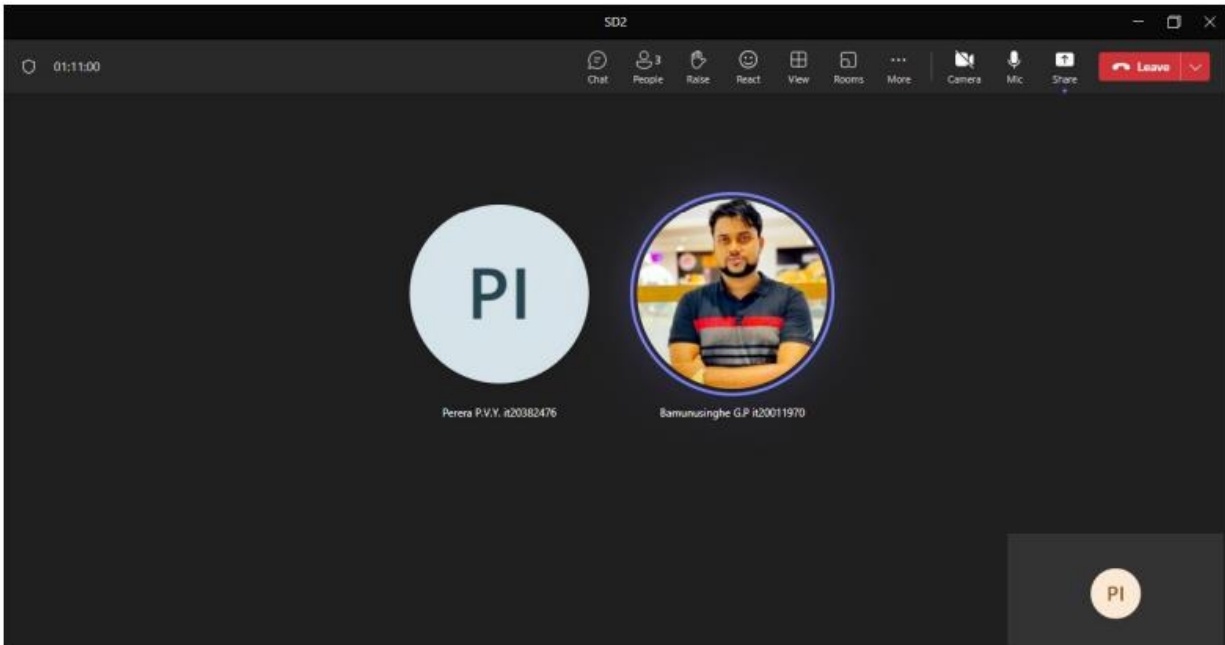
Meet

+ New
Upload
Share
Copy link
Sync
Download
All Documents*

... > General > Bamunusinghe G.P it20011970, Perera P.V.Y. it20382476, Premathilake H. T. M it20265410

Name	Modified	Modified By
Modified By : Premathilake H. T. M it20265410 (1)		
Recordings	March 3	Premathilake H. T. ...
Modified By : Perera P.V.Y. it20382476 (4)		
agri robot.pdf	February 8	Perera P.V.Y. it2038...
IT4010-TAF (2).docx	February 8	Perera P.V.Y. it2038...
TA (1).docx	February 8	Perera P.V.Y. it2038...
TA.docx	February 8	Perera P.V.Y. it2038...
Modified By : Bamunusinghe G.P it20011970 (1)		
Submitted Docs	March 13	Bamunusinghe G.P...





1.4 Emails to the Supervisor

Requesting for the supervision for the research project

Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk>
To: Shashika Lokuliyana
Cc: Hettiarachchi T. C. D. S. it19206806; Perera P.V.Y. it20382476; +2 others

Thu 2/2/2023 12:30 PM

[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

Dear Madam,

We are a group of SE, IT, and DS. We would like to have you as our final year research project supervisor because the previous year's student who did Tangi Guru, Thiwanka Cholitha, recommended you as a supportive supervisor. So, we discussed many research areas and identified that increasing the productivity of agricultural fields will be a good impact on Sri Lanka.

As our topic, we have chosen to develop, an agriculture robot for large-scale agriculture fields.

We are looking forward to a positive reply from you.

Thank you!

Best Regards,

Gunawardana I.I.E

Requesting for the co-supervision for the research project

Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk>
To: Narmada Gamage
Cc: Hettiarachchi T. C. D. S. it19206806; Perera P.V.Y. it20382476; +2 others

Thu 2/2/2023 12:35 PM

[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

Dear Madam,

We are a group of SE, IT, and DS. We would like to have you as our final year research project co-supervisor because the previous year's student who did Tangi Guru, Thiwanka Cholitha, recommended you as a supportive co-supervisor. So, we discussed many research areas and identified that increasing the productivity of agricultural fields will be a good impact on Sri Lanka.

As our topic, we have chosen to develop, an agriculture robot for large-scale agriculture fields.

We are looking forward to a positive reply from you.

Thank you!

Best Regards,

Gunawardana I.I.E

Requesting for an Available Time Slot on 23rd Sunday to Discuss "TeaBot" Research Project



GI

Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk>

To: Shashika Lokuliyana

Cc: Perera P.V.Y. it20382476; Premathilake H. T. M it20265410; Bamunusinghe G.P it20011970



Wed 4/19/2023 11:25 AM

[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

Dear Madam,

You mentioned us previously to meet on 23rd of Sunday after 12:30 PM to discuss the progress of our "TeaBot" research project. Could you kindly let me know if there is any availability on Sunday 23rd to discuss about the research?

Thank you for your time and consideration.

Best regards,

Gunawardana I.I.E (IT19973470)



Discuss the TeaBot Research

Follow up



This event occurred 6 months ago (Sun 4/23/2023 11:45 AM - 12:15 PM)



Microsoft Teams Meeting;
Teams meeting



Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk> invited you Didn't respond 4

Messages

Meeting Details



[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

Discuss the TeaBot Research

Organizer



Gunawardana I.I.E. it19973470
Sent on Friday, 4/21/2023 at 9:23 AM

Didn't respond: 4



Shashika Lokuliyana
Required



Perera P.V.Y. it20382476
Required



Premathilake H. T. M it20265410
Required



Bamunusinghe G.P it20011970
Required

Microsoft Teams meeting

Join on your computer, mobile app or room device
[Click here to join the meeting](#)

Meeting ID: 443 648 677 991

Passcode: rnxrt6

[Download Teams](#) | [Join on the web](#)

Requesting for an Available Time Slot on 14th Sunday to Discuss "TeaBot" Research Project



GI

Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk>



To: Shashika Lokuliyana

Wed 5/10/2023 5:48 PM

Cc: Perera P.V.Y. it20382476; Premathilake H. T. M it20265410; Bamunusinghe G.P it20011970

[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

Dear Madam,

As per the previous discussion, we discussed to meet again on 14th of Sunday to see the progress of our "TeaBot" research project. Could you kindly let me know if there is any availability on Sunday 14th to discuss the research?

Thank you for your time and consideration.

Best regards,

Gunawardana I.I.E (IT19973470)



TeaBot Discussion

Follow up ▾



This event occurred **5 months ago** (Tue 5/16/2023 3:00 PM - 3:30 PM)



Microsoft Teams Meeting;
Teams meeting



Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk> invited you [Declined 1](#), [Didn't respond 3](#)

Messages

Meeting Details



[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

To discuss the teabot research

Microsoft Teams meeting

Join on your computer, mobile app or room device

[Click here to join the meeting](#)

Organizer



Gunawardana I.I.E. it19973470
Sent on Monday, 5/15/2023 at 4:25 PM

▽ No: 1



Shashika Lokuliyana
Required

▽ Didn't respond: 3



Perera P.V.Y. it20382476
Required



Premathilake H. T. M it2026...
Required

TeaBot Discussion

Follow up

This event occurred 4 months ago (Fri 6/2/2023 10:00 AM - 10:30 AM)

Microsoft Teams Meeting;

Teams meeting

Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk> invited you

Didn't respond 4

Messages

Meeting Details

[EXTERNAL EMAIL] This email has been received from an external source. please review before actioning, clicking on links, or opening attachments.

