



Research Project (IT 4010)
4th year

Research Logbook

TeaBot

Tea Plantation Preservation Using an Intelligent Robot

2023-044

IT20265410

Premathilake H.T.M

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

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

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

Wed 8/23/2023 2:05 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 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

TeaBot Discussion  

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

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

Thu 10/26/2023 11:48 AM

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

Dear Madam,

We would like to share the current progress of TeaBot with you. We apologize for not being able to provide an update in the past weeks due to our CA submissions and other academic work. Madam, our final viva is scheduled for the 31st. As this weekend also includes a Poya day, we were wondering if it would be possible for you to have a brief online meeting with us for a quick update. We would greatly appreciate your guidance before the final viva.

Thank you in advance.

Sincerely,
Gunawardana I.I.E (IT19973470)

Figure 1.1.1: Viva Meeting

- In this section, I 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

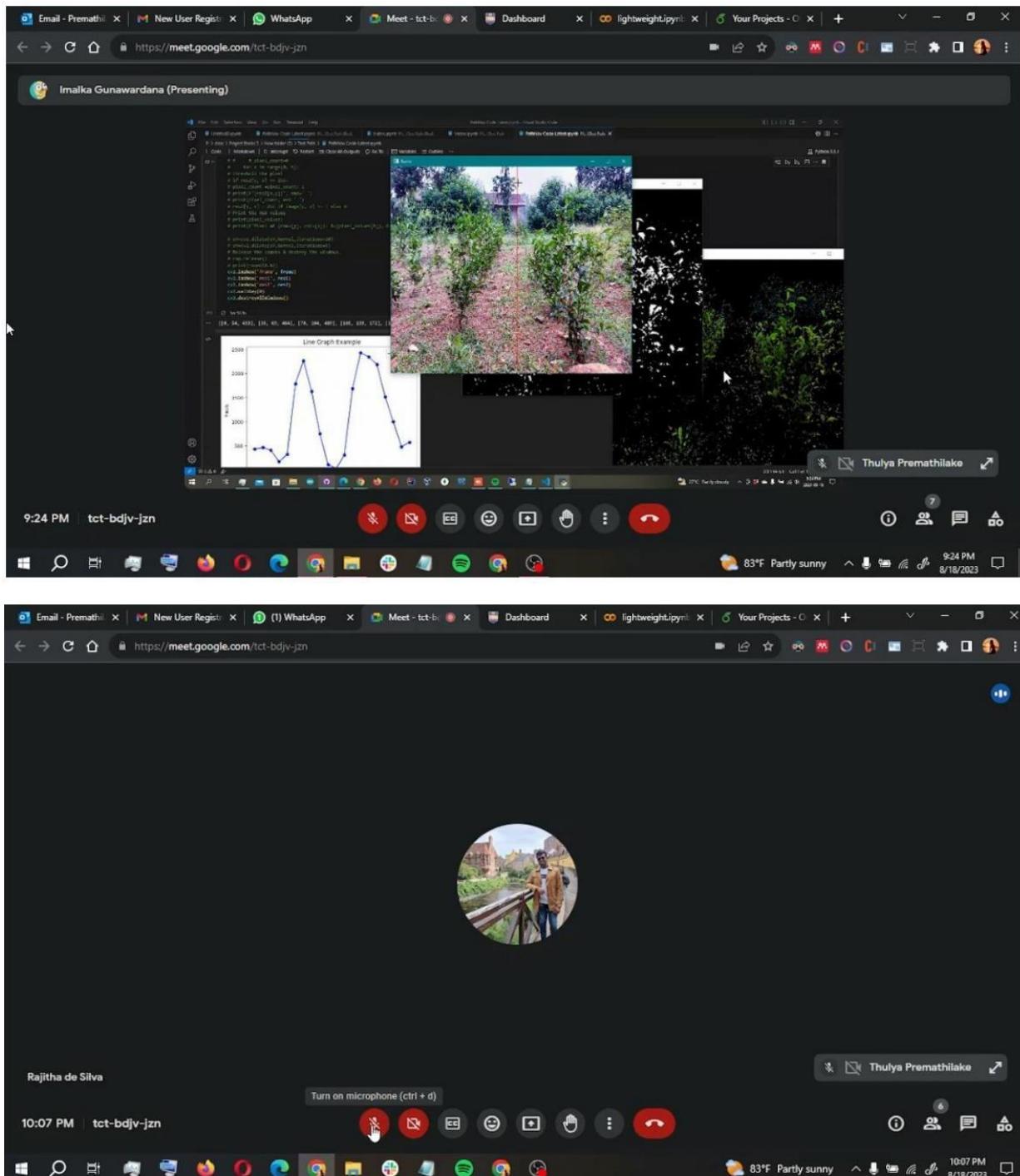


Figure 1.2.1: Components Modification

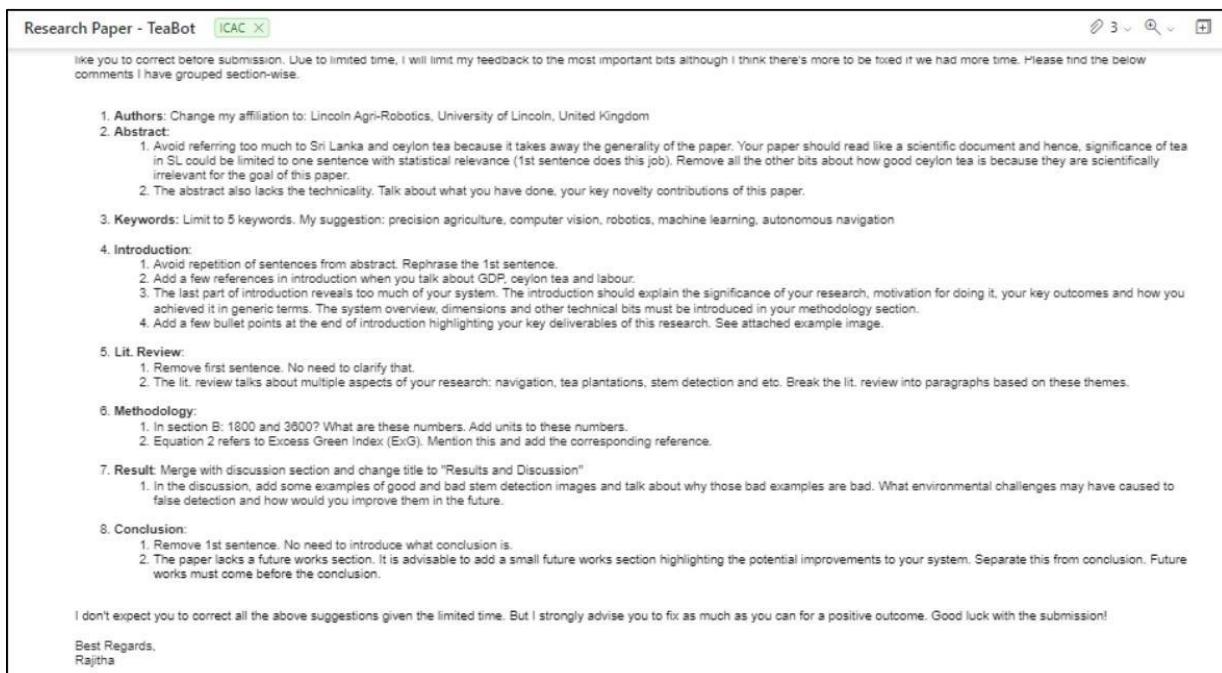
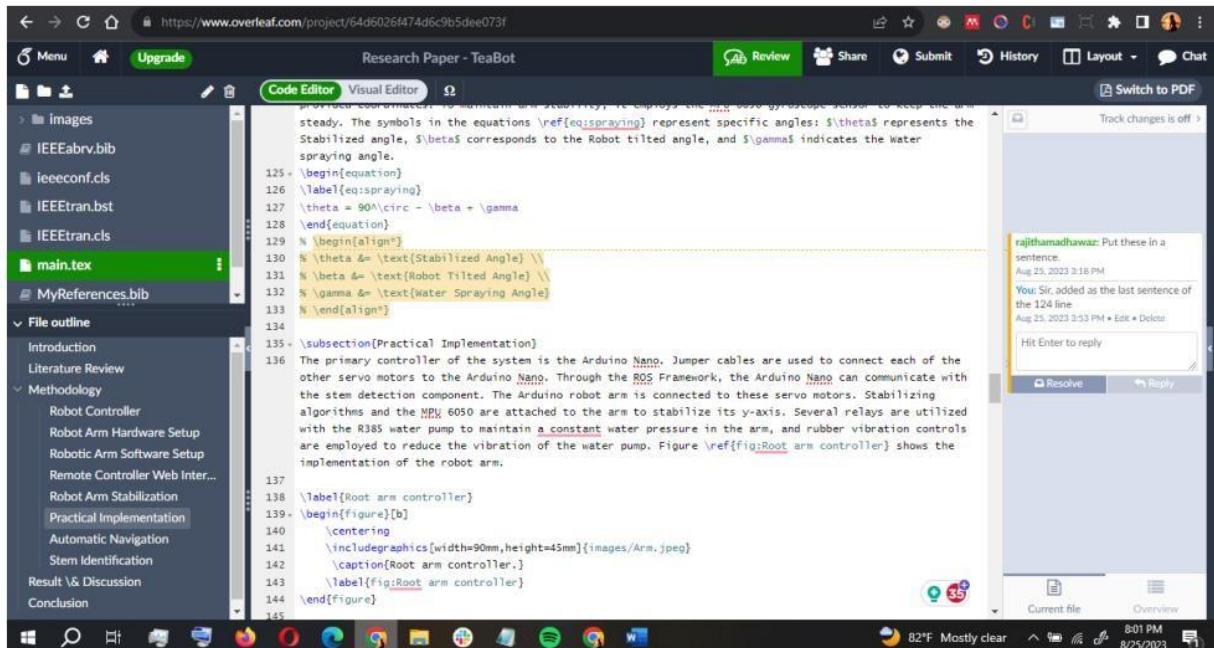


Figure 1.2.2: Research Paper Writing

1.3 Meetings with the team

General Posts Files Tasks + ⚡ Meet ⌂ ...

Wednesday, June 21, 2023

Premathilake H. T. M it20265410 6/21 10:08 PM
https://drive.google.com/drive/folders/1rKJn0XN3R-nJN6H_Z0FXxVsrBd-3HVL3?usp=sharing

PI ↗ Reply

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

Timeline (2022-2023):

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

PI ↗ Reply

Thursday, June 29, 2023

Meeting in "General" ended:

PI 🍀 GI PI

PI ↗ Reply

General Posts Files Tasks + ⚡ Meet ⌂ ...

PP2 Slide Deck ended: 1h 16m

PI 🍀 PI 🍀

PP2 Slides started

Collapse all

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 🍀 PI 🍀

General Posts Files Tasks + Meet ...

