

STATUS DOCUMENT 2

“TeaBot” – Tea Plantation Preservation Using an Intelligent Robot.



STUDENT NAME: PERERA P.V.Y

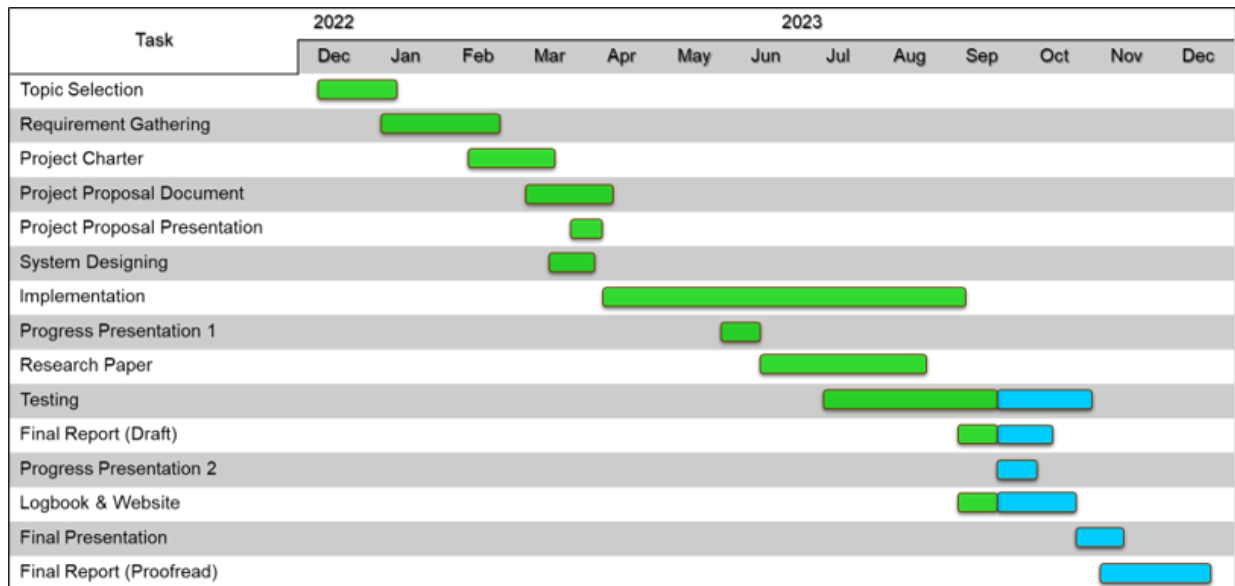
STUDENT NUMBER: IT20382476

GROUP ID: 2023-044

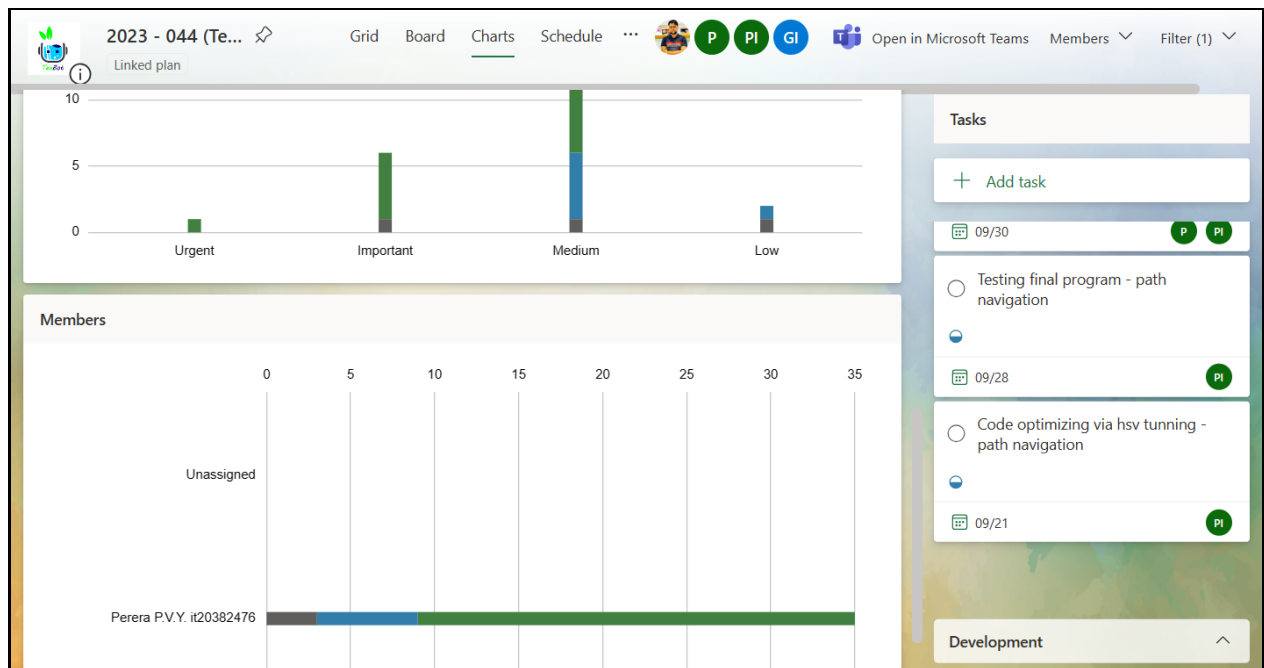
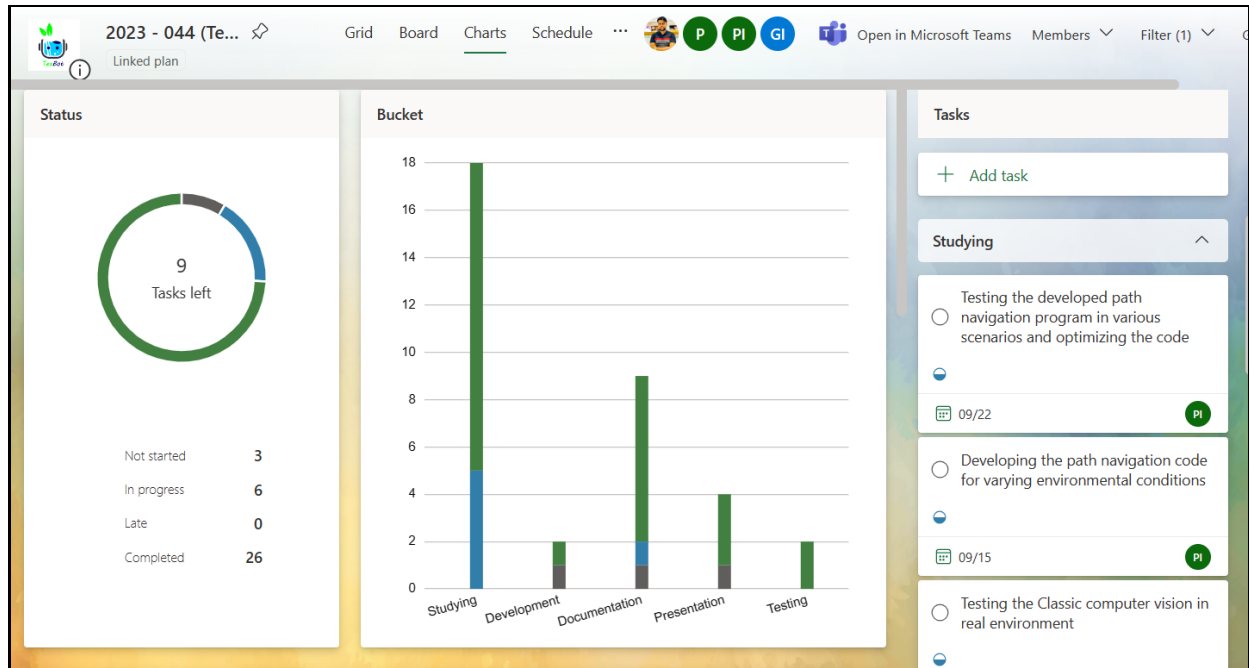
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1 GANNT CHART