TeaBot Discussion

Microsoft Teams meeting

Join on your computer, mobile app or room device

Click here to join the meeting

Meeting ID: 428 033 701 504

Organizer

GI

Gunawardana I.I.E. it19973470

Sent on Thursday, 6/1/2023 at 4:59 PM

Didn't respond: 4

Shashika Lokuliyana

Required

PI

Perera P.V.Y. it20382476

Required

P

Premathilake H. T. M it20265410

Required

Bamunusinghe G.P it20011970

Required

Research Paper - TeaBot

3

GI

Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk>

To: Shashika Lokuliyana; Narmada Gamage

Cc: Premathilake H. T. M it20265410; Perera P.V.Y. it20382476; Bamunusinghe G.P it20011970

Wed 8/16/2023 10:28 AM

Intelligent Agriculture Robot ...

662 KB

[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

Dear Madam,

I hereby attached the final version (up to now) of the paper. We only submitted the paper to the ICAC. Because of the busy with project work, we were bit late to complete the paper and we had only the time to do only Rajitha sir's comments. But we heard yesterday, the ICAC deadline was extended. So, we hope to do another amendments given by Narmada madam and do some improvements and resubmit the paper to the ICAC.

Madam, shall we arrange a meeting to share the updates on the project? Can you provide us a free date and a time slot to discuss the project? We will explain the source codes and the functionalities of the robot on the meeting day.

Thank you

Regards,
Gunawardana I I E

Request for Available Time Slot to Discuss Progress on the "TeaBot" Research Project



Gunawardana I.I.E. it19973470 <it19973470@my.sliit.lk>



To: Shashika Lokuliyana

Wed 8/23/2023 2:05 PM

Cc: Premathilake H. T. M it20265410; Bamunusinghe G.P it20011970; +2 others

[EXTERNAL EMAIL] This email has been received from an external source – please review before actioning, clicking on links, or opening attachments.

Dear Madam,

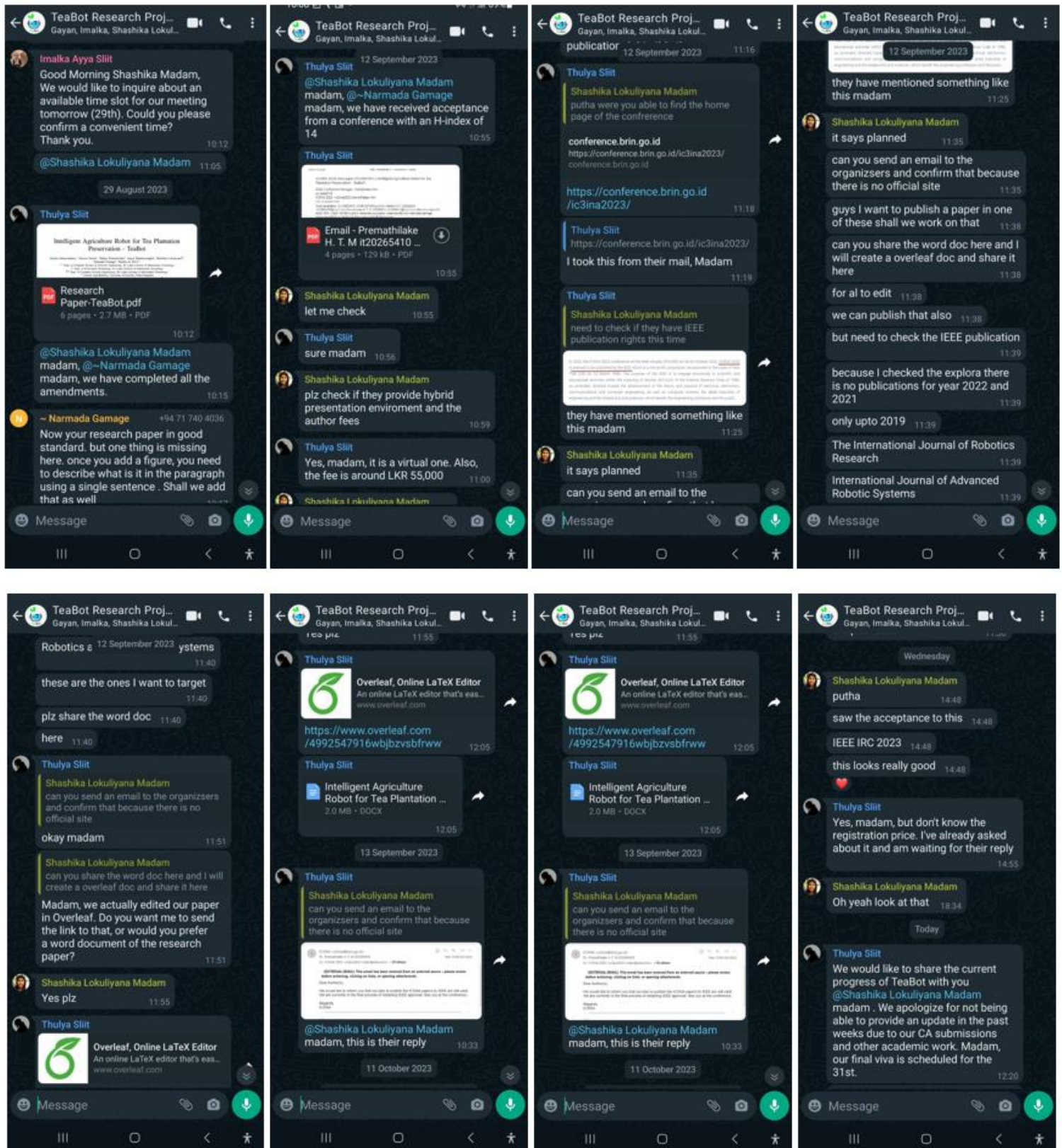
We are reaching out to request an available time slot for a discussion concerning the recent developments in our "TeaBot" research project. The extension of the ICAC submission deadline is until August 30th, and we have been working with Rajitha Sir to implement further enhancements. Additionally, we are working on the amendments suggested by Narmada Madam.

Our intention is to present both the project updates and our research paper for your review. Considering your demanding schedule madam, we kindly ask for your assistance in identifying a suitable date and time for the meeting.