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

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 PI

Reply

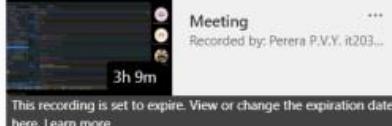
Sunday, September 3, 2023

General started

Collapse all

Recording has started

Recording has stopped. Saving recording...



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

Meeting ended: 12h 20m PI

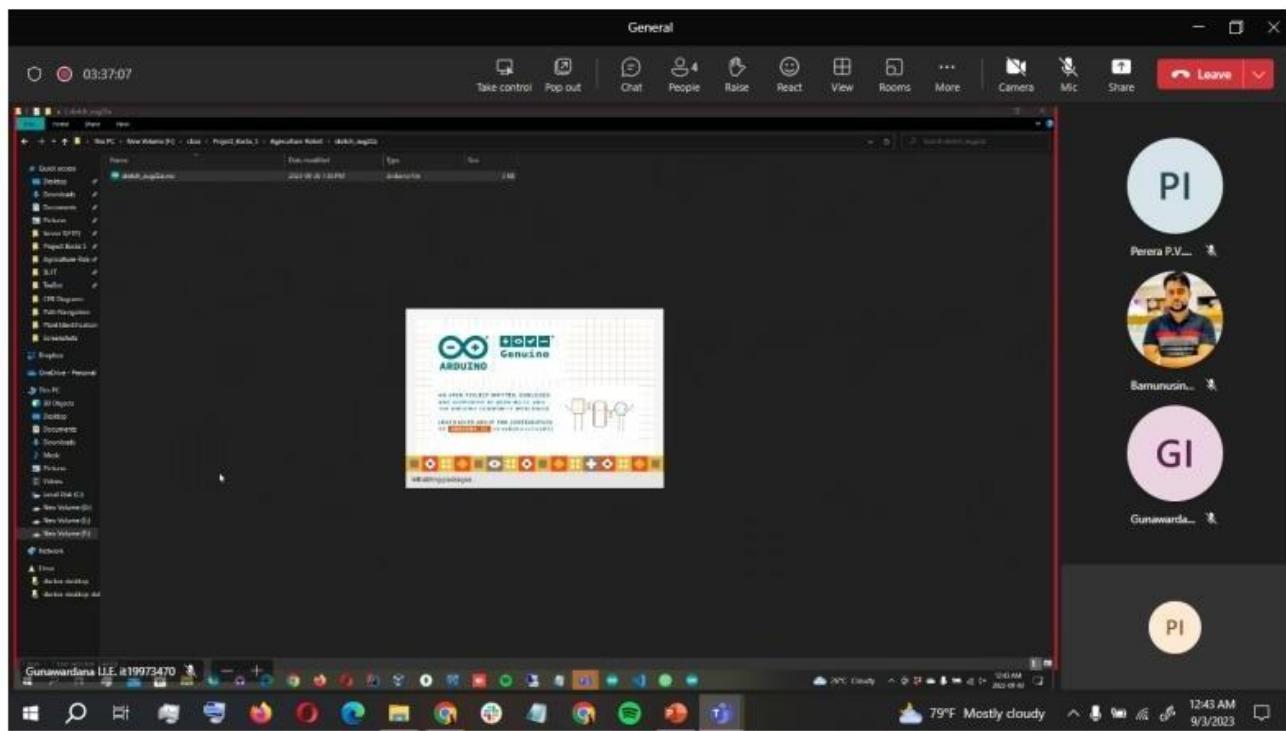
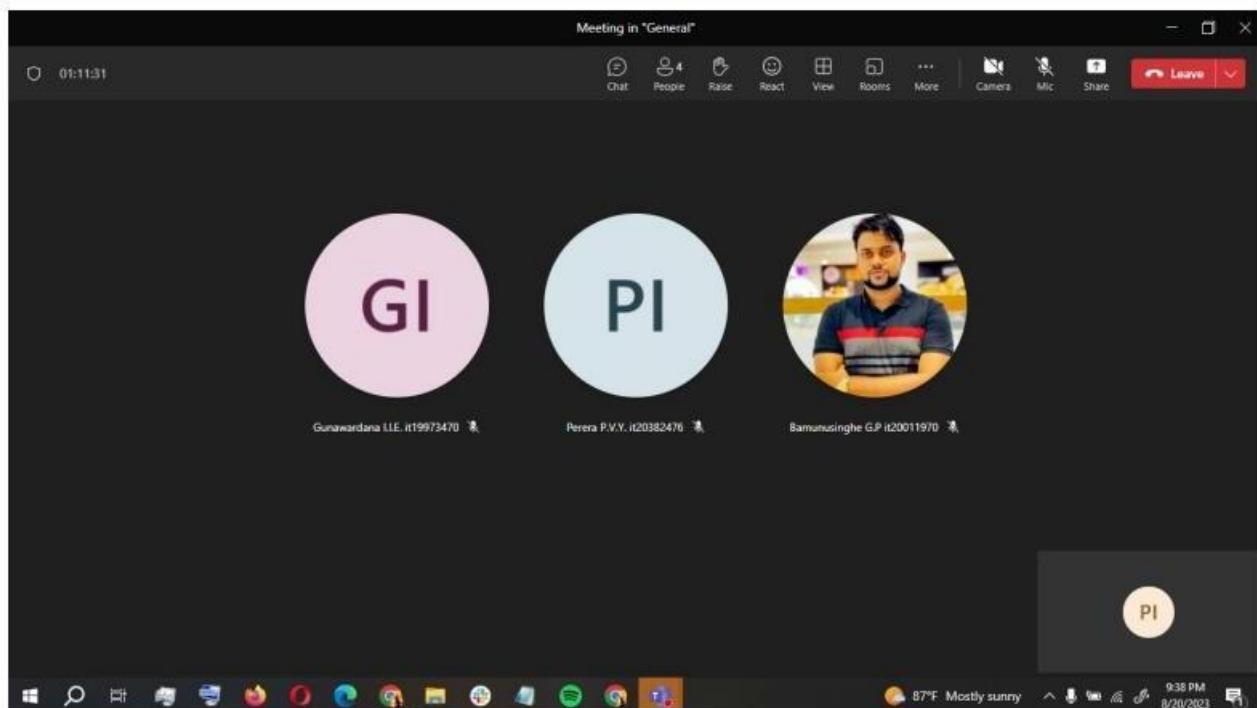
Reply

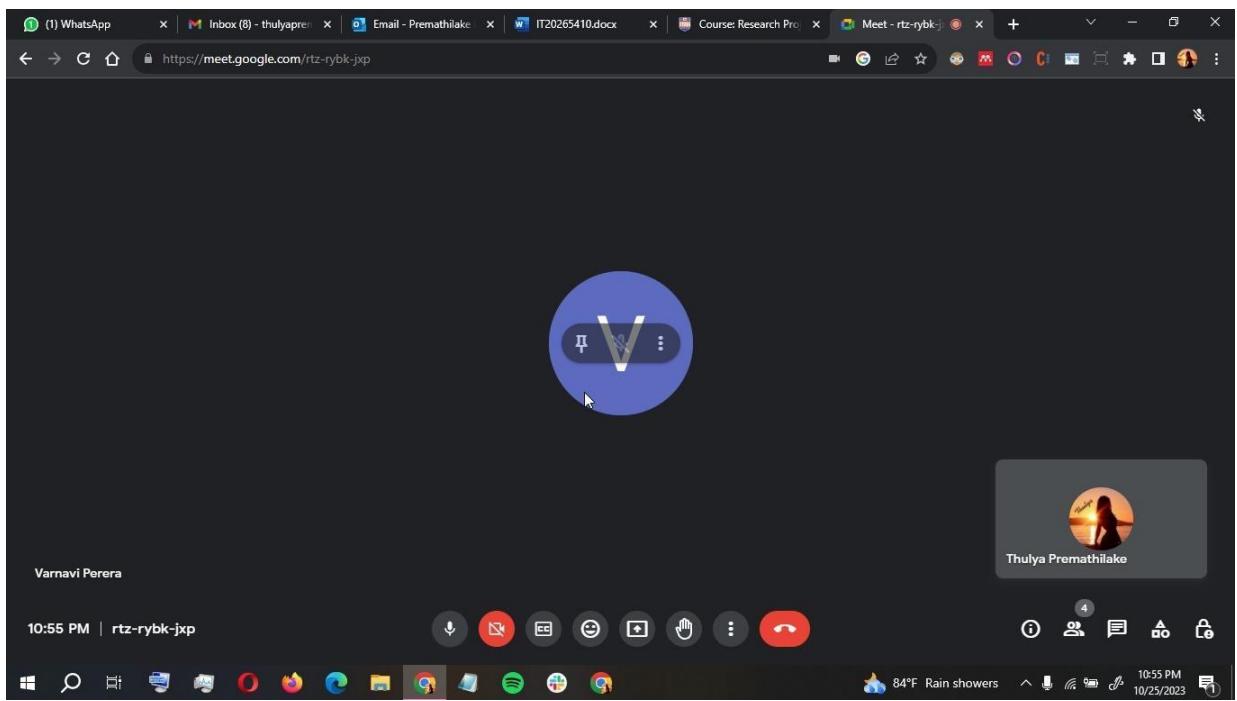
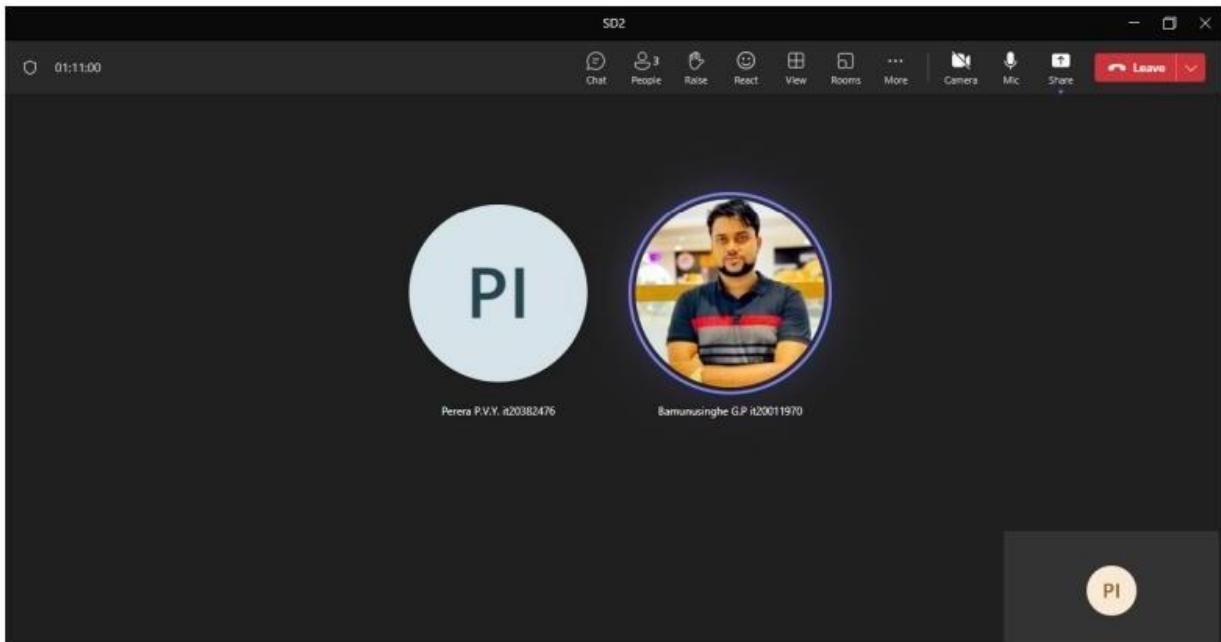
General Posts Files Tasks + Meet ...