2 PROJECT VIEWS MS PLANNER

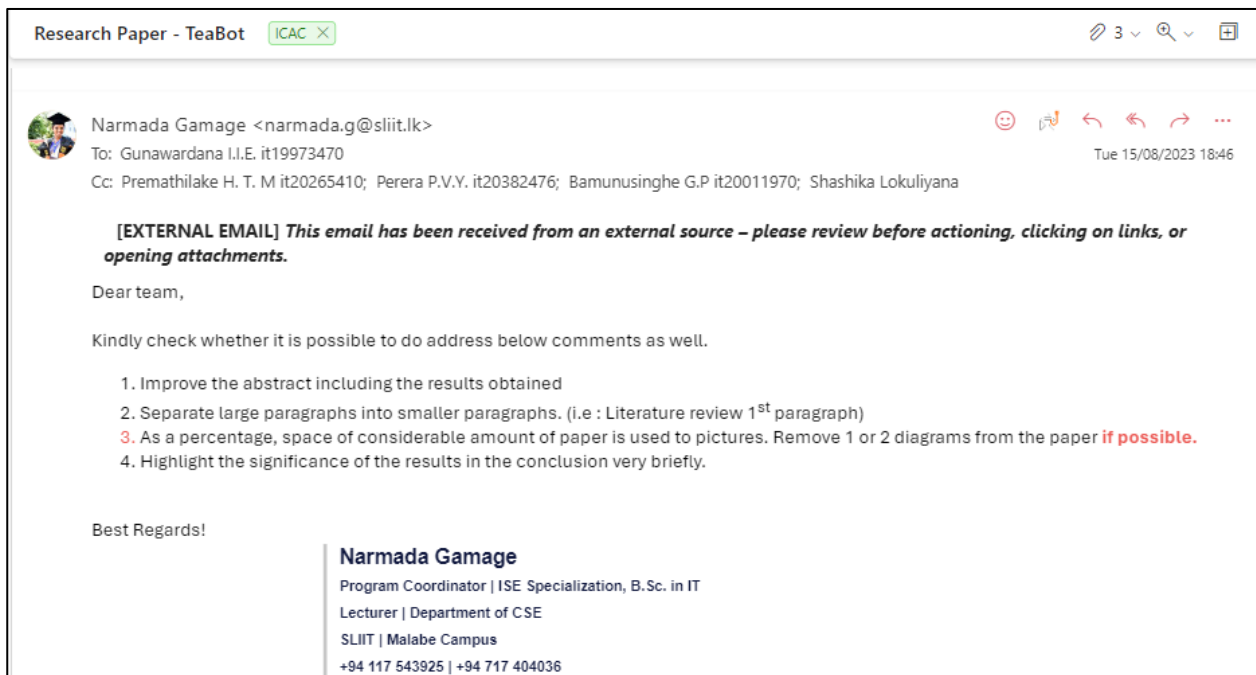
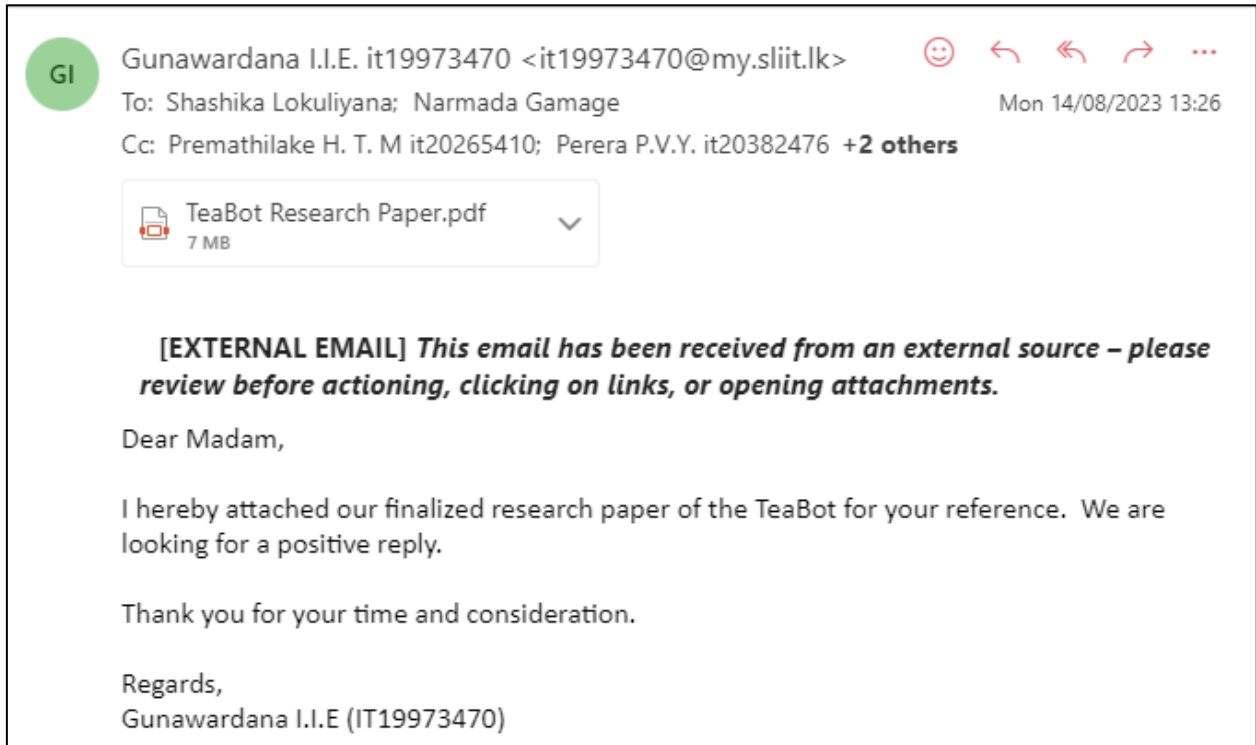