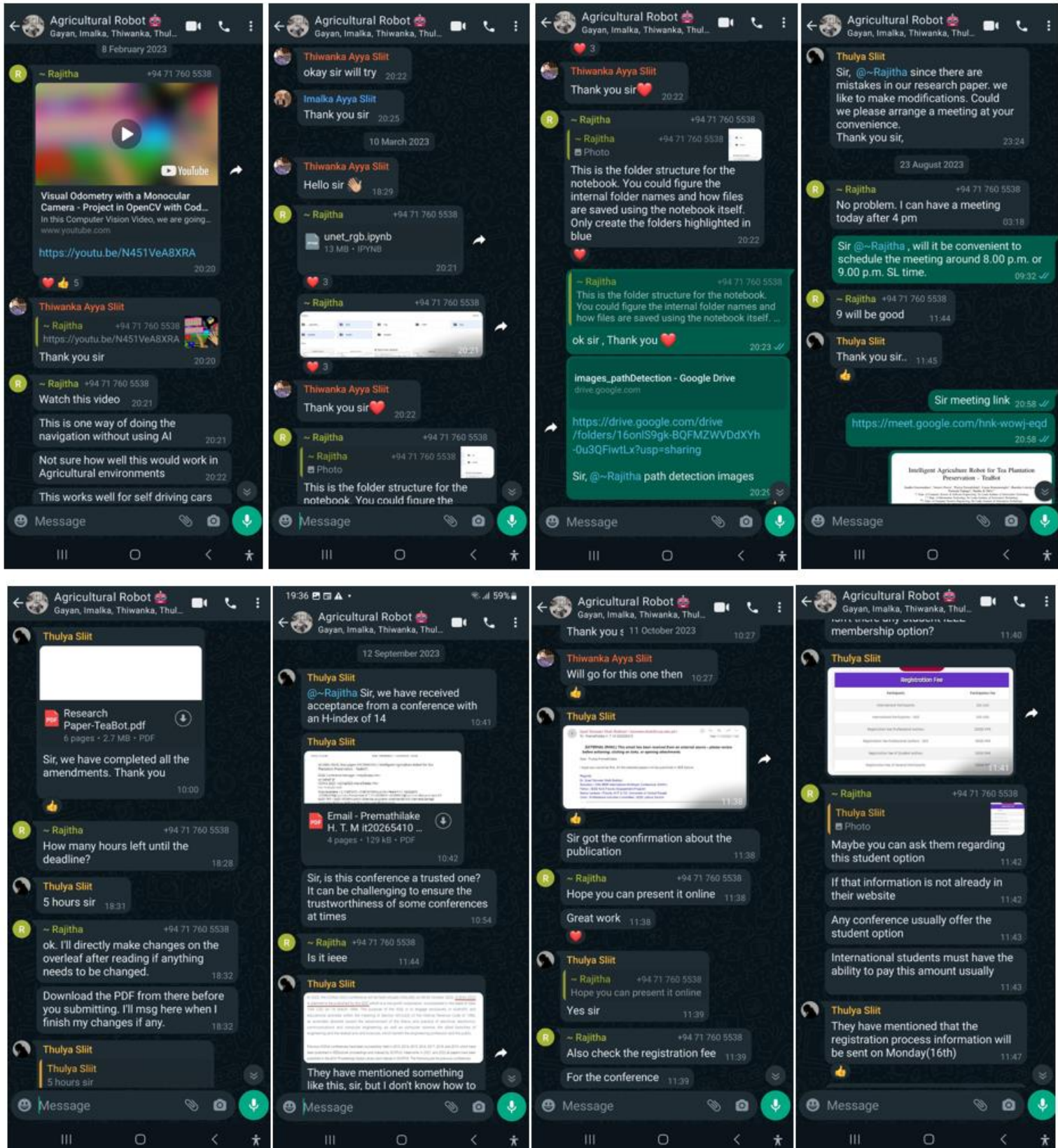
Your time and consideration are highly valued. Thank you for your continued support.

Best Regards,
Gunawardana I.I.E

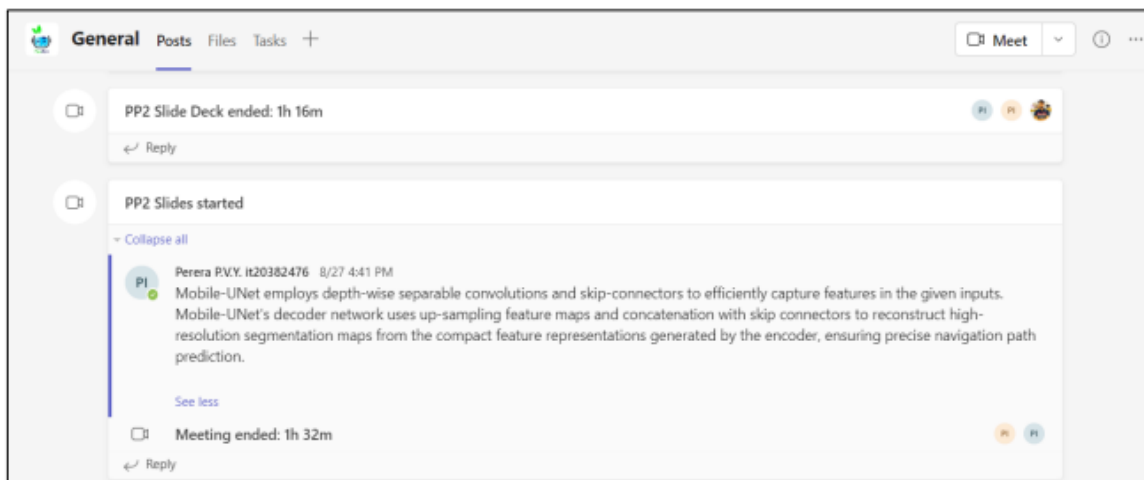
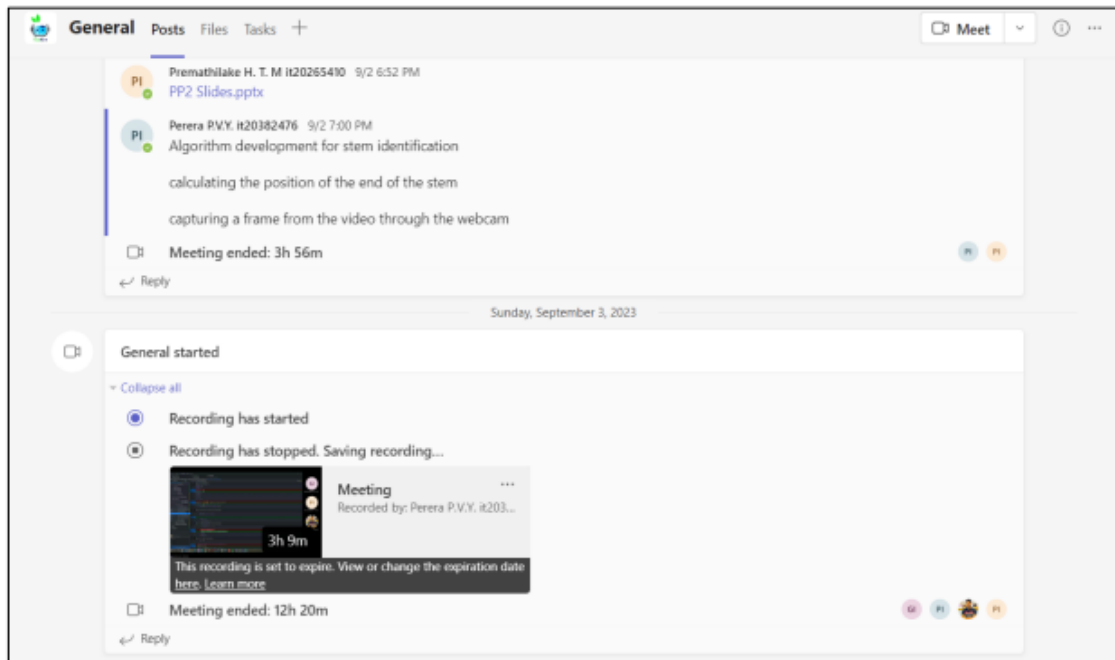
1.5.1 Messages with the supervisor



1.5.2 Messages with the External Supervisor



1.5.3 Messages in the official TeaBot Group



2 Individual Project Logs

2.1 MS Planner

The screenshot shows the MS Planner interface for the 'General' channel. The 'Tasks' tab is selected, and the view is set to 'Board'. The tasks are organized into three buckets: Studying, Development, and Documentation. Each bucket has an 'Add task' button and a list of tasks with their due dates and assignees. The 'Studying' bucket has 18 completed tasks, 'Development' has 1, and 'Documentation' has 8.

Bucket	Task Name	Due Date	Assignees	Status
Studying	Submit Thesis - Proof read	11/27	GI, P, +1	Pending
	Publish Paper	11/06	GI, P, +1	Pending
	Testing the developed path navigation program in various scenarios and optimizing the code		PI	Completed
Development	Project Website	11/06	GI, P, +1	Pending
	Developing the UNet model		PI	Completed
Documentation	Research Logbook	10/30	GI, P, +1	Pending
	Final Report - IT20382476		PI	Completed
	Project Status Document 2 - IT20382476		PI	Completed
	Research Paper		P	Completed
	Project Status Document 1 - IT20382476		PI	Completed
	Research Paper		P	Completed
	Project Status Document 2 - IT20382476		PI	Completed
	Project Status Document 1 - IT20382476		PI	Completed

The screenshot shows the MS Planner interface for the 'General' channel, continuing from the previous view. The 'Tasks' tab is selected, and the view is set to 'Board'. The tasks are organized into three buckets: Documentation, Presentation, and Testing. Each bucket has an 'Add task' button and a list of tasks with their due dates and assignees. The 'Documentation' bucket has 8 completed tasks, 'Presentation' has 3, and 'Testing' has 2.