New ▼ Upload ▼ Share Copy link Sync Download ... All Documents* ▼ Y ...

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

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





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

GI

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

▼ 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

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)

Follow up ▾



TeaBot Discussion



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

Organizer

GI

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

▼ No: 1



Shashika Lokuliyana
Required

▼ Didn't respond: 3

PI

Perera P.V.Y. it20382476
Required

P

Premathilake H. T. M it2026...
Required

Microsoft Teams meeting

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

 TeaBot Discussion

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

Organizer
 Gunawardana I.I.E. it19973470
Sent on Thursday, 6/1/2023 at 4:59 PM

Didnt 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: 428 033 701 504

Research Paper - TeaBot

 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



GI

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

To: Shashika Lokuliyana

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



Wed 8/23/2023 2:05 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 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.

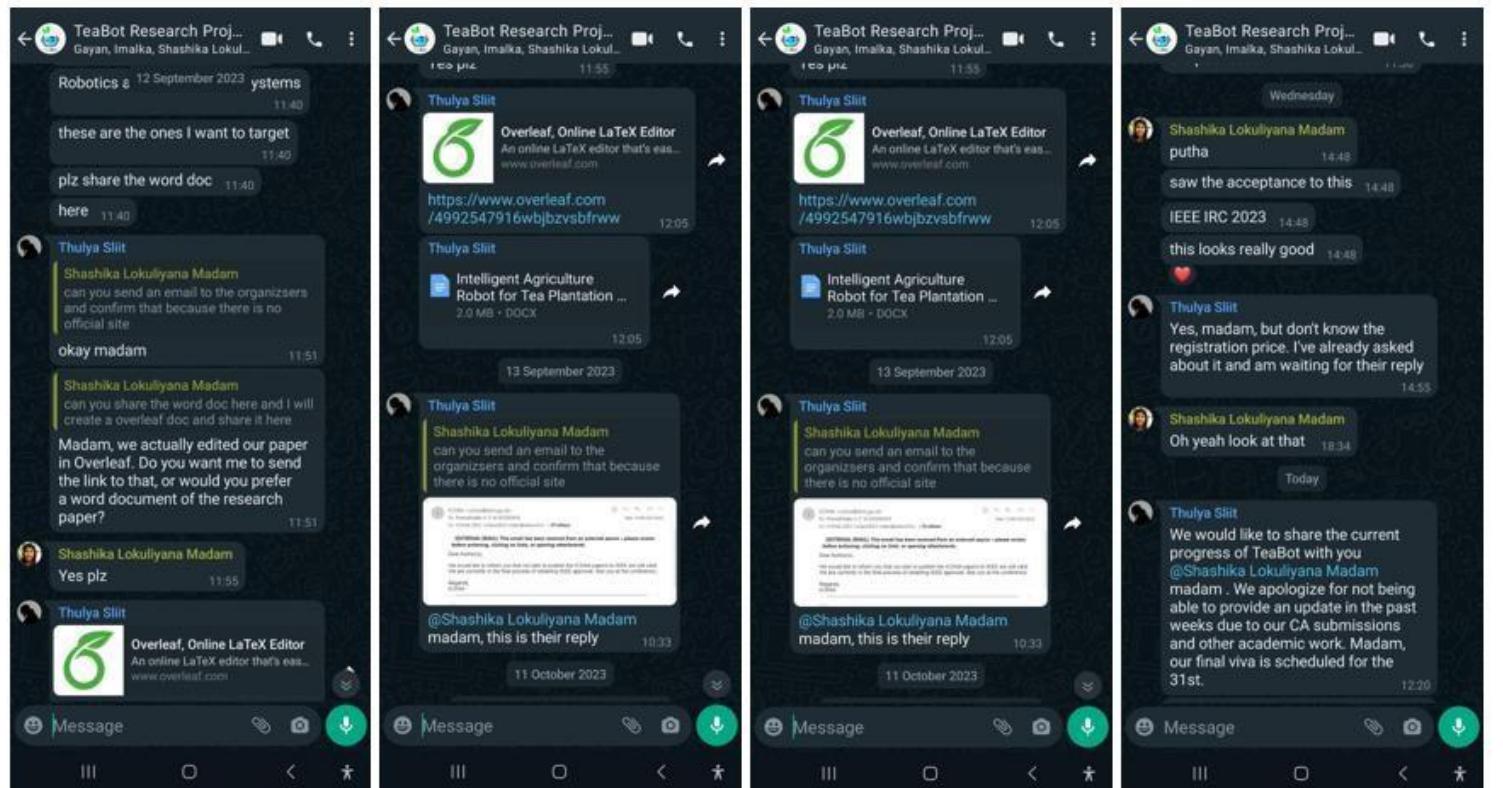
Our intention is to present both the project updates and our research paper for your review. Considering your demanding schedule madam, we kindly ask for your assistance in identifying a suitable date and time for the meeting.

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

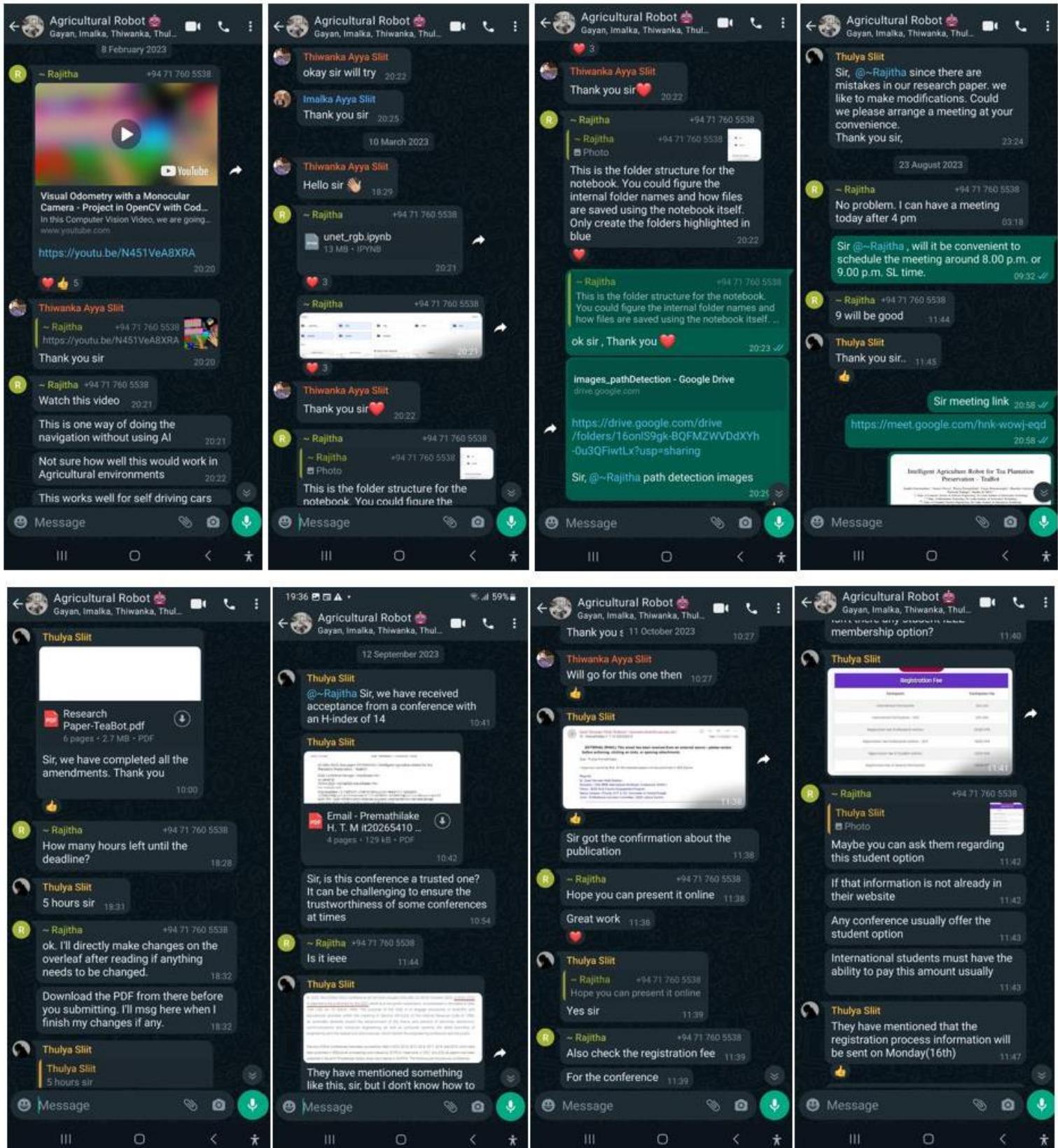
Best Regards,
Gunawardana I.I.E

1.5 Messages

1.5.1 Messages with the supervisor



1.5.2 Messages with the External Supervisor



1.5.3 Messages in the official TeaBot Group

The screenshot shows the Microsoft Teams 'General' channel interface. At the top, there are tabs for 'Posts', 'Files', and 'Tasks'. On the right side, there are buttons for 'Meet', a profile picture, and more options. The main area displays a message from 'Premathilake H. T. M it20265410' at 9/2 6:52 PM, containing a file named 'PP2 Slides.pptx'. Below this, another message from 'Perera P.V.Y. it20382476' at 9/2 7:00 PM discusses algorithm development for stem identification, mentioning calculating the position of the end of the stem and capturing a frame from the video through the webcam. A note indicates a meeting ended at 3h 56m. A 'Reply' button is present. The date 'Sunday, September 3, 2023' is shown at the bottom. The next section shows a 'General started' message with a recording status: 'Recording has started' and 'Recording has stopped. Saving recording...'. It includes a thumbnail for a 'Meeting' recorded by Perera P.V.Y. it20382476, which lasted 3h 9m. A note states the recording is set to expire and provides a link to change the expiration date. A 'Reply' button is also here.

This screenshot shows the same Microsoft Teams 'General' channel. The top part of the interface is identical. The main area displays a message from 'Perera P.V.Y. it20382476' at 8/27 4:41 PM, starting with 'PP2 Slide Deck ended: 1h 16m'. Below this, another message from 'Perera P.V.Y. it20382476' at 8/27 4:41 PM starts with 'PP2 Slides started'. This message is expanded to show a detailed description of Mobile-UNet's architecture and its use of skip-connectors for feature capture. A 'See less' link is available. A note indicates a meeting ended at 1h 32m. A 'Reply' button is present.