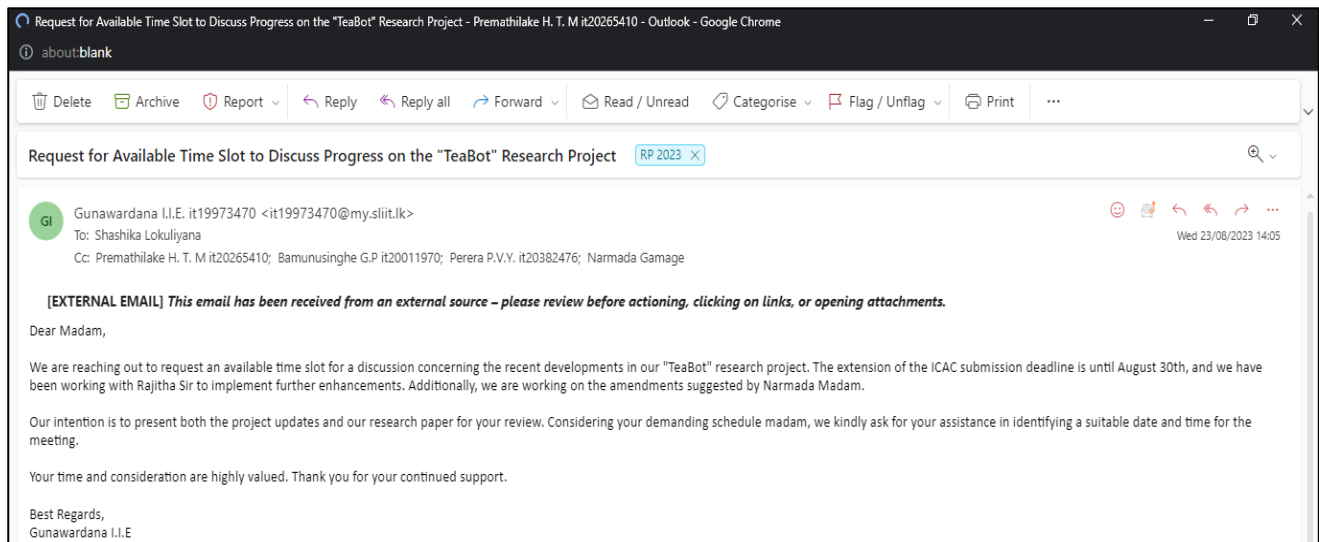
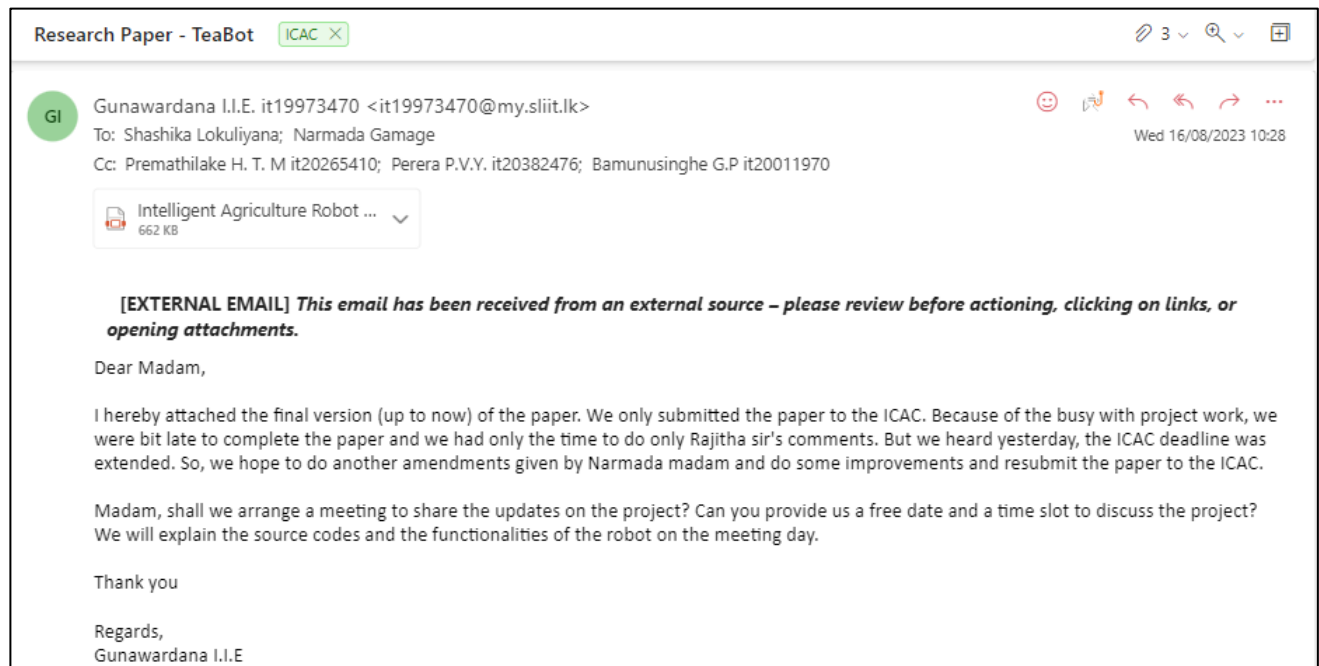
3 WORK BREAK DOWN STRUCTURE MS PLANNER

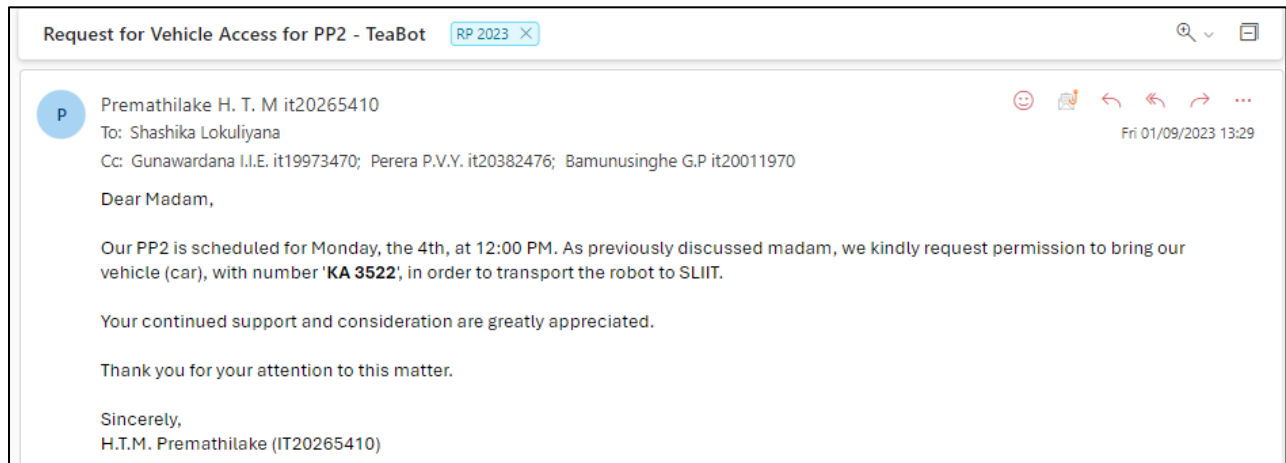
The screenshot displays the Microsoft Planner interface for a project titled "2023 - 044 (TeaBot)". The interface is organized into five main columns: Studying, Development, Documentation, Presentation, and Testing. Each column contains a list of tasks with their respective due dates and completion status. The "Studying" column has four tasks, the "Development" column has one, the "Documentation" column has three, the "Presentation" column has three, and the "Testing" column has two. The "Completed tasks" section on the right shows a total of 2 completed tasks.

Column	Task	Due Date	Status	Assignee
Studying	Testing the developed path navigation program in various scenarios and optimizing the code	09/22	Planned	PI
	Developing the path navigation code for varying environmental conditions	09/15	Planned	PI
	Testing the Classic computer vision in real environment	09/30	Planned	P, PI
	Testing final program - path navigation	09/28	Planned	PI
Development	Project Website	11/06	Planned	GI, P, +1
	Completed tasks	1	Completed	PI
Documentation	Research Logbook	10/30	Planned	GI, P, +1
	Final Report - IT20382476	09/10	Planned	PI
	Completed tasks	7	Completed	PI
Presentation	Final Presentation and Viva	09/28	Planned	GI, P, +1
	Completed tasks	3	Completed	PI
	Completed tasks	2	Completed	PI

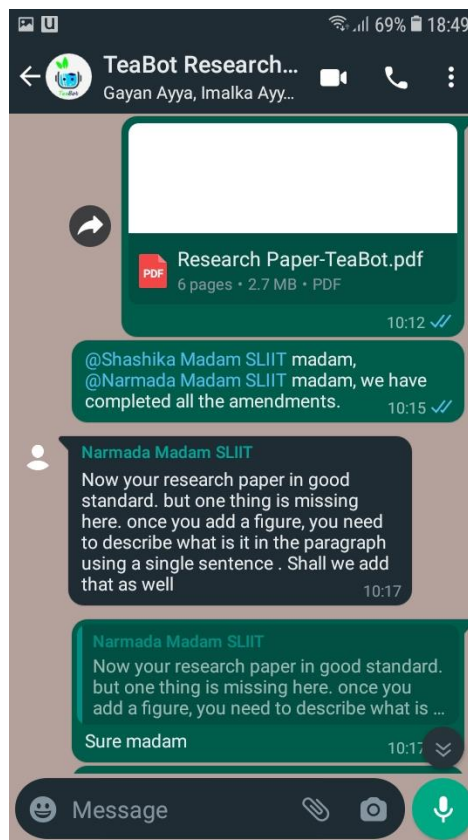
4 EMAILS, MEETINGS WITH SUPERVISOR, CO-SUPERVISOR