Bucket	Task Name	Due Date	Assignees	Status
Documentation	Research Logbook	10/30	GI, P, +1	Pending
	Final Report - IT20382476		PI	Completed
	Project Status Document 2 - IT20382476		PI	Completed
	Research Paper		P	Completed
	Project Status Document 1 - IT20382476		PI	Completed
	Research Paper		P	Completed
	Project Status Document 2 - IT20382476		PI	Completed
	Project Status Document 1 - IT20382476		PI	Completed
Presentation	Final Presentation and Viva	10/31	GI, P, +1	Pending
	Progress Presentation - I		PI	Completed
	Progress Presentation - II		PI	Completed
Testing	Testing the ML models in the testing field		GI	Completed
	UNet Model testing		PI	Completed

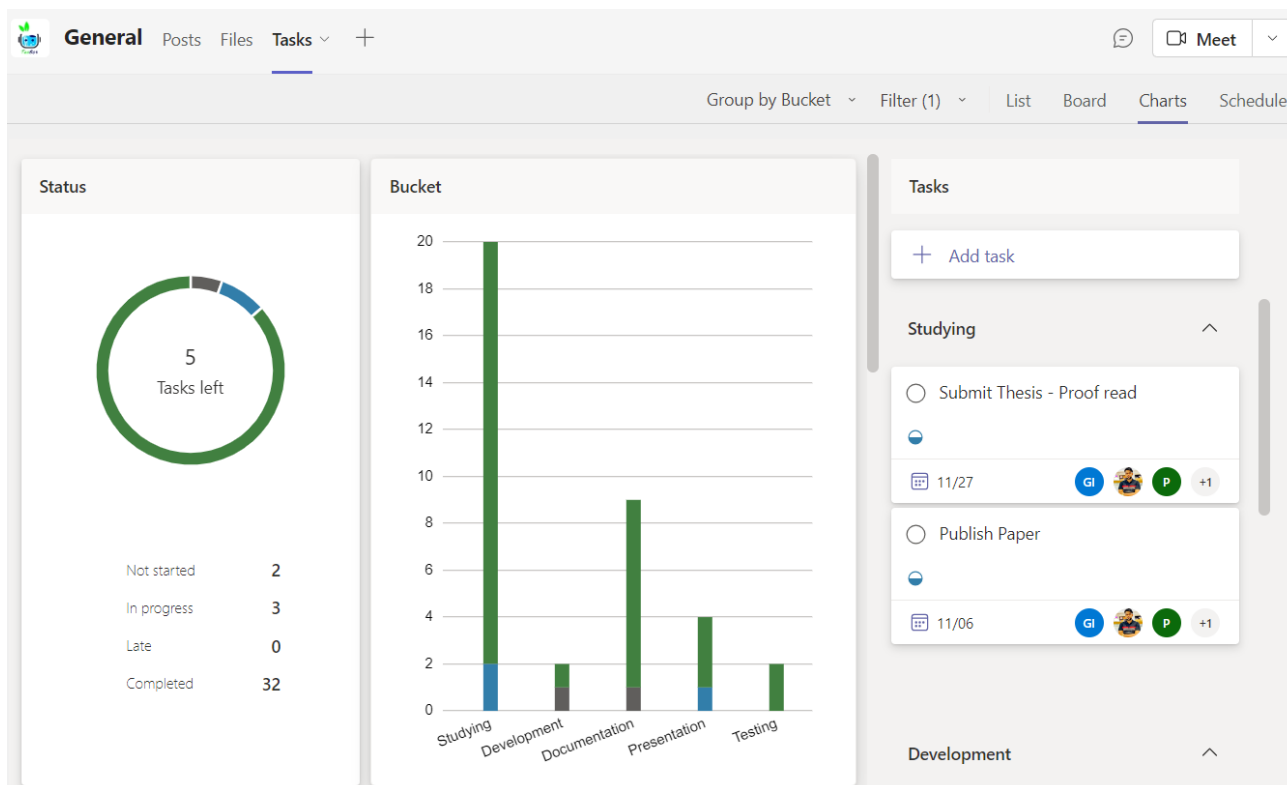


Figure 2.1.2: Chart View of Tasks

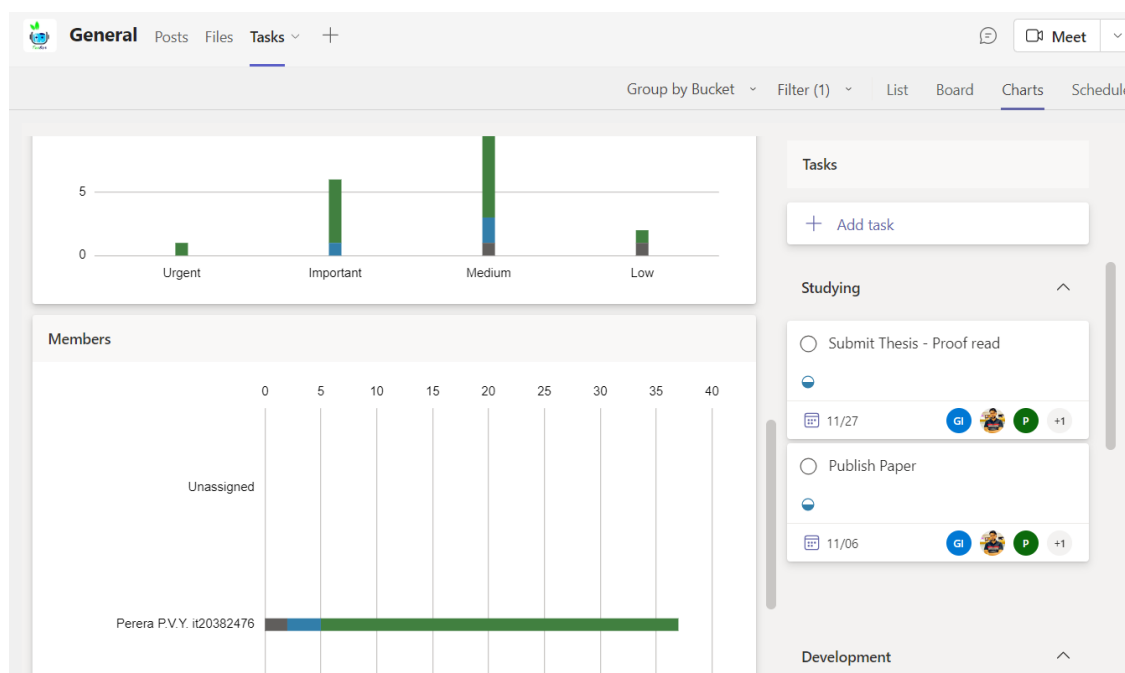
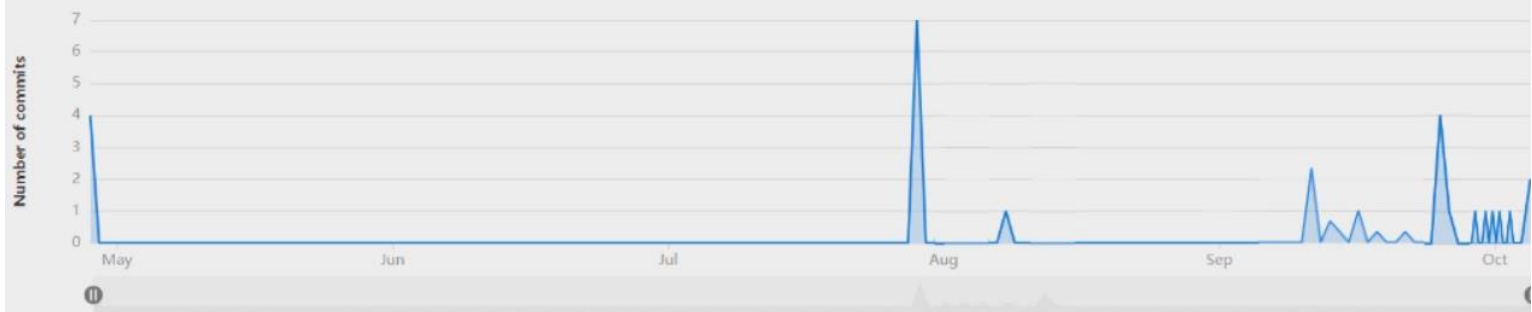


Figure 2.1.1: Completed Tasks on Teams Charts

2.2 Git Lab

Commits to it20382476_varnavi

Excluding merge commits. Limited to 6,000 commits.