2 Individual Project Logs

2.1 MS Planner

The image displays two screenshots of the Microsoft Planner application interface, showing task lists for different project categories.

Screenshot 1 (Top):

- Studying:**
 - + Add task
 - Submit Thesis - Proof read (Due 11/27)
 - Publish Paper (Due 11/06)
- Completed tasks:** 18
 - Testing the developed path navigation program in various scenarios and optimizing the code (Completed by Perera P.V.Y. it203...)
 - Developing the path navigation code for varying environmental conditions (Completed by Perera P.V.Y. it203...)
- Development:**
 - + Add task
 - Project Website (Due 11/06)
- Documentation:**
 - + Add task
 - Research Logbook (Due 10/30)
- Completed tasks:** 8
 - Developing the UNet model (Completed by Perera P.V.Y. it203...)
 - Final Report - IT20302476 (Completed by Perera P.V.Y. it203...)
 - Project Status Document 2 - IT20302476 (Completed by Perera P.V.Y. it203...)
 - Research Paper (Completed by Premathilake H. T....)
 - Project Status Document 1 - (Completed by Premathilake H. T....)

Screenshot 2 (Bottom):

- Documentation:**
 - + Add task
 - Research Logbook (Due 10/30)
- Completed tasks:** 8
 - Final Report - IT20302476 (Completed by Perera P.V.Y. it203...)
 - Project Status Document 2 - IT20302476 (Completed by Perera P.V.Y. it203...)
 - Research Paper (Completed by Premathilake H. T....)
 - Project Status Document 1 - (Completed by Premathilake H. T....)
- Presentation:**
 - + Add task
 - Final Presentation and Viva (Due 10/31)
- Completed tasks:** 3
 - Progress Presentation - I (Completed by Perera P.V.Y. it203...)
 - Progress Presentation - II (Completed by Perera P.V.Y. it203...)
 - Proposal Presentation (Completed by Perera P.V.Y. it203...)
- Testing:**
 - + Add task
- Completed tasks:** 2
 - Testing the ML models in the testing field (Completed by Gunawardana I.I.E....)
 - UNet Model testing (Completed by Perera P.V.Y. it203...)

2023 - 044 (Te...)

Grid Board Charts Schedule ...

Open in Microsoft Teams Members Filter (1) Group by

Studying

+ Add task

- Submit Thesis - Proof read (Due: 27/11, Status: In progress, Assigned to: GI, P, PI, GL)
- Publish Paper (Due: 06/11, Status: In progress, Assigned to: GI, P, GL)

Completed tasks 16

Development

+ Add task

- Project Website (Due: 06/11, Status: In progress, Assigned to: GI, P, GL)

Completed tasks 3

- Optimizing the ResNet Model (Completed, Assigned to: P)
- Developing the Lightweight Model (Completed, Assigned to: P)
- Developing the ResNet Model (Completed, Assigned to: P)

Documentation

+ Add task

- Research Logbook (Completed, Assigned to: GL)
- Final Report - IT20265410 (Completed, Assigned to: P)
- Project Status Document 2 - IT20265410 (Completed, Assigned to: P)
- Research Paper (Completed, Assigned to: GL)

Completed tasks 9

Presentation

+ Add task

- Progress Presentation - I (Completed, Assigned to: GL)
- Completed by Gunaward (Completed, Assigned to: GL)
- Progress Presentation - II (Completed, Assigned to: GL)
- Completed by Bamunusir (Completed, Assigned to: GL)
- Proposal Presentation (Completed, Assigned to: GL)
- Completed by Gunaward (Completed, Assigned to: GL)

Completed tasks 3

2023 - 044 (TeaBot)

Grid Board Charts Schedule ...

Open in Microsoft Teams Members Filter (1)

Title	Assignment	Start Date	Due Date	Bucket	Progress	Priority
Submit Thesis - Proof read	GI, P, PI, GL	27/11/2023	27/11/2023	Studying	In progress	●
Publish Paper	GI, P, GL	6/11/2023	6/11/2023	Studying	In progress	●
Testing the stem detection program for all ages of tea...	Premathilake H. T.	22/9/2023	22/9/2023	Studying	Completed	●
Developing the stem identification code for various a...	Premathilake H. T.	12/9/2023	12/9/2023	Studying	Completed	●
Testing the Classic computer vision in real environment	P, PI	30/9/2023	30/9/2023	Studying	Completed	●
Code testing - Stem-Detection	Premathilake H. T.	3/10/2023	3/10/2023	Studying	Completed	●
Edge-Detection code optimizing - Stem-Detection	Premathilake H. T.	22/9/2023	22/9/2023	Studying	Completed	●
Stem-Detection Component - Testing	Premathilake H. T.	14/9/2023	14/9/2023	Studying	Completed	●
Optimizing the ResNet Model	Premathilake H. T.	1/7/2023	1/7/2023	Development	Completed	●
Developing the Lightweight Model	Premathilake H. T.	17/7/2023	17/7/2023	Development	Completed	!
Research Logbook	GI, P, PI, GL	30/10/2023	30/10/2023	Documentation	Completed	●
Project Status Document 2 - IT20265410	Premathilake H. T.	24/7/2023	24/7/2023	Documentation	Completed	●
Project Website	GI, P, GL	6/11/2023	6/11/2023	Development	In progress	●

+ Add new task

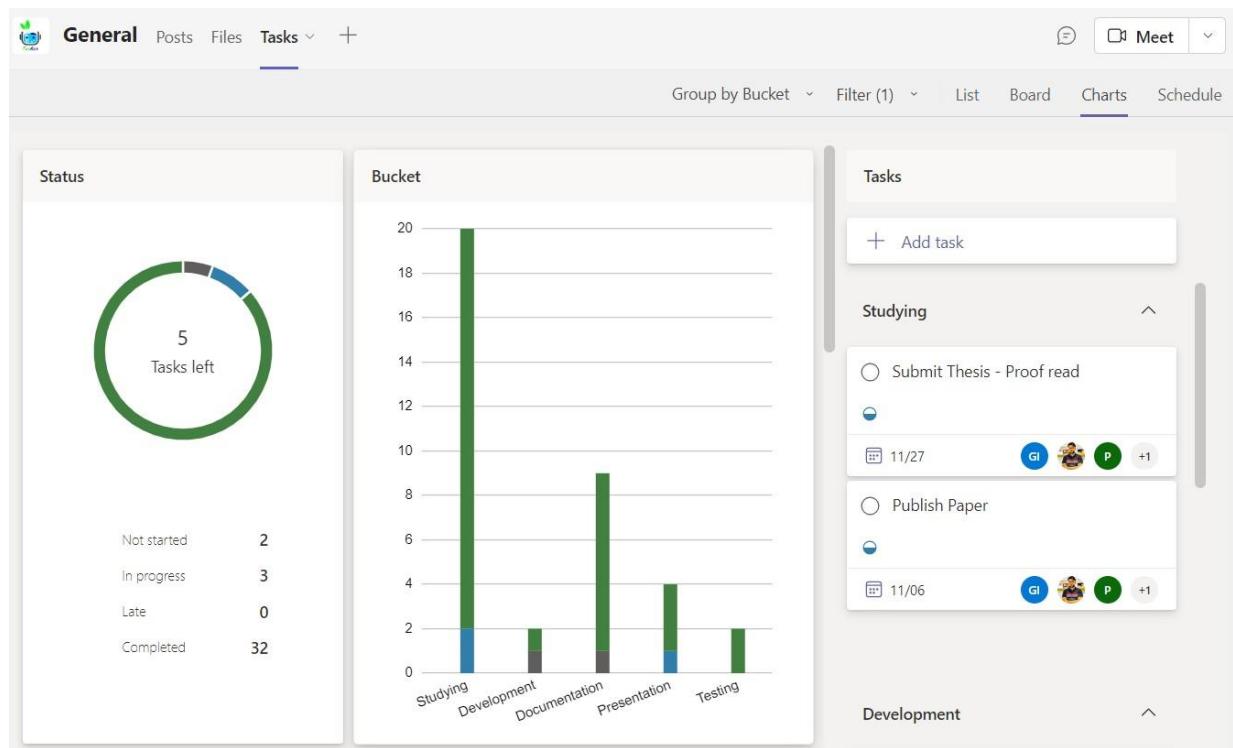
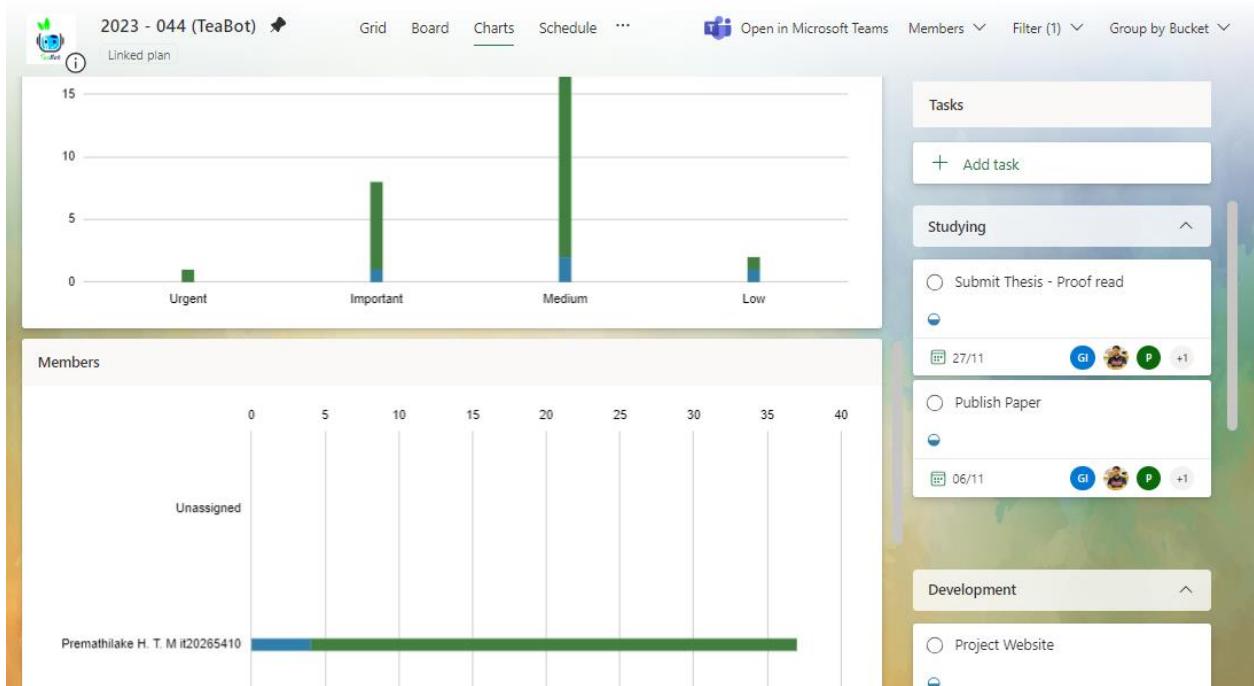
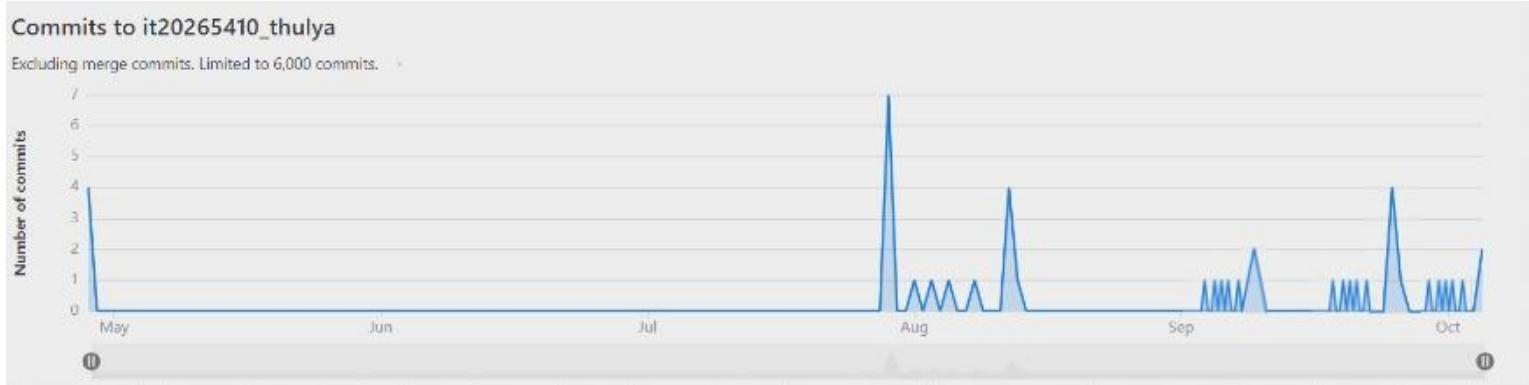