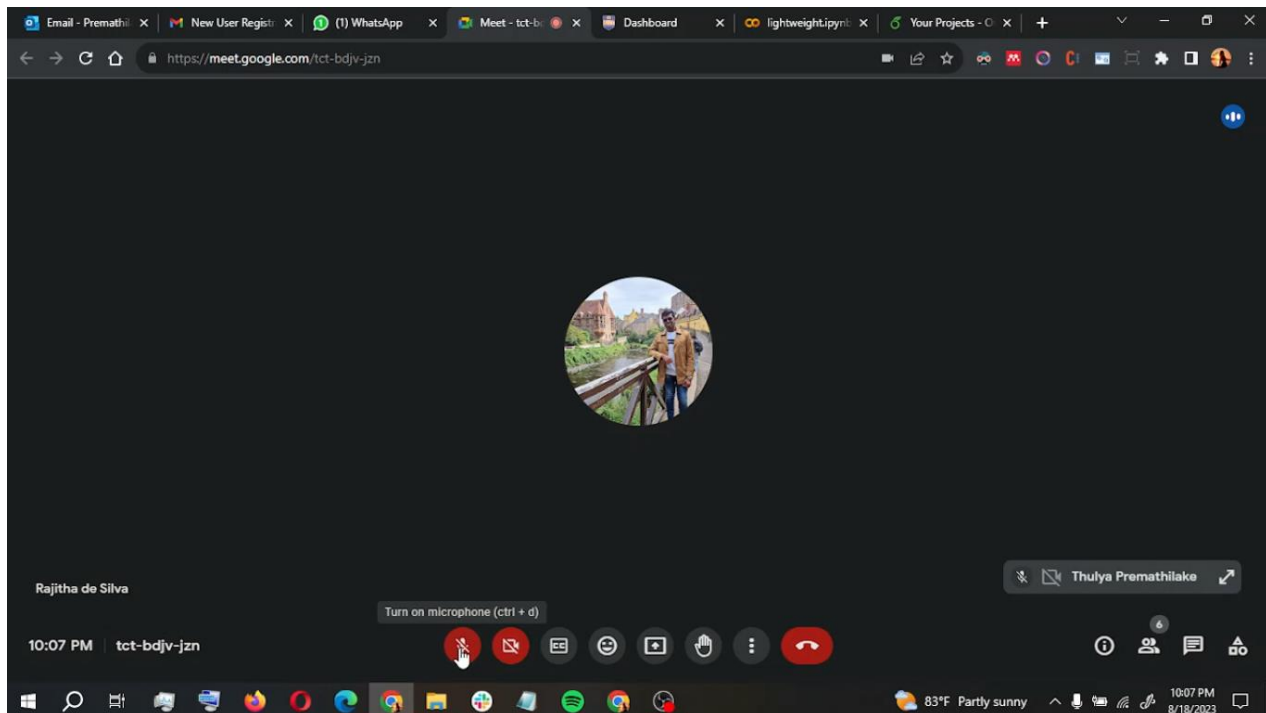
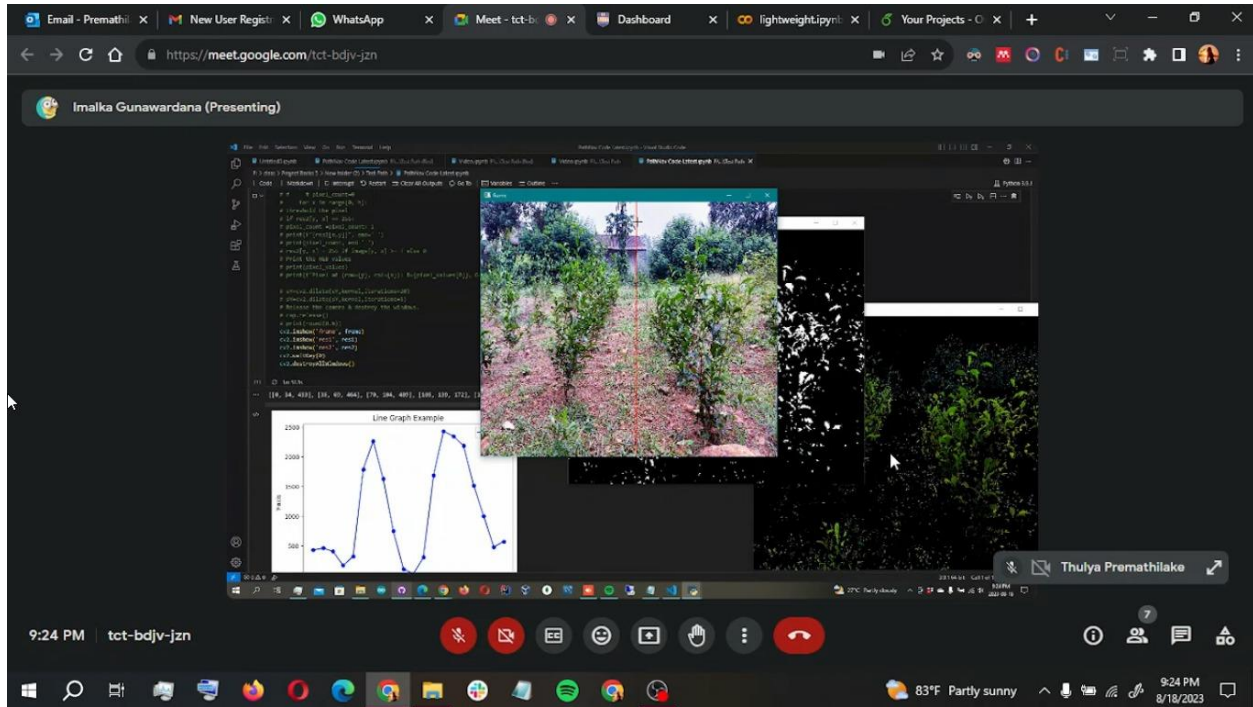




WhatsApp conversations with the supervisor and co-supervisor



5 EMAILS, MEETINGS WITH EXTERNAL SUPERVISOR



Discussions regarding research paper with external supervisor Dr Rajitha De Silva.

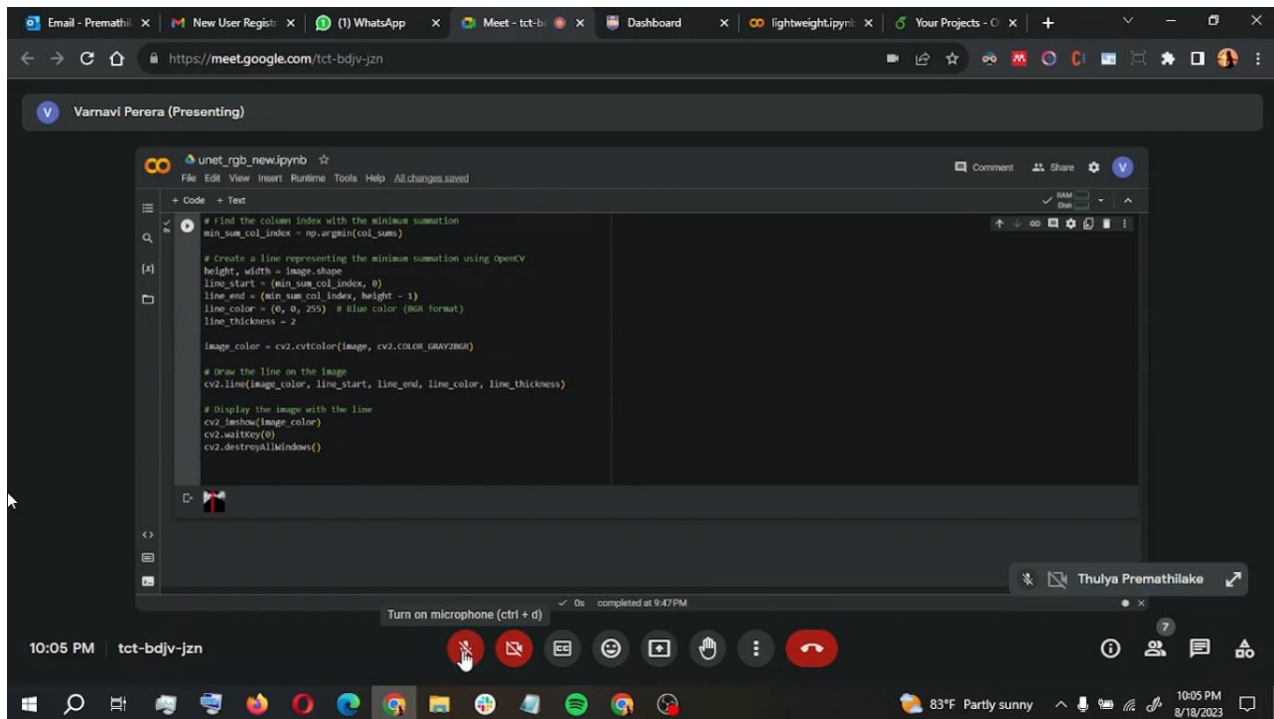
Research Paper - Teabot

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.