3 Monthly Progress

3.1 2022 November 1st to 30th

- In November, the process of selecting research topics for our project began, as the submission deadline was approaching on February 10th. On November 10th, 2022, we had our first Research Project Lecture, which marked the official start of our research journey.
- To initiate the topic selection process, we used mind maps to explore various research areas and potential components that we could investigate. Simultaneously, we embarked on the task of identifying potential supervisors, co-supervisors, and external supervisors who could guide us in our research endeavors.
- Throughout the month, we engaged in extensive discussions with potential supervisors, presenting and deliberating on each proposed research topic and its associated components. These discussions were crucial in helping us make an informed decision about the most suitable research topic to pursue.
- After careful consideration and input from our mentors, we ultimately settled on a specific research topic. With the topic chosen, we solidified the scope of our research team and prepared to move forward with this focused area of investigation.
- In addition to topic selection, we also recognized the importance of team improvement and cohesion. To assess our strengths, weaknesses, opportunities, and threats, we conducted a SWOT analysis. This allowed us to identify areas where our team needed improvement and formulate strategies to address these shortcomings.
- By the end of November, we were well-prepared with a chosen research topic and a clear understanding of how to move forward as a research team, ensuring that our work would be both original and well-structured to avoid plagiarism.

3.2 2022 January 1st to 31st

- The deadline for submitting the topic evaluation was set for January 20th. Consequently, we began the preparations for this evaluation process on December 1st. During this time frame, we meticulously refined the topic evaluation document, ensuring that it met all the necessary requirements. On the 20th of January, we successfully submitted the document and eagerly awaited the results of the topic evaluation. Upon receiving the results, we were pleased to find that our project had been accepted with only minor changes required. We promptly engaged in discussions with our supervisors to gain a deeper understanding of the feedback and recommendations provided. Subsequently, we made the necessary adjustments to address the minor changes and improve our project's quality.
- Having addressed the feedback and revisions, we turned our attention to the creation of the project charter. This phase began on January 21st, setting the stage for the next steps in our research journey.



IT4010 – Research Project - 2023 Topic Assessment Form

Project ID : TMP-23-044

1. Topic (12 words max)

"TeaBot" – Tea plantation preservation using an intelligent robot.

2. Research group the project belongs to

Autonomous Intelligent Machines and Systems (AIMS)

3. Research area the project belongs to

Robotics (R)

4. If a continuation of a previous project:

Project ID	
Year	

5. Team member details

Student Name	Student ID	Specialization
Leader: Gunawardana I.I.E	IT19973470	SE
Member 2: Bamunusinghe G.P	IT20011970	SE
Member 3: Premathilake H.T.M	IT20265410	IT
Member 4: Perera P.V.Y	IT20382476	DS

- Following the selection of our research topic with minor adjustments, we proceeded to create the project charter and the required cover sheet for submission by January 30th. Once these documents were successfully submitted, we shifted our focus to the creation of the proposal draft, which is due by March 24th.



Sri Lanka Institute of Information Technology

PROJECT REGISTRATION FORM

(This form should be completed and uploaded to the Cloud space on or before XXXXXXXXX)

The purpose of this form is to allow final-year students of the B.Sc. (Hon) degree program to enlist in the final-year project group. Enlisting in a project entails specifying the project title and the details of four members in the group, the internal supervisor (compulsory), the external supervisor (may be from the industry), and indicating a brief description of the project. The description of the project entered on this form will not be considered as the formal project proposal. It should however indicate the scope of the project and provide the main potential outcome.

PROJECT TITLE
(As per the accepted
Topic Assessment Form)

TeaBot: Tea plantation preservation using an intelligent robot

RESEARCH GROUP
(As per the Topic
Assessment Form)

Robotics & Intelligent Systems

PROJECT NUMBER

(Will be assigned by the RP Team)

PROJECT GROUP MEMBER DETAILS: (Please start with the group leader's details)

	STUDENT NAME	STUDENT NO.	CONTACT NO.	EMAIL ADDRESS
1	Gunawardana I.I.E	IT19973470	077 678 8890	it19973470@my.sliit.lk
2	Perera P.V.Y	IT20382476	071 881 8052	it20382476@my.sliit.lk
3	Premathilake H.T.M	IT20265410	076 553 5277	it20265410@my.sliit.lk
4	Bamunisinghe G.P	IT20011970	076 640 9484	it20011970@my.sliit.lk

SUPERVISOR, CO_SUPERVISOR Details

SUPERVISOR Name	CO-SUPERVISOR Name
Ms. Shashika Lokuliyana	Ms. Narmada Gamage
Signature	Signature
Attach the email as Appendix 1	Attach the email as Appendix 1
24.03.2023	24.03.2023
Date	Date

EXTERNAL SUPERVISOR Details (If any, may be from the industry)

				Attach the email as Appendix 3
Name	Affiliation	Contact Address	Contact Numbers	Signature/Date
Mr. Rajitha De Silva	University of Lincoln	rajitha@ieee.org	0717605538	<i>Rajitha</i>

ACCEPTANCE BY CDAP MEMBER (This part will be filled by the RP team)

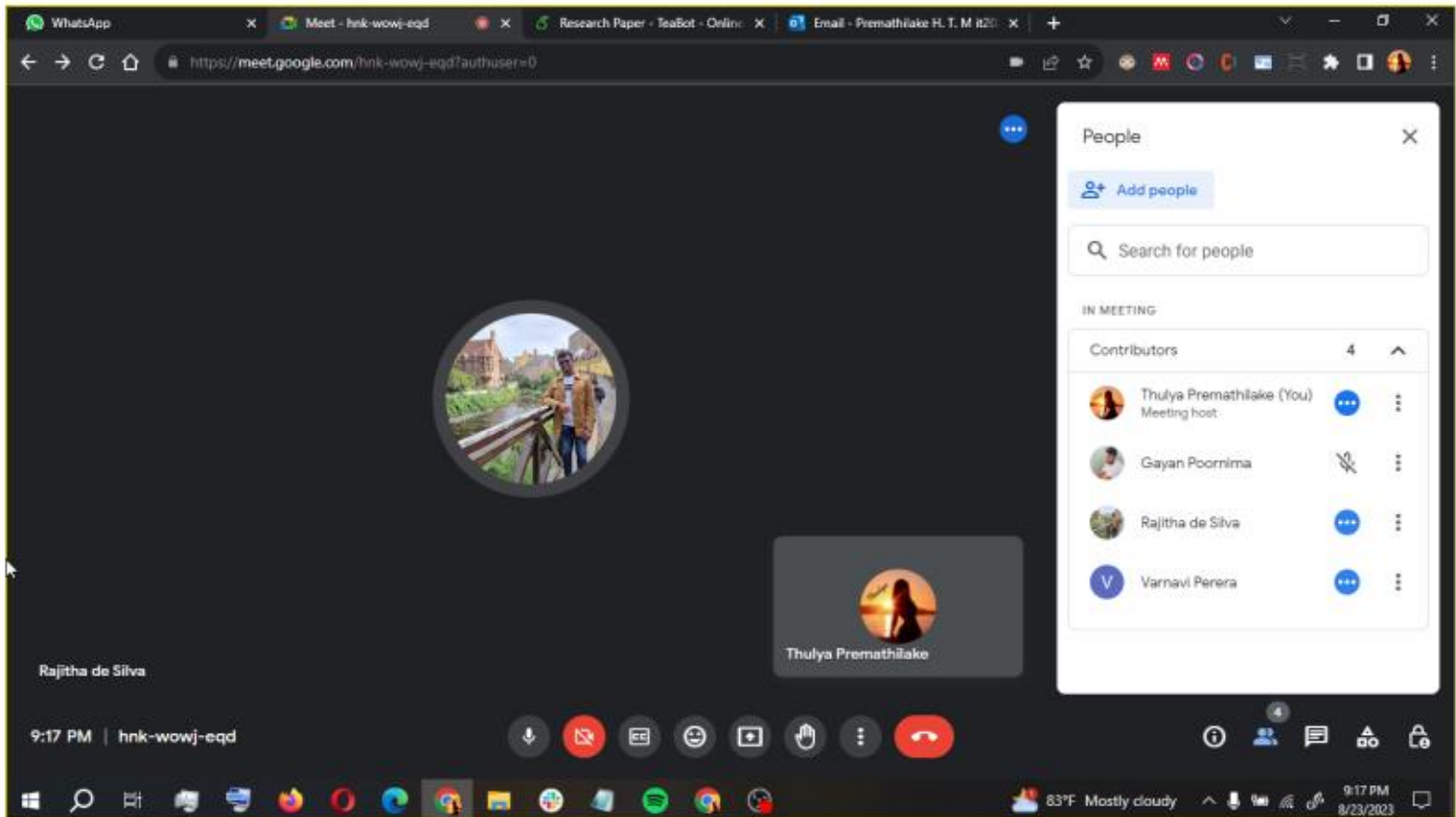
Name	Signature	Date

Figure 3.2.2: Project Cover Sheet

- After the proposal draft document slides were created to do the proposal presentations because the presentations were on the 27th of March.