Figure 2.1.2: Chart View of Tasks

Figure 2.1.1: Completed Tasks on Teams Charts



2.2 Git Lab



3 Monthly Progress

3.1 2022 November 1st to 30th

- In November, our project entered the initial phase of selecting research topics, driven by the looming submission deadline of February 10th. On November 10th, 2022, we officially commenced our research journey with the first Research Project Lecture.
- To kickstart the process of topic selection, we employed mind maps to explore various research areas and potential components worth investigating. Concurrently, we initiated the task of identifying potential supervisors, co-supervisors, and external mentors who could provide guidance throughout our research.
- Throughout the month, we engaged in extensive discussions with these potential mentors, presenting and deliberating on each proposed research topic and its associated components. These discussions played a pivotal role in enabling us to make an informed decision regarding the most suitable research topic for our project.
- After careful consideration and input from our mentors, we ultimately made a definitive choice regarding our research topic. With this decision made, we solidified the scope of our research team and prepared to move forward with this focused area of investigation.
- In addition to the topic selection, we also recognized the significance of enhancing our team's cohesiveness and performance. To assess our strengths, weaknesses, opportunities, and threats, we conducted a SWOT analysis. This exercise allowed us to identify areas where our team needed improvement and formulate strategies to address these shortcomings.
- By the end of November, we had not only settled on a specific research topic but also gained a clear understanding of how to proceed as a research team. This preparation ensured that our work would be both original and well-structured, guarding against the risk of 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.

Project Registration Form-Final Year Project-202

RP-02



Sri Lanka Institute of Information Technology

PROJECT REGISTRATION FORM

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

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	Percera 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	Bamunusinghe G.P	IT20011970	076 640 9484	it20011970@my.sliit.lk

Page | 1

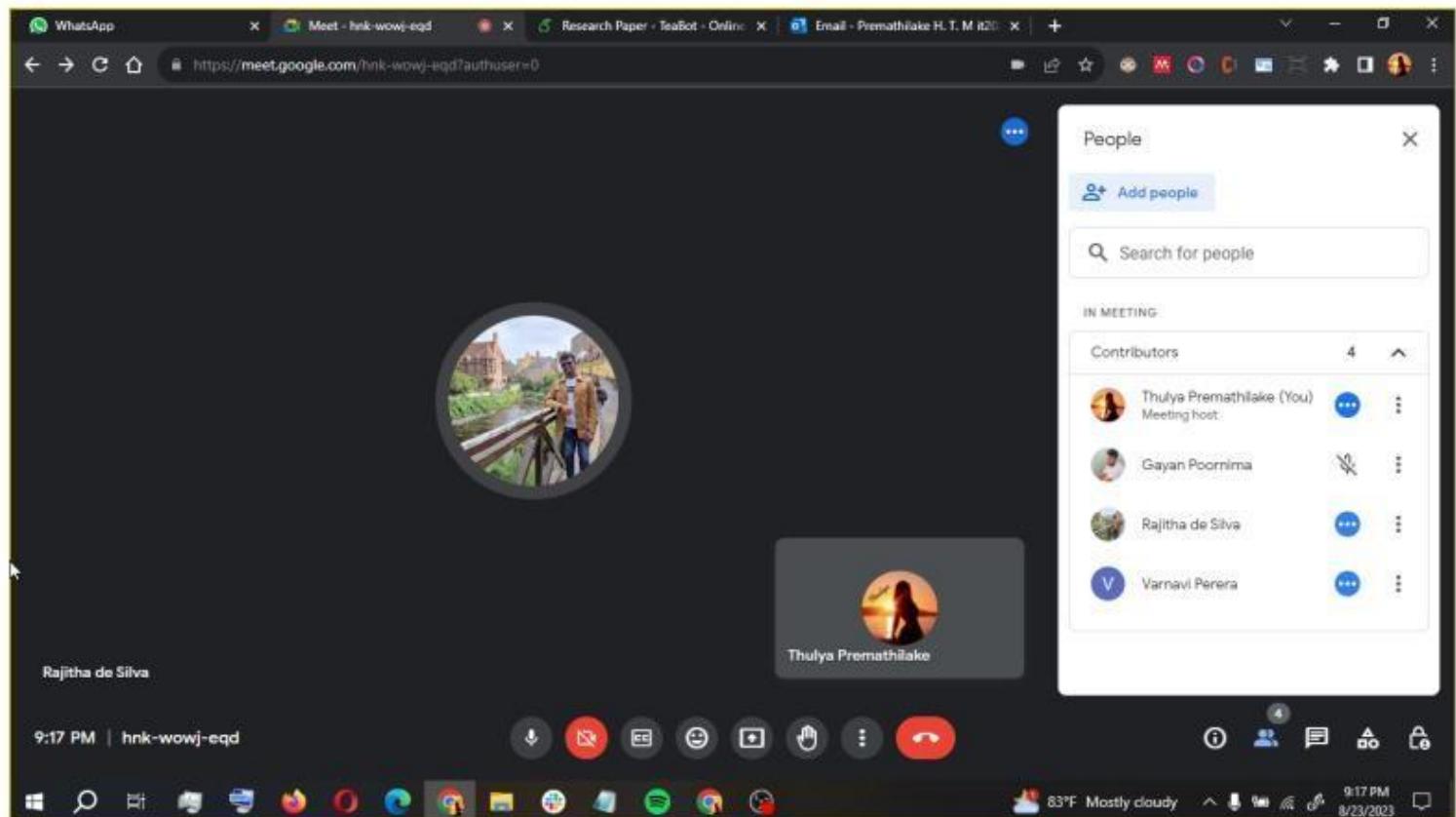
Page | 2

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.
- Developed the resnet50 model for stem identification.

```
data = []
targets = []
filenames = []
for image_dir in image_directories:
    # load the image and preprocess it
    image = load_img(image_dir, target_size=(224, 224))
    image = img_to_array(image)

    # update our list of data, targets, and filenames
    data.append(image)

    # get the image name from the image dir
    #filename = image_dir[]
    filename = os.path.basename(image_dir)

    row_df = label_df.loc[label_df['filename'] == filename]
    new_x, new_y = row_df['new_x'].values, row_df['new_y'].values
    targets.append(np.concatenate([new_x, new_y], axis = 0))
    filenames.append(filename)
```

Figure 3.4.1 : Implementation of the three lists

```

# convert the data and targets to NumPy arrays, scaling the input
# pixel intensities from the range [0, 255] to [0, 1]
data = np.array(data, dtype="float32") / 255.0
targets = np.array(targets, dtype="float32")

# partition the data into training and testing splits using 80% of
# the data for training and the remaining 20% for testing
split = train_test_split(data, targets, filenames, test_size=0.20,
    random_state=42)

# unpack the data split
(trainImages, valImages) = split[:2]
(trainTargets, valTargets) = split[2:4]
(trainFilenames, valFilenames) = split[4:]

split = train_test_split(valImages, valTargets, valFilenames, test_size=0.50,
    random_state=42)

# unpack the data split
(valImages, testImages) = split[:2]
(valTargets, testTargets) = split[2:4]
(valFilenames, testFilenames) = split[4:]

# write the testing filenames to disk so that we can use them when evaluating/testing
print("[INFO] saving testing filenames...")
f = open(TEST_FILERAMES, "w")
f.write("\n".join(testFilenames))
f.close()

```

Figure 3.4.2 : Implementation of the three lists

Model: "model"				
Layer (type)	Output Shape	Param #	Connected to	
input_1 (InputLayer)	[(None, 224, 224, 3 0)]		[]	
conv1_pad (ZeroPadding2D)	(None, 230, 230, 3) 0		['input_1[0][0]']	
conv1_conv (Conv2D)	(None, 112, 112, 64 9472)		['conv1_pad[0][0]']	
conv1_bn (BatchNormalization)	(None, 112, 112, 64 256)		['conv1_conv[0][0]']	
conv1_relu (Activation)	(None, 112, 112, 64 0)		['conv1_bn[0][0]']	
pool1_pad (ZeroPadding2D)	(None, 114, 114, 64 0)		['conv1_relu[0][0]']	
pool1_pool (MaxPooling2D)	(None, 56, 56, 64) 0		['pool1_pad[0][0]']	
conv2_block1_1_conv (Conv2D)	(None, 56, 56, 64) 4160		['pool1_pool[0][0]']	
conv2_block1_1_bn (BatchNormal ization)	(None, 56, 56, 64) 256		['conv2_block1_1_conv[0][0]']	
conv2_block1_1_relu (Activatio n)	(None, 56, 56, 64) 0		['conv2_block1_1_bn[0][0]']	
conv2_block1_2_conv (Conv2D)	(None, 56, 56, 64) 36928		['conv2_block1_1_relu[0][0]']	
conv2_block1_2_bn (BatchNormal ization)	(None, 56, 56, 64) 256		['conv2_block1_2_conv[0][0]']	
conv2_block1_2_relu (Activatio n)	(None, 56, 56, 64) 0		['conv2_block1_2_bn[0][0]']	
conv2_block1_0_conv (Conv2D)	(None, 56, 56, 256) 16640		['pool1_pool[0][0]']	
conv2_block1_3_conv (Conv2D)	(None, 56, 56, 256) 16640		['conv2_block1_2_relu[0][0]']	