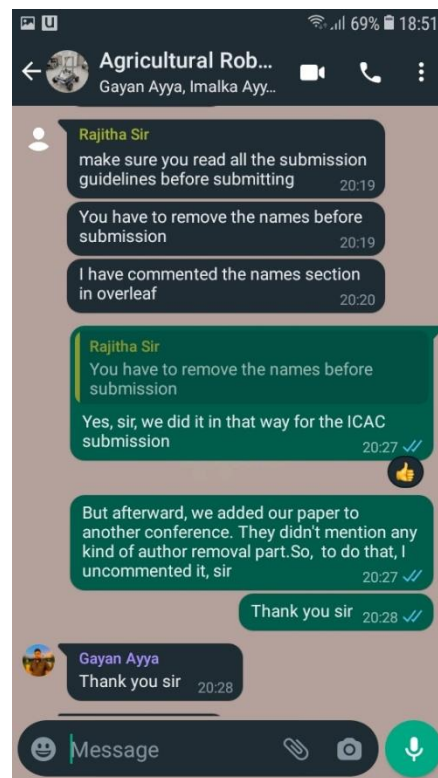
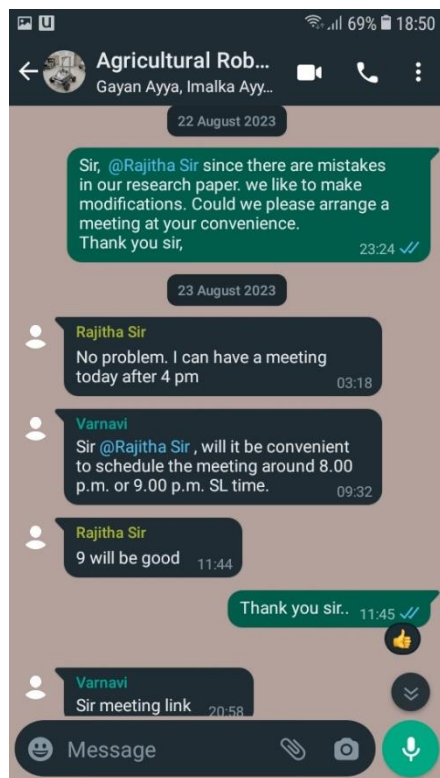
1. **Authors:** Change my affiliation to: Lincoln Agri-Robotics, University of Lincoln, United Kingdom
2. **Abstract:**
 1. Avoid referring too much to Sri Lanka and ceylon tea because it takes away the generality of the paper. Your paper should read like a scientific document and hence, significance 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.
 2. 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:**
 1. Avoid repetition of sentences from abstract. Rephrase the 1st sentence.
 2. Add a few references in introduction when you talk about GDP, ceylon tea and labour.
 3. 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.
 4. Add a few bullet points at the end of introduction highlighting your key deliverables of this research. See attached example image.
5. **Lit. Review:**
 1. Remove first sentence. No need to clarify that.
 2. 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:**
 1. In section B: 1800 and 3800? What are these numbers. Add units to these numbers.
 2. 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"
 1. 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:**
 1. Remove 1st sentence. No need to introduce what conclusion is.
 2. 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!

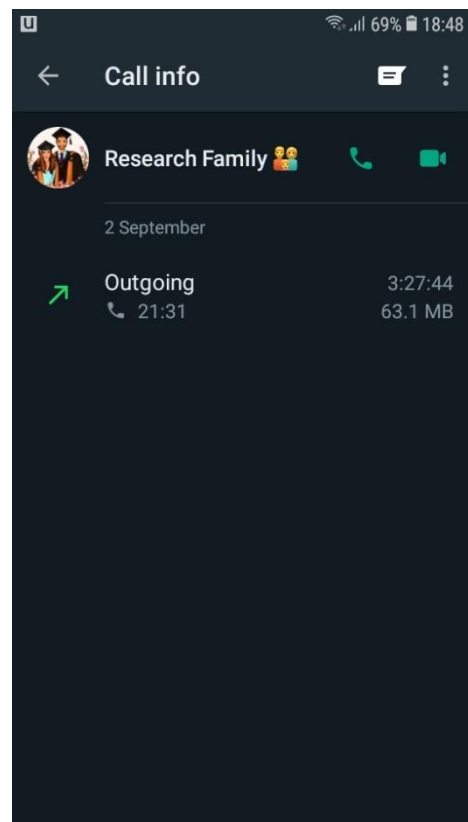
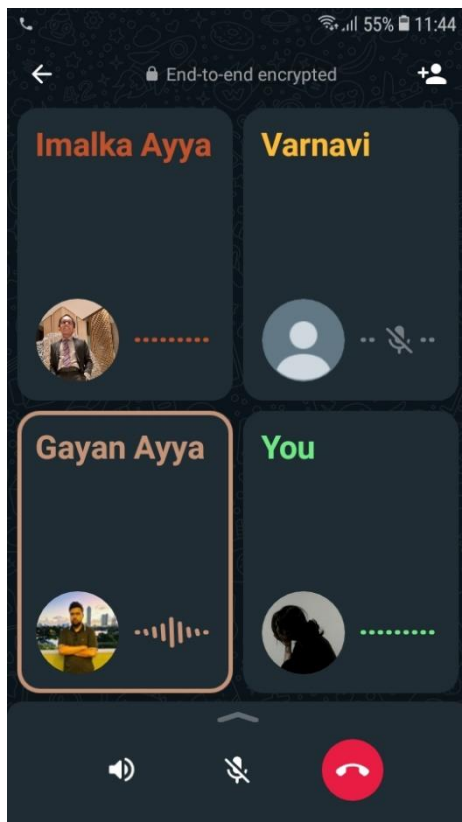
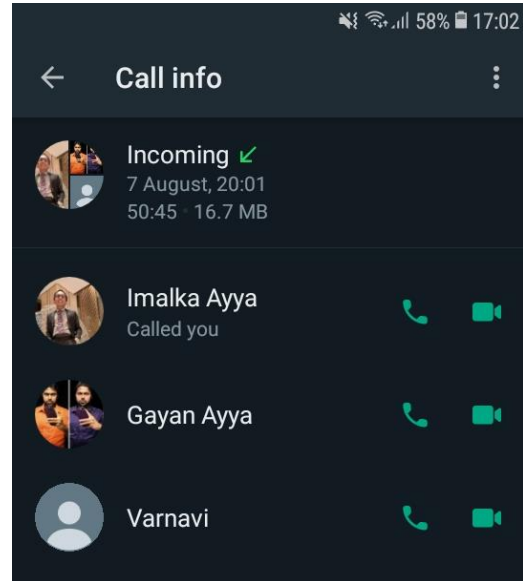
Best Regards,
Rajitha



WhatsApp conversations with the external supervisor.



WhatsApp conversations with the team members.



6 MS TEAMS AND CALLS

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

...