3.3 February 1st to 28th

- The proposed solution is weighted with computer vision artificial intelligence around half of the project. Necessary knowledge is gathered in this step.
- In this month we got ready for our proposal presentation which will be held on 27th March.



3.4 2023 March 1st - 31st

- The proposal presentation was held on the 27th of March 2023, and the proposal report was prepared during this phrase.
- The panel approval was received for the project.
- The report was submitted.
- In the later part of the month implementation of the project is carried out.

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 32, 32, 3)]	0	[]
conv2d (Conv2D)	(None, 32, 32, 64)	1792	['input_1[0][0]']
conv2d_1 (Conv2D)	(None, 32, 32, 64)	36928	['conv2d[0][0]']
max_pooling2d (MaxPooling2D)	(None, 16, 16, 64)	0	['conv2d_1[0][0]']
conv2d_2 (Conv2D)	(None, 16, 16, 128)	73856	['max_pooling2d[0][0]']
conv2d_3 (Conv2D)	(None, 16, 16, 128)	147584	['conv2d_2[0][0]']
max_pooling2d_1 (MaxPooling2D)	(None, 8, 8, 128)	0	['conv2d_3[0][0]']
conv2d_4 (Conv2D)	(None, 8, 8, 256)	295168	['max_pooling2d_1[0][0]']
conv2d_5 (Conv2D)	(None, 8, 8, 256)	590080	['conv2d_4[0][0]']
max_pooling2d_2 (MaxPooling2D)	(None, 4, 4, 256)	0	['conv2d_5[0][0]']
conv2d_6 (Conv2D)	(None, 4, 4, 32)	73760	['max_pooling2d_2[0][0]']
conv2d_7 (Conv2D)	(None, 4, 4, 32)	9248	['conv2d_6[0][0]']
dropout (Dropout)	(None, 4, 4, 32)	0	['conv2d_7[0][0]']
max_pooling2d_3 (MaxPooling2D)	(None, 2, 2, 32)	0	['dropout[0][0]']
conv2d_8 (Conv2D)	(None, 2, 2, 1024)	295936	['max_pooling2d_3[0][0]']
conv2d_9 (Conv2D)	(None, 2, 2, 1024)	943808	['conv2d_8[0][0]']
dropout_1 (Dropout)	(None, 2, 2, 1024)	0	['conv2d_9[0][0]']
up_sampling2d (UpSampling2D)	(None, 4, 4, 1024)	0	['dropout_1[0][0]']
conv2d_10 (Conv2D)	(None, 4, 4, 32)	131104	['up_sampling2d[0][0]']
concatenate (Concatenate)	(None, 4, 4, 64)	0	['dropout[0][0]',

conv2d_12 (Conv2D)	(None, 4, 4, 32)	9248	['conv2d_11[0][0]']
up_sampling2d_1 (UpSampling2D)	(None, 8, 8, 32)	0	['conv2d_12[0][0]']
conv2d_13 (Conv2D)	(None, 8, 8, 256)	33024	['up_sampling2d_1[0][0]']
concatenate_1 (Concatenate)	(None, 8, 8, 512)	0	['conv2d_5[0][0]', 'conv2d_13[0][0]']
conv2d_14 (Conv2D)	(None, 8, 8, 256)	1179904	['concatenate_1[0][0]']
conv2d_15 (Conv2D)	(None, 8, 8, 256)	590080	['conv2d_14[0][0]']
up_sampling2d_2 (UpSampling2D)	(None, 16, 16, 256)	0	['conv2d_15[0][0]']
conv2d_16 (Conv2D)	(None, 16, 16, 128)	131200	['up_sampling2d_2[0][0]']
concatenate_2 (Concatenate)	(None, 16, 16, 256)	0	['conv2d_3[0][0]', 'conv2d_16[0][0]']
conv2d_17 (Conv2D)	(None, 16, 16, 128)	295040	['concatenate_2[0][0]']
conv2d_18 (Conv2D)	(None, 16, 16, 128)	147584	['conv2d_17[0][0]']
up_sampling2d_3 (UpSampling2D)	(None, 32, 32, 128)	0	['conv2d_18[0][0]']
conv2d_19 (Conv2D)	(None, 32, 32, 64)	32832	['up_sampling2d_3[0][0]']
concatenate_3 (Concatenate)	(None, 32, 32, 128)	0	['conv2d_1[0][0]', 'conv2d_19[0][0]']
conv2d_20 (Conv2D)	(None, 32, 32, 64)	73792	['concatenate_3[0][0]']
conv2d_21 (Conv2D)	(None, 32, 32, 64)	36928	['conv2d_20[0][0]']
conv2d_22 (Conv2D)	(None, 32, 32, 2)	1154	['conv2d_21[0][0]']
conv2d_23 (Conv2D)	(None, 32, 32, 1)	3	['conv2d_22[0][0]']

=====

Total params: 13,642,917
Trainable params: 13,642,917
Non-trainable params: 0

loading data

3.5 2023 April 1st to 30th

- After getting the panel approval the implementation was started. Initially the dataset was created for the machine learning models.
- We visited several tea estates and collected videos of the tea plantation navigation path. The frames were split using the videos.
- Around 1000 frames were created in this stage.
- Preprocessing technics were applied for this frame, and the images were converted into black and white format.

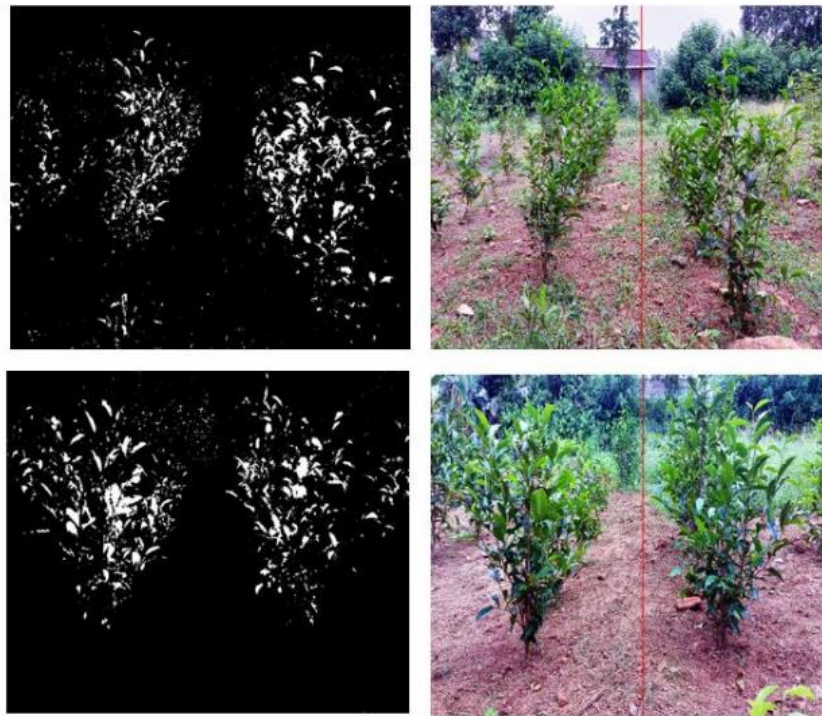


Figure 3.5.1: Preprocessed images and original frames

3.6 2023 May 1st to 31st

- Using the Dataset U-Net semantic segmentation model was built. The model was trained and tested it has around 88% accuracy.
- On the 22nd we has our PP1 presentation for this presentation, the center path detection using U-Net sematic segmentation model was completed and the center path was detected.