Figure 3.4.3 : ResNet50 model layer part 1

conv2_block1_0_conv (Conv2D) (None, 56, 56, 256)	16640	['pool1_pool[0][0]']
conv2_block1_3_conv (Conv2D) (None, 56, 56, 256)	16640	['conv2_block1_2_relu[0][0]']
conv2_block1_0_bn (BatchNormal (None, 56, 56, 256) 1024 ization)		['conv2_block1_0_conv[0][0]']
conv2_block1_3_bn (BatchNormal (None, 56, 56, 256) 1024 ization)		['conv2_block1_3_conv[0][0]']
conv2_block1_add (Add) (None, 56, 56, 256) 0		['conv2_block1_0_bn[0][0]', 'conv2_block1_3_bn[0][0]']
conv2_block1_out (Activation) (None, 56, 56, 256) 0		['conv2_block1_add[0][0]']
conv2_block2_1_conv (Conv2D) (None, 56, 56, 64) 16448		['conv2_block1_out[0][0]']
conv2_block2_1_bn (BatchNormal (None, 56, 56, 64) 256 ization)		['conv2_block2_1_conv[0][0]']
conv2_block2_1_relu (Activatio (None, 56, 56, 64) 0 n)		['conv2_block2_1_bn[0][0]']
conv2_block2_2_conv (Conv2D) (None, 56, 56, 64) 36928		['conv2_block2_1_relu[0][0]']
conv2_block2_2_bn (BatchNormal (None, 56, 56, 64) 256 ization)		['conv2_block2_2_conv[0][0]']
conv2_block2_2_relu (Activatio (None, 56, 56, 64) 0 n)		['conv2_block2_2_bn[0][0]']
conv2_block2_3_conv (Conv2D) (None, 56, 56, 256) 16640		['conv2_block2_2_relu[0][0]']
conv2_block2_3_bn (BatchNormal (None, 56, 56, 256) 1024 ization)		['conv2_block2_3_conv[0][0]']
conv2_block2_add (Add) (None, 56, 56, 256) 0		['conv2_block1_out[0][0]', 'conv2_block2_3_bn[0][0]']
conv2_block2_out (Activation) (None, 56, 56, 256) 0		['conv2_block2_add[0][0]']

Figure 3.4.4 : ResNet50 model layer part 2

conv5_block3_out (Activation) (None, 7, 7, 2048) 0		['conv5_block3_add[0][0]']
conv2d (Conv2D) (None, 7, 7, 2048)	37750784	['conv5_block3_out[0][0]']
conv2d_1 (Conv2D) (None, 7, 7, 1024)	18875392	['conv2d[0][0]']
conv2d_2 (Conv2D) (None, 7, 7, 512)	4719104	['conv2d_1[0][0]']
conv2d_3 (Conv2D) (None, 7, 7, 256)	1179904	['conv2d_2[0][0]']
conv2d_4 (Conv2D) (None, 7, 7, 128)	295040	['conv2d_3[0][0]']
flatten (Flatten) (None, 6272)	0	['conv2d_4[0][0]']
dense (Dense) (None, 1024)	6423552	['flatten[0][0]']
dense_1 (Dense) (None, 256)	262400	['dense[0][0]']
dense_2 (Dense) (None, 32)	8224	['dense_1[0][0]']
dense_3 (Dense) (None, 2)	66	['dense_2[0][0]']
<hr/>		
Total params:	93,102,178	
Trainable params:	69,514,466	
Non-trainable params:	23,587,712	

Figure 3.4.5 : ResNet50 model layer part 3

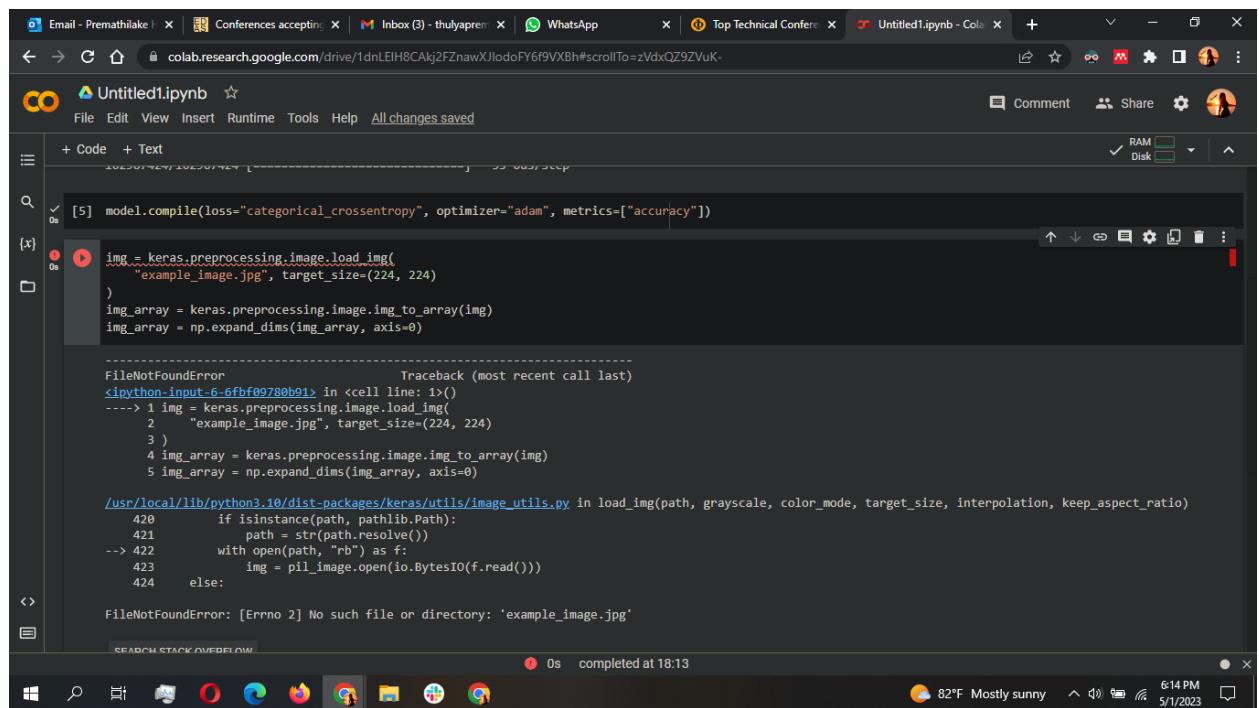
3.5 2023 April 1st to 30th

- 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 labeled data.



3.6 2023 May 1st to 31st

- Using the Dataset ResNet50 model was built. The model was trained and tested it has around 88% accuracy.
- On the 22nd we had our PP1 presentation for this presentation, the stem identification using ResNet50 model was completed, and the end of the tea stem was detected.
- I encountered an error while looping through the data in the CSV file.



```
[5] model.compile(loss="categorical_crossentropy", optimizer="adam", metrics=["accuracy"])

[5]: img = keras.preprocessing.image.load_img(
      "example_image.jpg", target_size=(224, 224)
    )
    img_array = keras.preprocessing.image.img_to_array(img)
    img_array = np.expand_dims(img_array, axis=0)

FileNotFoundError: [Errno 2] No such file or directory: 'example_image.jpg'
```

- Encountered the following error due to the output location.

The screenshot shows a Google Colab notebook titled "train.ipynb". The code cell contains the following Python code:

```

split = train_test_split(data, targets, filenames, test_size=0.10,
                        random_state=42)

# unpack the data split
(trainImages, testImages) = split[:2]
(trainTargets, testTargets) = split[2:4]
(trainFilenames, testFilenames) = split[4:]

# write the testing filenames to disk so that we can use them
# when evaluating/testing our bounding box regressor
print("[INFO] saving testing filenames...")
f = open(TEST_FILERAMES, "w")
f.write("\n".join(testFilenames))
f.close()

```

A dropdown menu is open over the last line of code, showing a stack trace for a `ValueError`:

```

ValueError                                Traceback (most recent call last)
<ipython-input-22-c0225b898d89> in <cell line: 8>()
      6 # partition the data into training and testing splits using 90% of
      7 # the data for training and the remaining 10% for testing
----> 8     split = train_test_split(data, targets, filenames, test_size=0.10,
      9         random_state=42)
     10

```

The stack trace continues with:

```

/usr/local/lib/python3.10/dist-packages/scikit_learn/model_selection/_split.py in train_test_split(test_size, train_size, random_state, shuffle, stratify, *arrays)
   2557         raise ValueError("At least one array required as input")
   2558
-> 2559     arrays = indexable(*arrays)

```

The status bar at the bottom indicates the cell completed at 10:59.

- Found the root code and make the directory list.

The screenshot shows a Google Colab notebook titled "Copy of train.ipynb". The code cell contains the following Python code:

```

[39] #print directory list
print(*image_directories, sep = "\n")

for image_dir in image_directories:
    # load the image and preprocess it
    image = load_img(image_dir, target_size=(224, 224))
    image = img_to_array(image)

    # update our list of data, targets, and filenames
    data.append(image)

    # get the image name from the image dir
    #filename = image_dir[]
    filename = os.path.basename(image_dir)

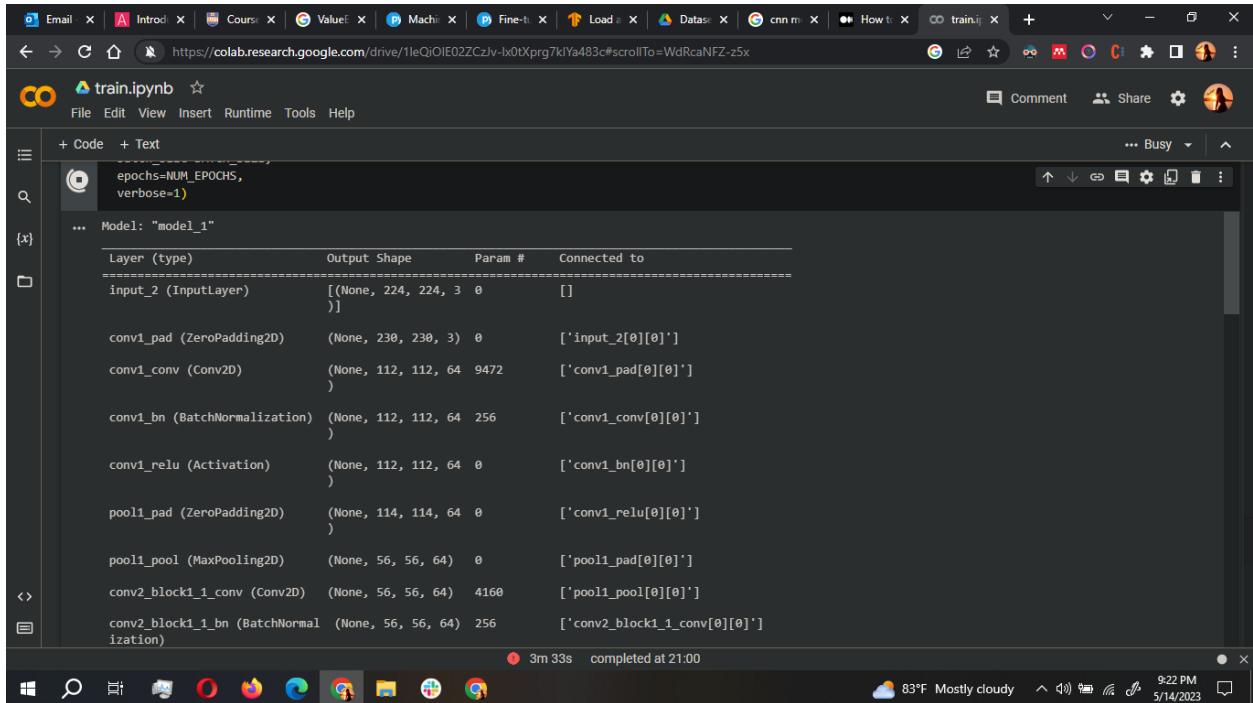
    # Printing the extracted last file names
    row_df = label_df.loc[label_df['filename'] == '1.jpg']
    new_x, new_y = row_df['new_x'], row_df['new_y']
    targets.append((new_x, new_y))
    filenames.append(filename)

# print directory list
print(*filenames, sep = "\n")

```

The status bar at the bottom indicates the cell completed at 16:57.