PI

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

Reply

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

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

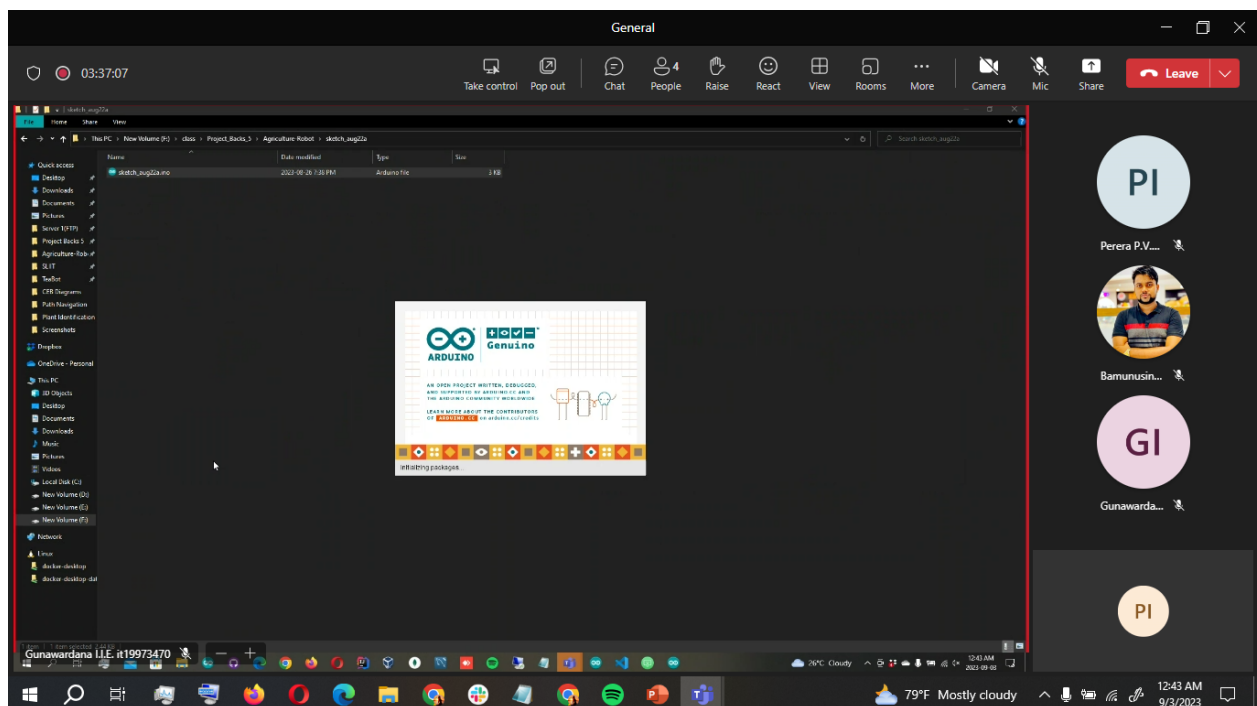
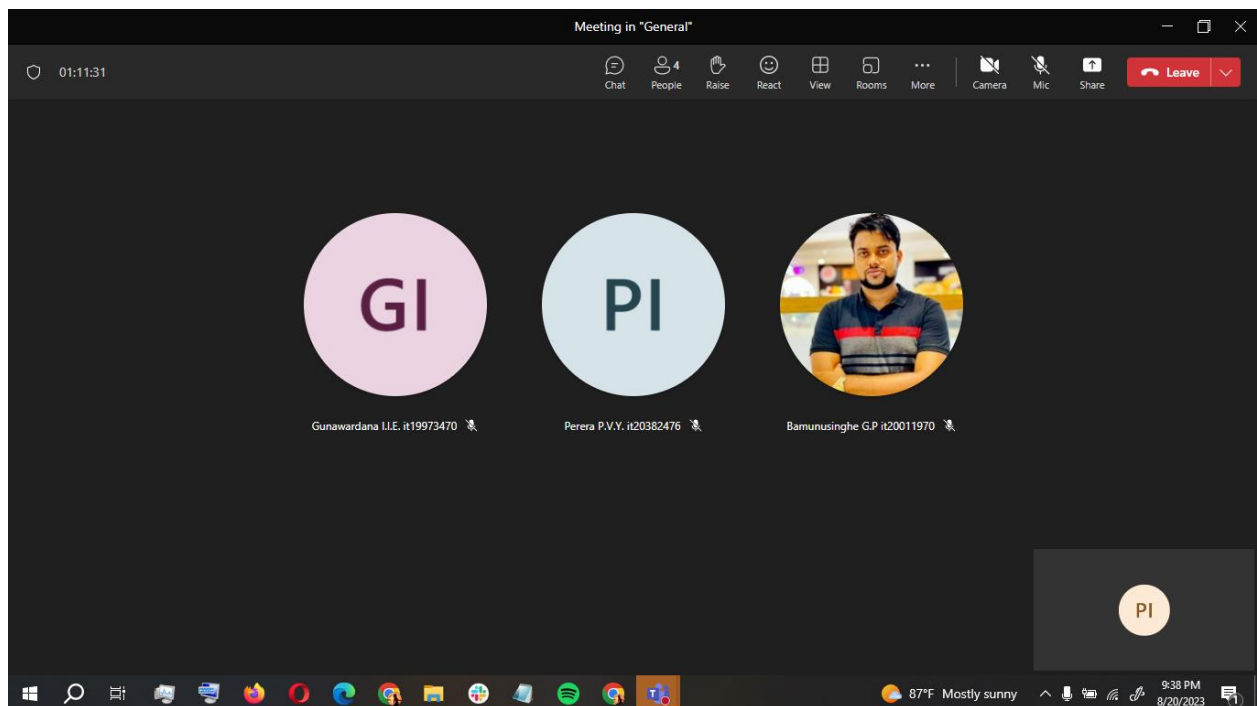
General
Posts
Files
Tasks
+

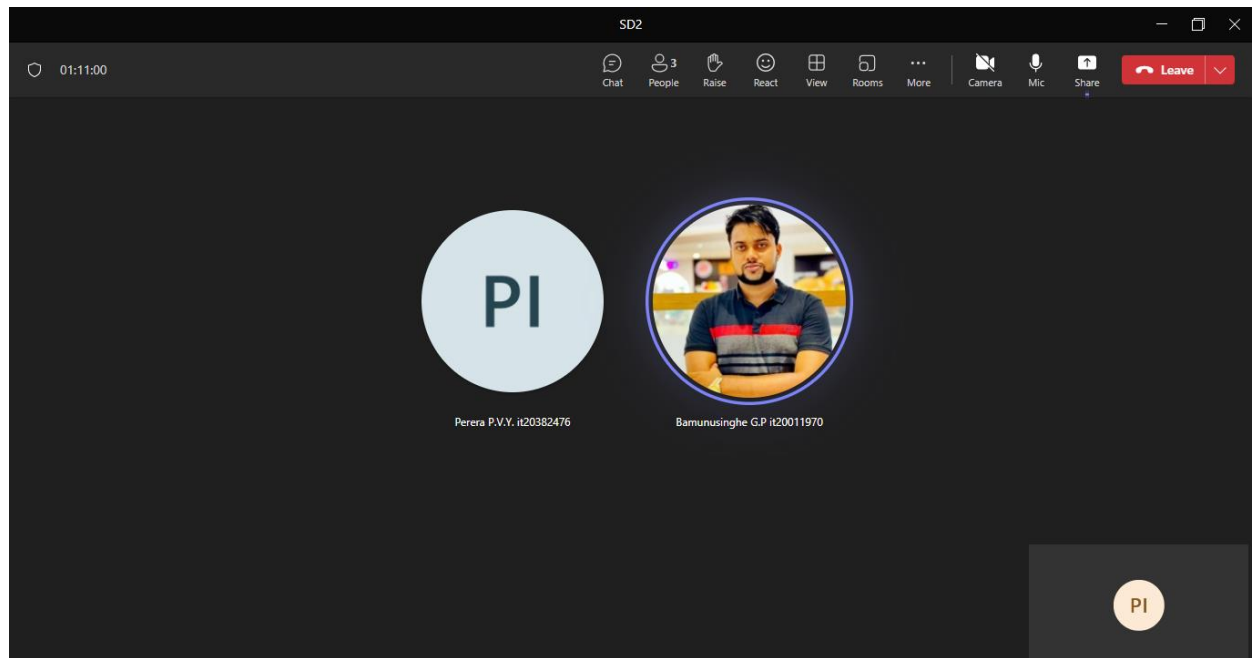
Meet

+ 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...