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	(None, 32, 32, 3)	0	[]
conv2d (Conv2D)	(None, 32, 32, 64)	1792	['input_1[0][0]']
conv2d_1 (Conv2D)	(None, 32, 32, 64)	36928	['conv2d[0][0]']
max_pooling2d (MaxPooling2D)	(None, 16, 16, 64)	0	['conv2d_1[0][0]']
conv2d_2 (Conv2D)	(None, 16, 16, 128)	73856	['max_pooling2d[0][0]']
conv2d_3 (Conv2D)	(None, 16, 16, 128)	147584	['conv2d_2[0][0]']
max_pooling2d_1 (MaxPooling2D)	(None, 8, 8, 128)	0	['conv2d_3[0][0]']
conv2d_4 (Conv2D)	(None, 8, 8, 256)	295168	['max_pooling2d_1[0][0]']
conv2d_5 (Conv2D)	(None, 8, 8, 256)	590080	['conv2d_4[0][0]']
max_pooling2d_2 (MaxPooling2D)	(None, 4, 4, 256)	0	['conv2d_5[0][0]']
conv2d_6 (Conv2D)	(None, 4, 4, 32)	73760	['max_pooling2d_2[0][0]']
conv2d_7 (Conv2D)	(None, 4, 4, 32)	9248	['conv2d_6[0][0]']
dropout (Dropout)	(None, 4, 4, 32)	0	['conv2d_7[0][0]']
max_pooling2d_3 (MaxPooling2D)	(None, 2, 2, 32)	0	['dropout[0][0]']
conv2d_8 (Conv2D)	(None, 2, 2, 1024)	295936	['max_pooling2d_3[0][0]']
conv2d_9 (Conv2D)	(None, 2, 2, 1024)	9438208	['conv2d_8[0][0]']
dropout_1 (Dropout)	(None, 2, 2, 1024)	0	['conv2d_9[0][0]']
up_sampling2d (UpSampling2D)	(None, 4, 4, 1024)	0	['dropout_1[0][0]']
conv2d_10 (Conv2D)	(None, 4, 4, 32)	131104	['up_sampling2d[0][0]']
concatenate (Concatenate)	(None, 4, 4, 64)	0	['dropout[0][0]',

conv2d_12 (Conv2D)	(None, 4, 4, 32)	9248	['conv2d_11[0][0]']
up_sampling2d_1 (UpSampling2D)	(None, 8, 8, 32)	0	['conv2d_12[0][0]']
conv2d_13 (Conv2D)	(None, 8, 8, 256)	33024	['up_sampling2d_1[0][0]']
concatenate_1 (Concatenate)	(None, 8, 8, 512)	0	['conv2d_5[0][0]', 'conv2d_13[0][0]']
conv2d_14 (Conv2D)	(None, 8, 8, 256)	1179904	['concatenate_1[0][0]']
conv2d_15 (Conv2D)	(None, 8, 8, 256)	590080	['conv2d_14[0][0]']
up_sampling2d_2 (UpSampling2D)	(None, 16, 16, 256)	0	['conv2d_15[0][0]']
conv2d_16 (Conv2D)	(None, 16, 16, 128)	131200	['up_sampling2d_2[0][0]']
concatenate_2 (Concatenate)	(None, 16, 16, 256)	0	['conv2d_3[0][0]', 'conv2d_16[0][0]']
conv2d_17 (Conv2D)	(None, 16, 16, 128)	295040	['concatenate_2[0][0]']
conv2d_18 (Conv2D)	(None, 16, 16, 128)	147584	['conv2d_17[0][0]']
up_sampling2d_3 (UpSampling2D)	(None, 32, 32, 128)	0	['conv2d_18[0][0]']
conv2d_19 (Conv2D)	(None, 32, 32, 64)	32832	['up_sampling2d_3[0][0]']
concatenate_3 (Concatenate)	(None, 32, 32, 128)	0	['conv2d_1[0][0]', 'conv2d_19[0][0]']
conv2d_20 (Conv2D)	(None, 32, 32, 64)	73792	['concatenate_3[0][0]']
conv2d_21 (Conv2D)	(None, 32, 32, 64)	36928	['conv2d_20[0][0]']
conv2d_22 (Conv2D)	(None, 32, 32, 2)	1154	['conv2d_21[0][0]']
conv2d_23 (Conv2D)	(None, 32, 32, 1)	3	['conv2d_22[0][0]']
=====			
Total params: 13,642,917			
Trainable params: 13,642,917			
Non-trainable params: 0			
loading data			

Figure 3.6.1: U_Net model layers

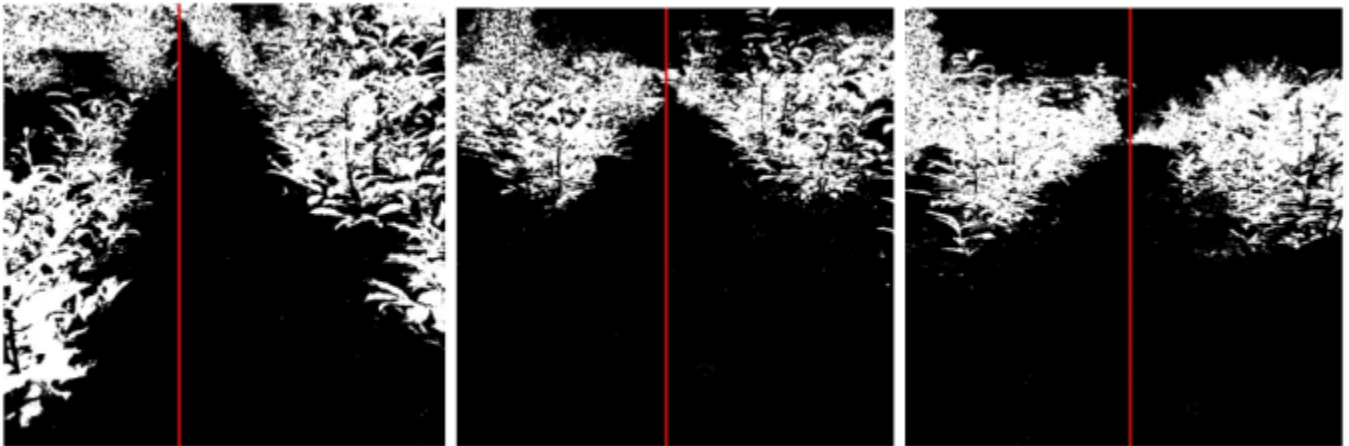


Figure 3.6.2: U-Net model results

3.7 2023 June 1st to 30st

- After the PP1 presentation the comments were viewed necessary adjustments were made
- The draft of the research paper was created and submitted.