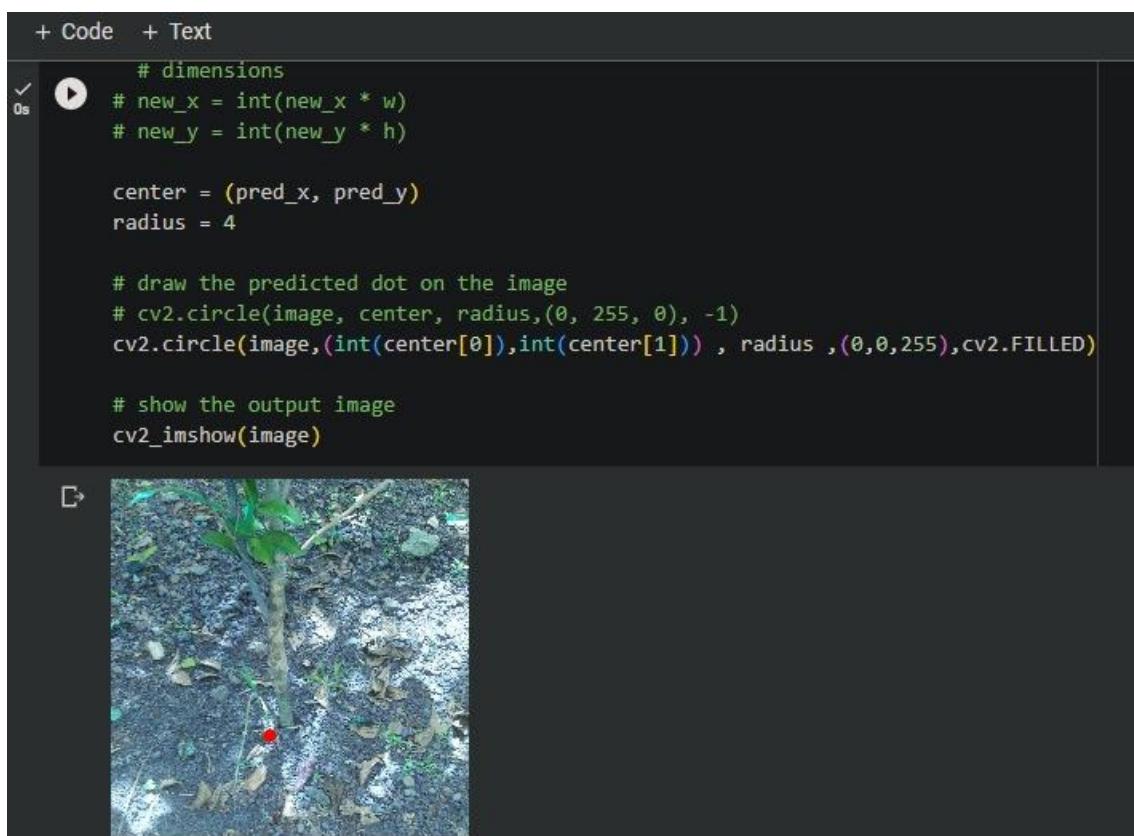
- Trained the model properly by overcome those issues.



```
train.ipynb
File Edit View Insert Runtime Tools Help
Comment Share ... Busy
+ Code + Text
epochs=NUM_EPOCHS,
verbose=1)
...
Model: "model_1"
Layer (type) Output Shape Param # Connected to
=====
input_2 (InputLayer) [(None, 224, 224, 3 0
)]
conv1_pad (ZeroPadding2D) (None, 230, 230, 3) 0 ['input_2[0][0]']
conv1_conv (Conv2D) (None, 112, 112, 64 9472 ['conv1_pad[0][0]']
conv1_bn (BatchNormalization) (None, 112, 112, 64 256 ['conv1_conv[0][0]']
conv1_relu (Activation) (None, 112, 112, 64 0 ['conv1_bn[0][0]']
pool1_pad (ZeroPadding2D) (None, 114, 114, 64 0 ['conv1_relu[0][0]']
pool1_pool (MaxPooling2D) (None, 56, 56, 64) 0 ['pool1_pad[0][0]']
conv2_block1_1_conv (Conv2D) (None, 56, 56, 64) 4160 ['pool1_pool[0][0]']
conv2_block1_1_bn (BatchNormalizat (None, 56, 56, 64) 256 ['conv2_block1_1_conv[0][0]']
ization)
```

3m 33s completed at 21:00

83°F Mostly cloudy 9:22 PM 5/14/2023



```
+ Code + Text
# dimensions
# new_x = int(new_x * w)
# new_y = int(new_y * h)

center = (pred_x, pred_y)
radius = 4

# draw the predicted dot on the image
# cv2.circle(image, center, radius,(0, 255, 0), -1)
cv2.circle(image,(int(center[0]),int(center[1])), radius ,(0,0,255),cv2.FILLED)

# show the output image
cv2_imshow(image)
```

Figure 3.6.1: ResNet50 model accurate results

```
✓ 0s # new_x = int(new_x * w)
# new_y = int(new_y * h)

center = (pred_x, pred_y)
radius = 4

# draw the predicted dot on the image
# cv2.circle(image, center, radius,(0, 255, 0), -1)
cv2.circle(image,(int(center[0]),int(center[1])), radius ,(0,0,255),cv2.FILLED)

# show the output image
cv2_imshow(image)
```



Figure 3.6.2: ResNet50 model accurate results

+ Code + Text

```
✓ 0s # new_x = int(new_x * w)
# new_y = int(new_y * h)

center = (pred_x, pred_y)
radius = 4

# draw the predicted dot on the image
# cv2.circle(image, center, radius,(0, 255, 0)
cv2.circle(image,(int(center[0]),int(center[1]

# show the output image
cv2_imshow(image)
```



```
+ Code + Text
✓ 0s  # new_x = int(new_x * w)
      # new_y = int(new_y * h)

    center = (pred_x, pred_y)
    radius = 4

    # draw the predicted dot on the image
    # cv2.circle(image, center, radius,(0, 255, 0), -1)
    cv2.circle(image,(int(center[0]),int(center[1])), radius ,(0,0,255),cv2.FILLED)

    # show the output image
    cv2_imshow(image)
```



Figure 3.6.3: ResNet50 model inaccurate results

```
+ Code + Text
✓ 0s  # new_x = int(new_x * w)
      # new_y = int(new_y * h)

    center = (pred_x, pred_y)
    radius = 4

    # draw the predicted dot on the image
    # cv2.circle(image, center, radius,(0, 255, 0), -1)
    cv2.circle(image,(int(center[0]),int(center[1])), radius ,(0,0,255),cv2.FILLED)

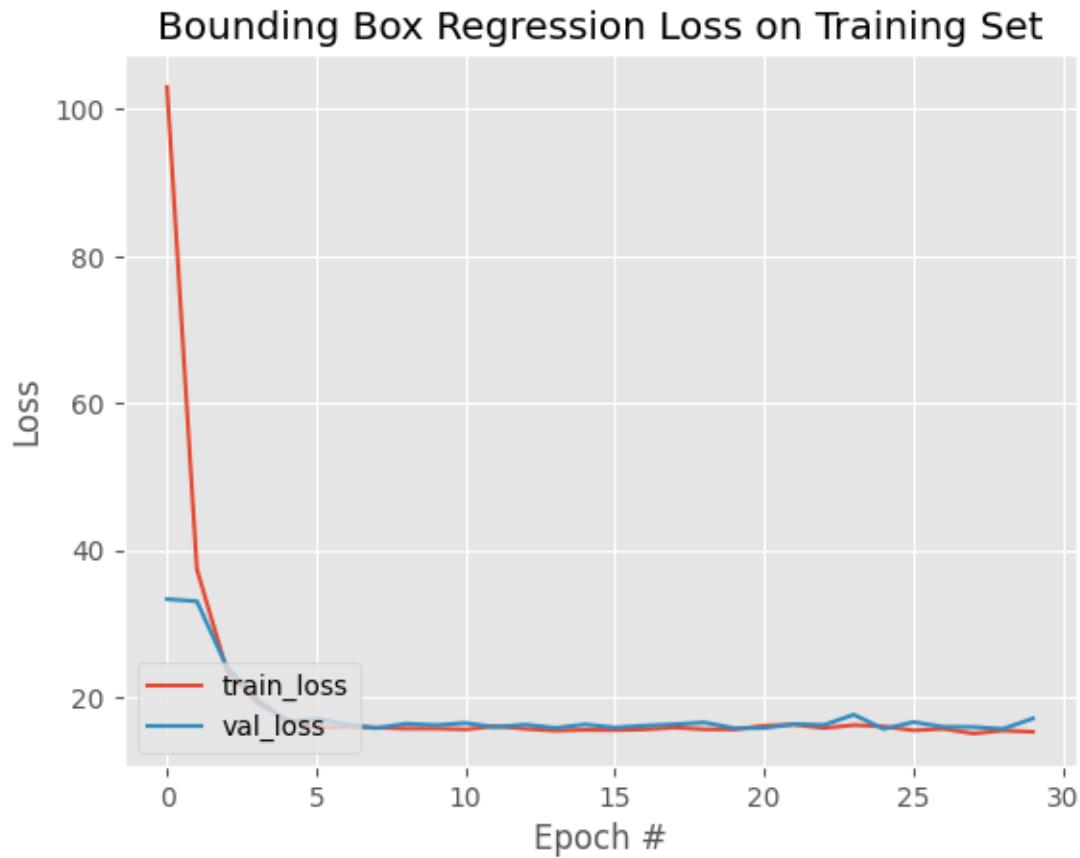
    # show the output image
    cv2_imshow(image)
```



Figure 3.6.4: ResNet50 model inaccurate results

```
Epoch 26/30
9/9 [=====] - 2s 255ms/step - loss: 15.1949 - accuracy: 0.9606 - val_loss: 14.0799 - val_accuracy: 1.0000
Epoch 27/30
9/9 [=====] - 2s 241ms/step - loss: 15.2958 - accuracy: 0.9606 - val_loss: 13.8940 - val_accuracy: 1.0000
Epoch 28/30
9/9 [=====] - 2s 242ms/step - loss: 15.4153 - accuracy: 0.9606 - val_loss: 13.9855 - val_accuracy: 1.0000
Epoch 29/30
9/9 [=====] - 2s 249ms/step - loss: 15.4054 - accuracy: 0.9606 - val_loss: 14.2795 - val_accuracy: 1.0000
Epoch 30/30
9/9 [=====] - 2s 245ms/step - loss: 15.4812 - accuracy: 0.9606 - val_loss: 15.1414 - val_accuracy: 1.0000
```

Figure 3.6.5: ResNet50 model summary



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.