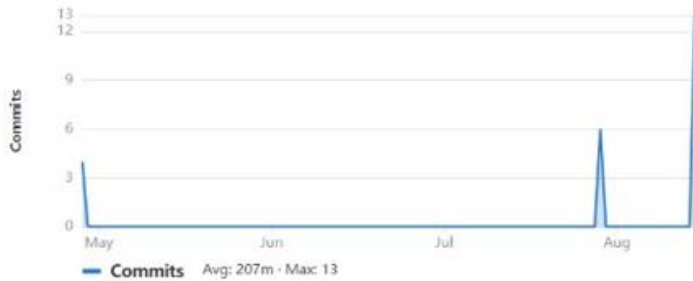




7 GITLAB GRAPHS

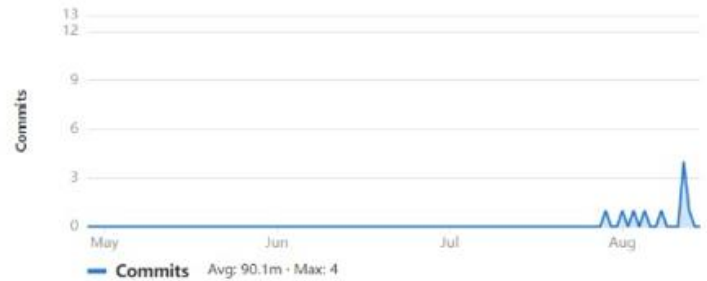
Gunawardana I.I.E

23 commits (it19973470@my.sliit.lk)



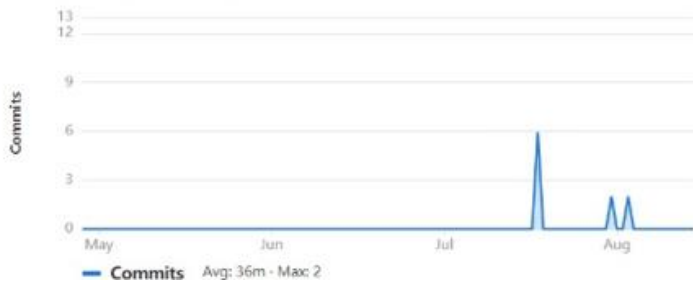
Bamunusinghe G.P

10 commits (it20011970@my.sliit.lk)



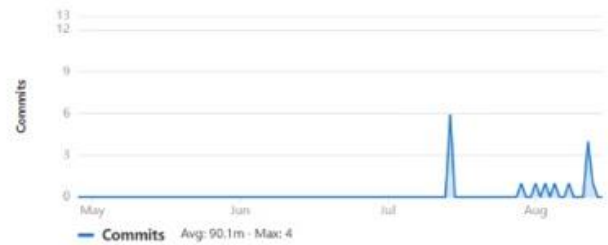
Premathilake H.T.M

9 commits (it20265410@my.sliit.lk)



Perera P.V.Y

10 commits (it20382476@my.sliit.lk)



8 DEVELOPED PROTOTYPE

Screenshots derived for the dataset creation.

```
[C] Creating training images...  
['/content/drive/MyDrive/TeaBot Research Dataset/TEABOT/model/train/image/145.jpg', '/content/drive/MyDrive/TeaBot Research Dataset/TEABOT/model/train/image/146.jpg', ...]  
Done: 0/614 images  
Done: 100/614 images  
Done: 200/614 images  
Done: 300/614 images  
Done: 400/614 images  
Done: 500/614 images  
Done: 600/614 images  
loading done  
Saving to .npy files done.  
Creating testall images...  
loading done  
Saving to .npy files done.  
Creating test images...  
loading done  
Saving to imgs_test.npy files done.  
Creating validation images...  
loading done  
Saving to .npy files done.
```

U-Net Model development.

```
KerasTensor(type_spec=TensorSpec(shape=(None, 32, 32, 64), dtype=tf.float32, name=None), name='conv2d_21/ReLU',
conv9 shape: (None, 32, 32, 2)
KerasTensor(type_spec=TensorSpec(shape=(None, 32, 32, 1), dtype=tf.float32, name=None), name='conv2d_23/Sigmoid',
Model: "model"
```