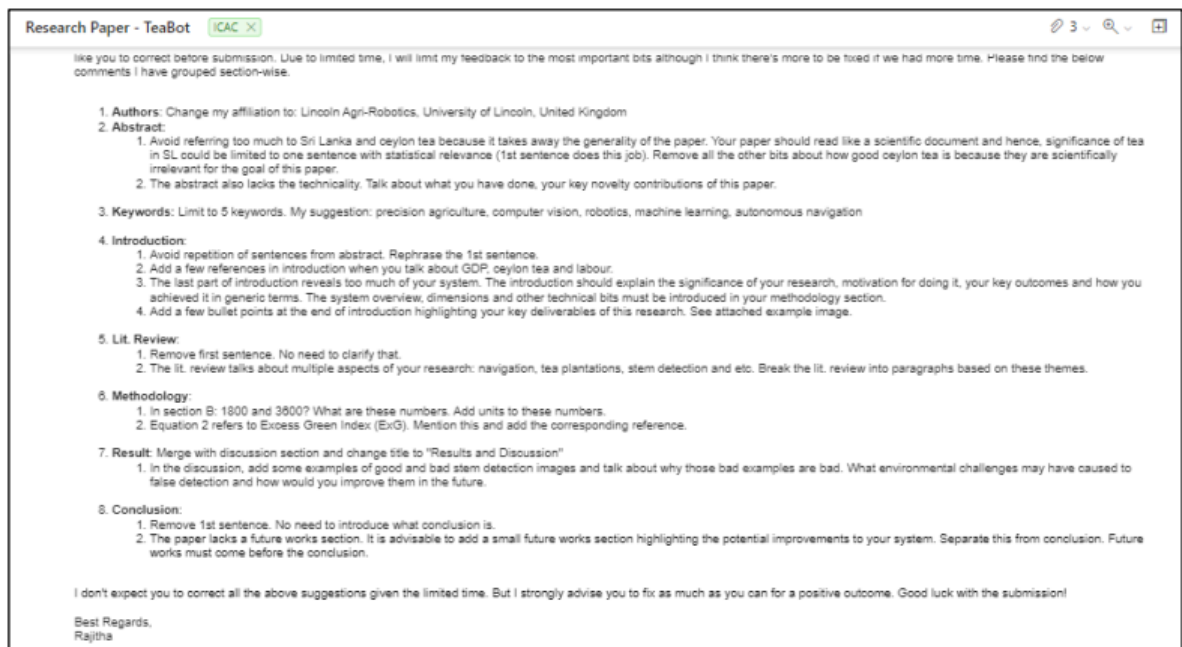
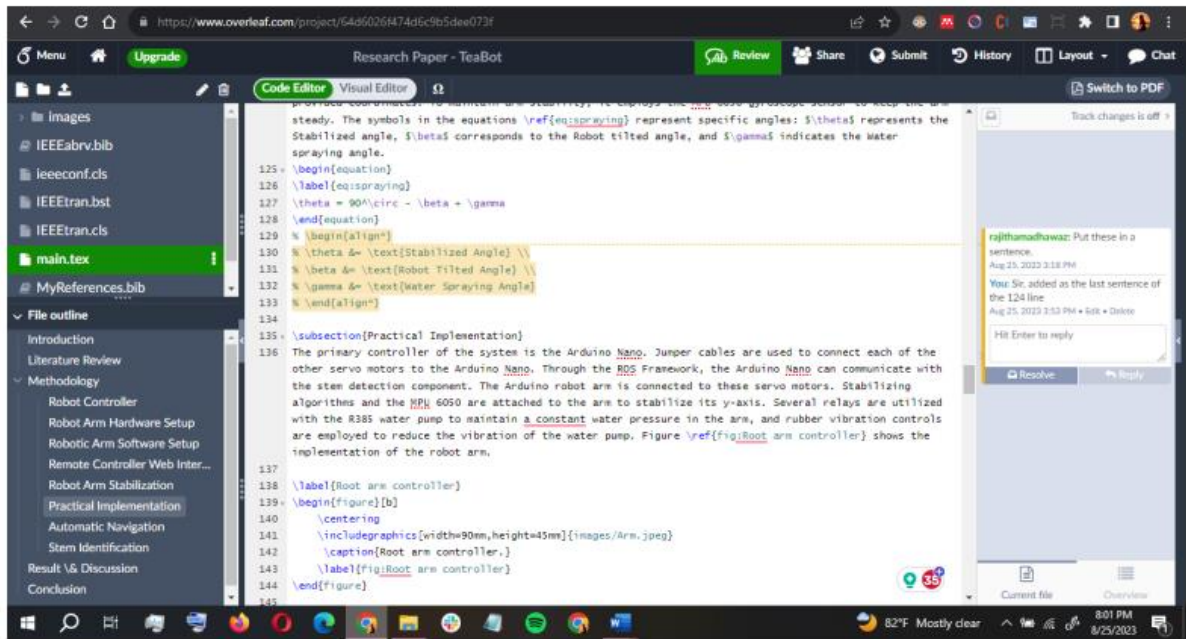


Figure 3.7.3: Written Research Paper

3.8 2023 July 1st to 31th

- On September 4th, we had a pivotal milestone with the submission of the second project progress report (PP2). This report served as an important update on our project's status and progress, highlighting the significant developments and achievements we had made.
- Simultaneously, during the month of September, we diligently worked on preparing the final report draft, which was scheduled for submission on September 10th. This comprehensive document encapsulated the culmination of our research efforts, encapsulating the entire project journey from inception to completion.
- In the final stages of our project, we embarked on the integration phase, a critical aspect of the research process. During this phase, we combined all project components and conducted extensive testing in a real-world environment. This allowed us to assess the functionality and performance of the integrated system. Moreover, we performed essential optimizations to fine-tune the system's performance, ensuring it met the desired standards and objectives. This thorough testing and optimization phase were crucial to delivering a successful and effective project outcome.

3.9 2023 August 1st 31st

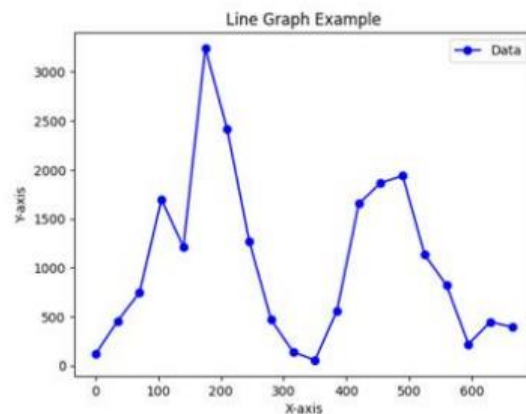
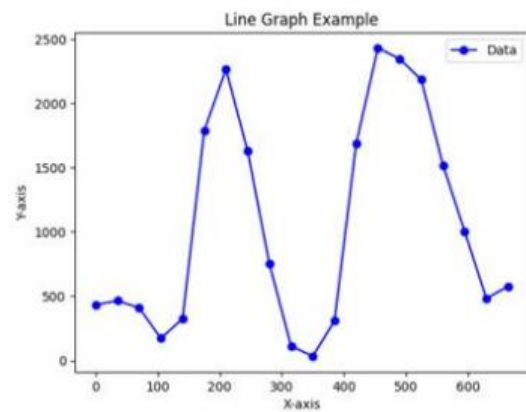
- With the research project nearing its completion, we also dedicated time to prepare for the publication of our research paper. This entailed finalizing the content, reviewing the format, and ensuring that all necessary citations and references were accurate and complete. Our aim was to disseminate our findings and contribute to the broader scientific community through this publication.
- Furthermore, we engaged in extensive discussions regarding the project's potential for future development. These conversations involved brainstorming innovative ideas and strategies to enhance and expand upon the work we had accomplished. We considered areas where the project could evolve, the incorporation of emerging technologies, and how to address any challenges or limitations encountered during the project. These discussions aimed to set a solid foundation for future research endeavors and improvements based on our project's outcomes and lessons learned.

3.10 2023 September 1st to 31st

- On the 4th of the month, we conducted the second project progress report (PP2) viva, a critical assessment of our project's progress and findings. During this viva, we had the opportunity to engage in a comprehensive discussion with our supervisor, addressing the advice and feedback provided. These discussions were instrumental in refining our project and making the necessary optimizations to prepare for the final viva, ensuring that we presented our work in the best possible manner.
- In addition to the PP2 viva, we also prepared and submitted a Status Document-2 on the same date. This document served as a concise update on the project's status and accomplishments up to that point, summarizing our achievements, milestones reached, and any changes made following the feedback from the PP2 viva. It provided a snapshot of the project's progress and contributed to the ongoing documentation of our research journey.

3.11 2023 October 1st to 31st

- Our research paper was completed and published.
- We practiced for the final viva which is scheduled on 31st October, and the optimization made for the autonomous navigation component were presented during the viva.



3.12 2023 November 1st 15th

- The website is created to submit on the 6th of November.
- The final report is proofread and will be submitted on the 27th.
- Research website was submitted to CDAP.