The screenshot shows the Overleaf web interface. On the left, the file tree includes 'main.tex' (selected), 'MyReferences.bib', and several configuration files like 'IEEEabrv.bib', 'ieeconf.cls', 'IEEETran.bst', and 'IEEETran.cls'. The main area displays LaTeX code for a document section. A right-hand sidebar shows a review panel with a message from 'rajithamadhavaz' asking to put certain text in a sentence. The bottom status bar shows the date as Aug 25, 2023, at 3:18 PM.

```

\begin{equation}
\theta = 90^\circ - \beta + \gamma
\end{equation}

\begin{array}{l}
\text{Stabilized Angle} \\
\text{Robot Tilted Angle} \\
\text{Water Spraying Angle}
\end{array}

```

The screenshot shows the final research paper document. It contains a large block of text with numbered suggestions for improvement. At the bottom, there is a note from the author: "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!" and "Best Regards,
Rajitha".

1. Authors: Change my affiliation to: Lincoln Agri-Robotics, University of Lincoln, United Kingdom

2. 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.

3. Keywords: Limit to 5 keywords. My suggestion: precision agriculture, computer vision, robotics, machine learning, autonomous navigation

4. 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.

5. 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.

6. Methodology:

- In section B: 1800 and 3600? What are these numbers. Add units to these numbers.
- Equation 2 refers to Excess Green Index (ExG). Mention this and add the corresponding reference.

7. 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.

8. 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 3.7.3: Written Research Paper

- Due to high computational power in ResNet50 mode, Developed lightweight model based on ResNet50 model to identify the tea stem.
- Compared the ResNet50 model answer with the developed lightweight model, which is MobileNetV2 got an 90% of accuracy.
- While developing the MobileNetV2 model encountered the error below and overcome those by refereeing to the internet resources.

Model: "model_6"			
Layer (type)	Output Shape	Param #	Connected to
input_7 (InputLayer)	[(None, 224, 224, 3 0)]		[]
Conv1 (Conv2D)	(None, 112, 112, 32 864)		['input_7[0][0]']
bn_Conv1 (BatchNormalization)	(None, 112, 112, 32 128)		['Conv1[0][0]']
Conv1_relu (ReLU)	(None, 112, 112, 32 0)		['bn_Conv1[0][0]']
expanded_conv_depthwise (Depth wiseConv2D)	(None, 112, 112, 32 288)		['Conv1_relu[0][0]']
expanded_conv_depthwise_BN (BatchNormalization)	(None, 112, 112, 32 128)		['expanded_conv_depthwise[0][0]']
expanded_conv_depthwise_relu (ReLU)	(None, 112, 112, 32 0)		['expanded_conv_depthwise_BN[0][0]']
expanded_conv_project (Conv2D)	(None, 112, 112, 16 512)		['expanded_conv_depthwise_relu[0][0]']
expanded_conv_project_BN (BatchNormalization)	(None, 112, 112, 16 64)		['expanded_conv_project[0][0]']

Figure 3.7.8 : MobileNetV2 model layers 1

block_15_depthwise_BN (BatchNormalizat	(None, 7, 7, 960)	3840	['block_15_depthwise[0][0]']
block_15_depthwise_relu (ReLU)	(None, 7, 7, 960)	0	['block_15_depthwise_BN[0][0]']
block_15_project (Conv2D)	(None, 7, 7, 160)	153600	['block_15_depthwise_relu[0][0]']
block_15_project_BN (BatchNorma	(None, 7, 7, 160)	640	['block_15_project[0][0]']
lization)			
block_15_add (Add)	(None, 7, 7, 160)	0	['block_14_add[0][0]', 'block_15_project_BN[0][0]']
block_16_expand (Conv2D)	(None, 7, 7, 960)	153600	['block_15_add[0][0]']
block_16_expand_BN (BatchNorma	(None, 7, 7, 960)	3840	['block_16_expand[0][0]']
lization)			
block_16_expand_relu (ReLU)	(None, 7, 7, 960)	0	['block_16_expand_BN[0][0]']
block_16_depthwise (DepthwiseC	(None, 7, 7, 960)	8640	['block_16_expand_relu[0][0]']
onv2D)			
block_16_depthwise_BN (BatchNormalizat	(None, 7, 7, 960)	3840	['block_16_depthwise[0][0]']
lization)			
block_16_depthwise_relu (ReLU)	(None, 7, 7, 960)	0	['block_16_depthwise_BN[0][0]']
block_16_project (Conv2D)	(None, 7, 7, 320)	307200	['block_16_depthwise_relu[0][0]']
block_16_project_BN (BatchNorma	(None, 7, 7, 320)	1280	['block_16_project[0][0]']
lization)			
Conv_1 (Conv2D)	(None, 7, 7, 1280)	409600	['block_16_project_BN[0][0]']
Conv_1_bn (BatchNormalizat	(None, 7, 7, 1280)	5120	['Conv_1[0][0]']
lization)			
out_relu (ReLU)	(None, 7, 7, 1280)	0	['Conv_1_bn[0][0]']
global_average_pooling2d_6 (Glo	(None, 1280)	0	['out_relu[0][0]']
balAveragePooling2D)			

Figure 3.7.8 : MobileNetV2 model layers 2

```

# new_y = int(new_y * h)
center = (pred_x, pred_y)
radius = 4

# draw the predicted dot on the image
# cv2.circle(image, center, radius,(0, 255, 0), -1)
cv2.circle(image,(int(center[0]),int(center[1])), radius ,(0,0,255),cv2.FILLED)

# show the output image
cv2.imshow(image)

```

Figure 3.7.9 : ResNet5 model answer

```

# draw the predicted dot on the image
# cv2.circle(image, center, radius,(0, 255, 0), -1)
cv2.circle(image,(int(center[0]),int(center[1])), radius ,(0,0,255),cv2.FILLED)

# show the output image
cv2.imshow(image)

1/1 [=====] - 2s 2s/step
Predicted x: 109.27317810058594
Predicted y: 168.06283569335938

```

Figure 3.7.8 :MobileNetV2 model answer

3.8 2023 July 1st to 31th

- In early September, a significant milestone was reached when we submitted the second project progress report (PP2) on September 4th. This report played a vital role in updating stakeholders on the current status and progress of our project. It highlighted the noteworthy developments and achievements we had accomplished.
- Concurrently, throughout the month of September, we dedicated ourselves to the creation of the final report draft, which had a submission deadline of September 10th. This comprehensive document encompassed the entire journey of our project, starting from its inception and concluding with its completion.
- In the latter stages of our project, we entered the integration phase, a critical component of the research process. During this phase, we brought together all the project components and conducted extensive testing in a real-world setting. This enabled us to evaluate the functionality and performance of the integrated system. Additionally, we made essential optimizations to fine-tune the system's performance, ensuring it aligned with the desired standards and objectives. This meticulous testing and optimization phase played a pivotal role in ensuring the successful and effective outcome of our project

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.
- Due to failure in lightweight model changed the model using computer vision.



Figure 3.9.1 : Accurate result of the computer vision-based approach

- 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

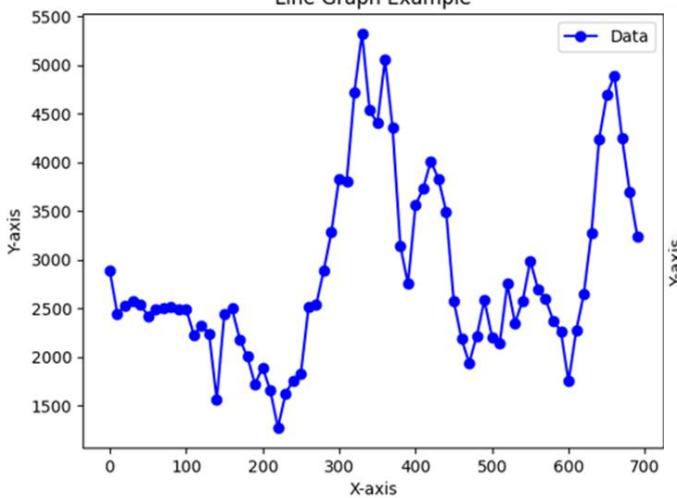
- On the 4th of the month, we conducted the second project progress report (PP2) viva, a critical assessment of our project's progress and findings. During this viva, we had the opportunity to engage in a comprehensive discussion with our supervisor, addressing the advice and feedback provided. These 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

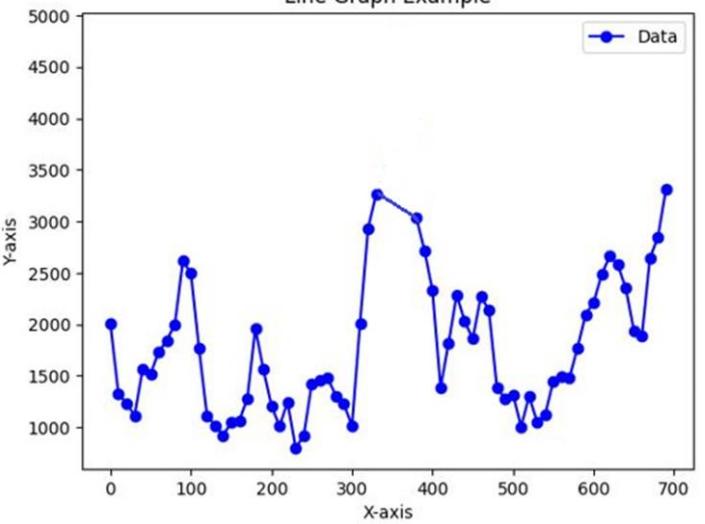
- Our research paper was completed and published.
- We practiced for the final viva which is scheduled on 31st October, and the optimization made for the autonomous navigation component were presented during the viva.



Line Graph Example



Line Graph Example



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.