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_10[0][0]']
conv2d_11 (Conv2D)	(None, 4, 4, 32)	18464	['concatenate[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]']

```

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
load train images...
-----
load test images...
-----
load test label images...
-----
load train images...
loading data done
conv1 shape: (None, 32, 32, 64)
conv1 shape: (None, 32, 32, 64)
pool1 shape: (None, 16, 16, 64)
conv2 shape: (None, 16, 16, 128)
conv2 shape: (None, 16, 16, 128)
pool2 shape: (None, 8, 8, 128)
conv3 shape: (None, 8, 8, 256)

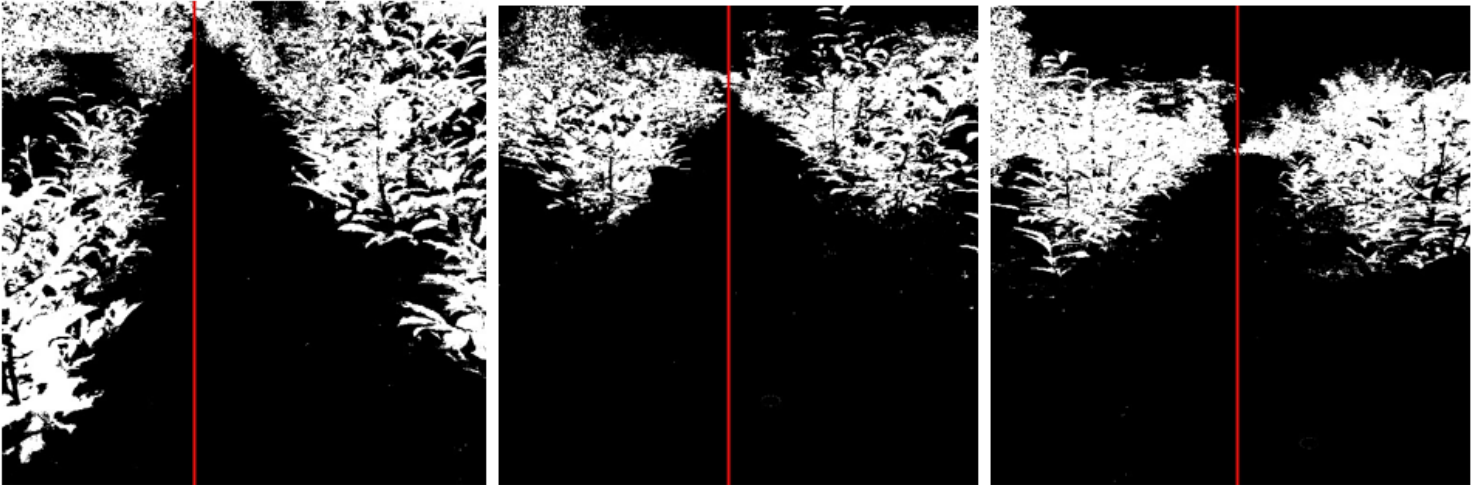
```

```

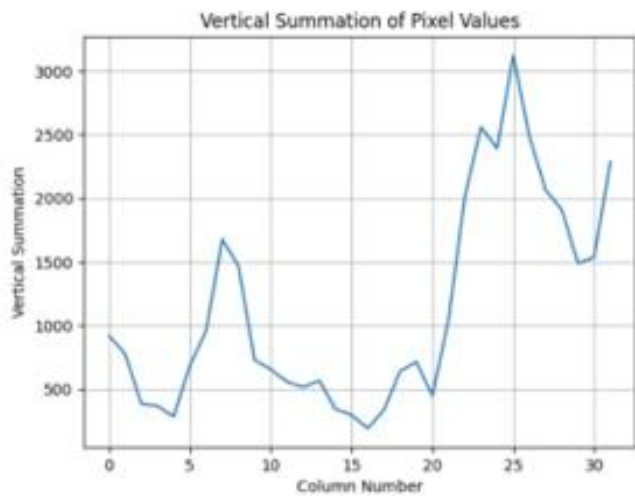
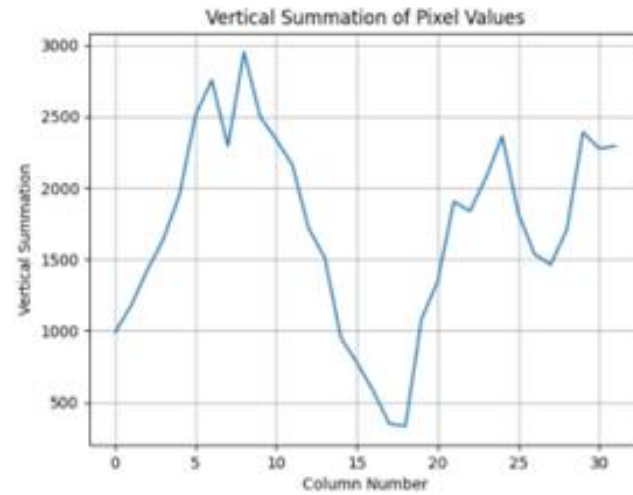
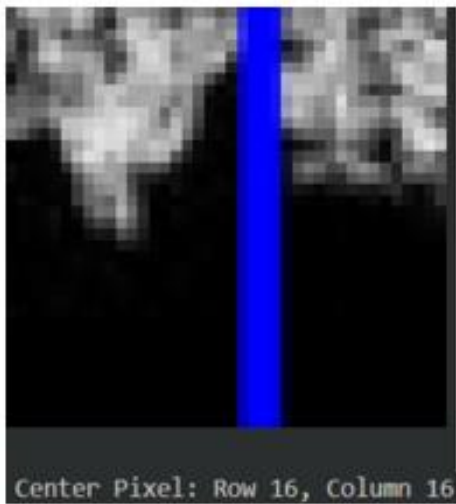
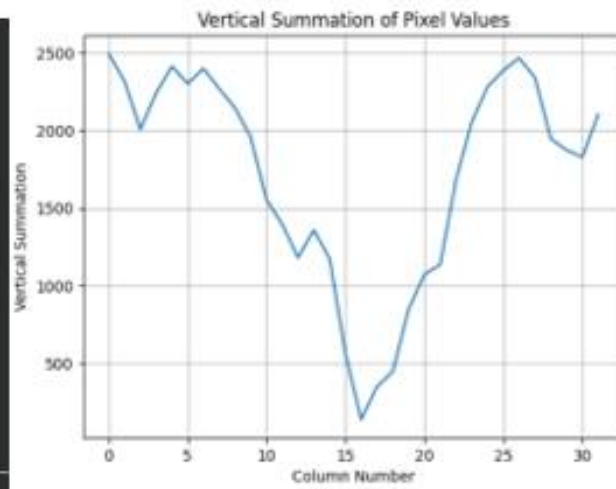
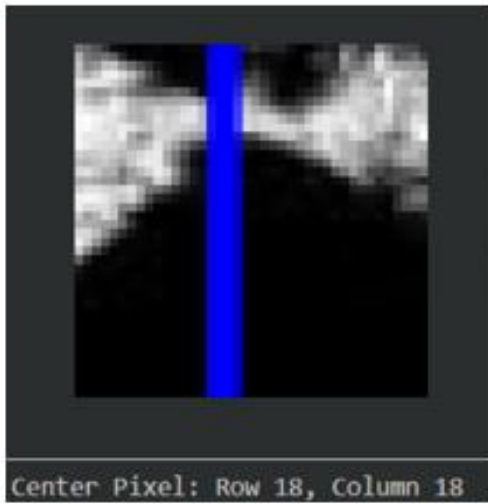
KerasTensor(type_spec=TensorSpec(shape=(None, 8, 8, 512), dtype=tf.float32, name=None), name='concatenate_5/concat:0', description="created by 1")
KerasTensor(type_spec=TensorSpec(shape=(None, 8, 8, 256), dtype=tf.float32, name=None), name='conv2d_38/Relu:0', description="created by 1")
KerasTensor(type_spec=TensorSpec(shape=(None, 8, 8, 256), dtype=tf.float32, name=None), name='conv2d_39/Relu:0', description="created by 1")
KerasTensor(type_spec=TensorSpec(shape=(None, 32, 32, 64), dtype=tf.float32, name=None), name='conv2d_43/Relu:0', description="created by 1")
KerasTensor(type_spec=TensorSpec(shape=(None, 32, 32, 128), dtype=tf.float32, name=None), name='concatenate_7/concat:0', description="created by 1")
KerasTensor(type_spec=TensorSpec(shape=(None, 32, 32, 64), dtype=tf.float32, name=None), name='conv2d_44/Relu:0', description="created by 1")
KerasTensor(type_spec=TensorSpec(shape=(None, 32, 32, 64), dtype=tf.float32, name=None), name='conv2d_45/Relu:0', description="created by 1")
conv9 shape: (None, 32, 32, 2)
KerasTensor(type_spec=TensorSpec(shape=(None, 32, 32, 1), dtype=tf.float32, name=None), name='conv2d_47/Sigmoid:0', description="created by 1")
got unet
Fitting model...
Epoch 1/2
WARNING:tensorflow:5 out of the last 5 calls to <function _BaseOptimizer.update_step_xla at 0x7faa502ddcf0> triggered tf.function retracing
WARNING:tensorflow:6 out of the last 6 calls to <function _BaseOptimizer.update_step_xla at 0x7faa502ddcf0> triggered tf.function retracing
491/491 [=====] - ETA: 0s - loss: 0.3750 - accuracy: 0.7989 - iou: 0.2100
Epoch 1: iou improved from -inf to 0.21002, saving model to /content/drive/MyDrive/TeaBot Research Dataset/TEABOT/model/model.hdf5
491/491 [=====] - 79s 126ms/step - loss: 0.3750 - accuracy: 0.7989 - iou: 0.2100 - val_loss: 0.4103 - val_accuracy: 0.2100
Epoch 2/2
491/491 [=====] - ETA: 0s - loss: 0.3490 - accuracy: 0.8245 - iou: 0.2227
Epoch 2: iou improved from 0.21002 to 0.22273, saving model to /content/drive/MyDrive/TeaBot Research Dataset/TEABOT/model/model.hdf5
491/491 [=====] - 60s 122ms/step - loss: 0.3490 - accuracy: 0.8245 - iou: 0.2227 - val_loss: 0.4126 - val_accuracy: 0.2227
Epoch 1/4
307/307 [=====] - ETA: 0s - loss: 0.3463 - accuracy: 0.8389 - iou: 0.2614
Epoch 1: iou improved from 0.22273 to 0.26144, saving model to /content/drive/MyDrive/TeaBot Research Dataset/TEABOT/model/model.hdf5
307/307 [=====] - 38s 119ms/step - loss: 0.3463 - accuracy: 0.8389 - iou: 0.2614
Epoch 2/4
307/307 [=====] - ETA: 0s - loss: 0.3410 - accuracy: 0.8428 - iou: 0.2651
Epoch 2: iou improved from 0.26144 to 0.26513, saving model to /content/drive/MyDrive/TeaBot Research Dataset/TEABOT/model/model.hdf5
307/307 [=====] - 35s 116ms/step - loss: 0.3410 - accuracy: 0.8428 - iou: 0.2651
Epoch 3/4
307/307 [=====] - ETA: 0s - loss: 0.3380 - accuracy: 0.8439 - iou: 0.2673
Epoch 3: iou improved from 0.26513 to 0.26734, saving model to /content/drive/MyDrive/TeaBot Research Dataset/TEABOT/model/model.hdf5
307/307 [=====] - 35s 115ms/step - loss: 0.3380 - accuracy: 0.8439 - iou: 0.2673
Epoch 4/4

```

Results derived from the U-Net semantic segmentation model.



Due to the high resource consumption of the U-Net model and the algorithm developed to capture the actual path. The size of the images was converted to 32 x 32, and a graph was visualized to discuss the results of the model. The X-axis derives the column index, and the y-axis derives the pixel value summation for each vertical column.



Also, a classic computer vision-based algorithm was developed due to the low accuracy, and high resource consumption of the U-Net model. The algorithm was developed using the OpenCV python library and HSV color space. Results of the algorithm is,



To discuss the results further graphs were developed. X-axis represents the column index and Y-axis represents the vertical column pixel summation for each column. The graph shows a mean-shifted double gaussian shape.

