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# STATUS DOCUMENT 1

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“TeaBot” – Tea plantation preservation using an intelligent robot.



STUDENT NAME: GUNAWARDANA I.I.E

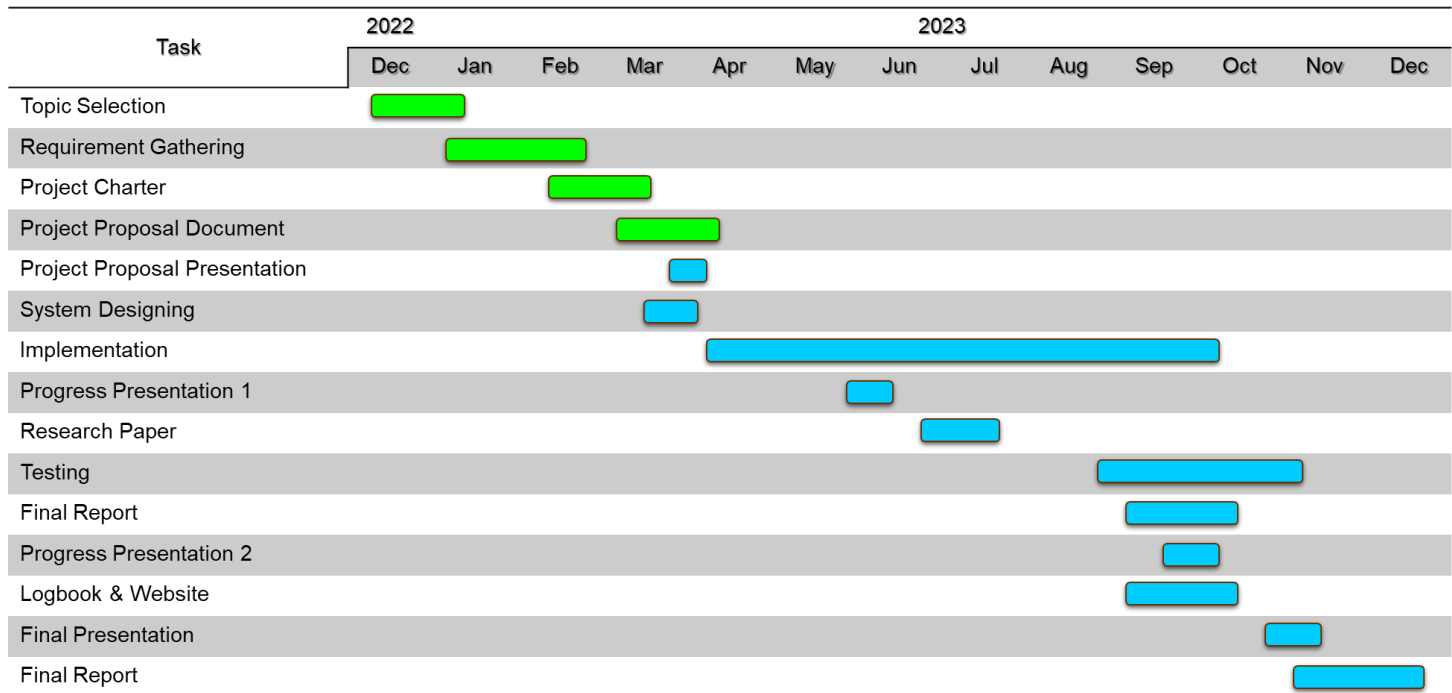
STUDENT NUMBER: IT19973470

GROUP ID:2023-044

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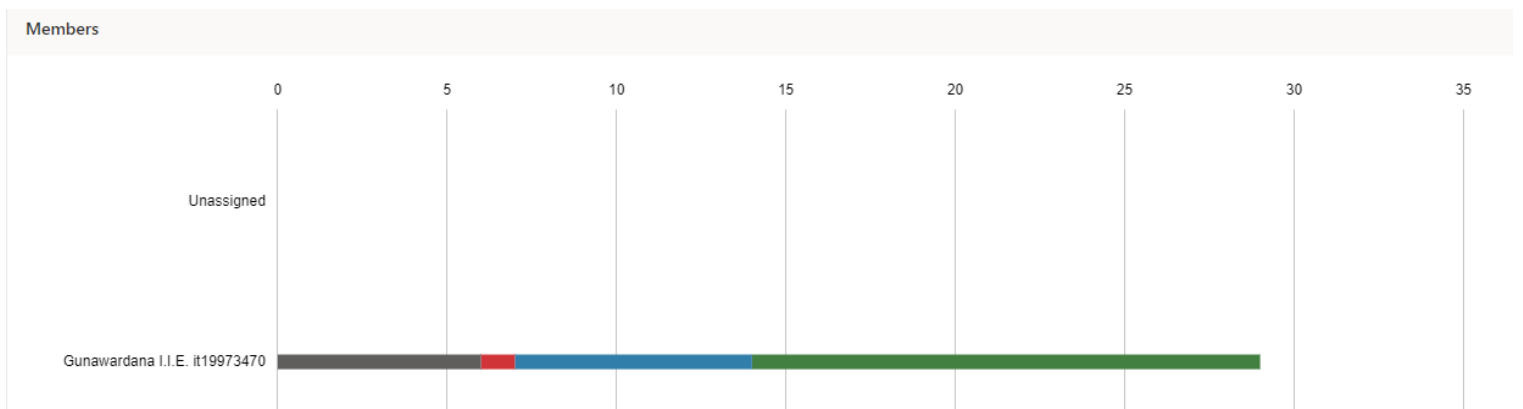
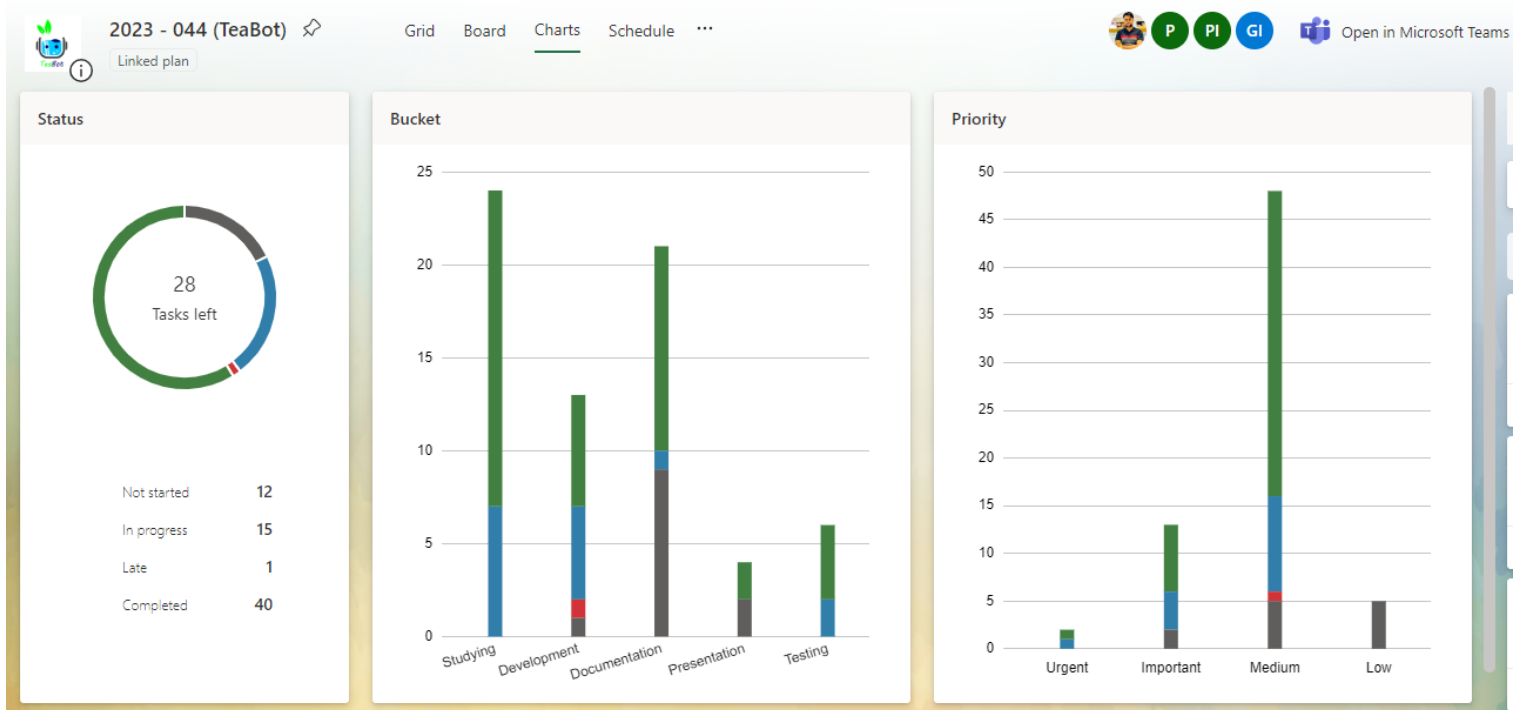
# 1 GANNT CHART



Completed

To be Completed

## 2 PROJECT VIEWS MS PLANNER



### 3 WORK BREAK DOWN STRUCTURE MS PLANNER

The image displays two screenshots of the Microsoft Planner interface, showing a work breakdown structure for a project named "2023 - 044 (TeaBot)".

**Top Screenshot:**

- Plan:** 2023 - 044 (TeaBot) (Linked plan)
- Views:** Grid, Board, Charts, Schedule
- Columns (Tasks):**
  - Studying:**
    - Tuning the robot arm (Due: 06/30)
    - Tuning the robot speed (Due: 06/30)
    - Research of laser module (Due)
    - Tuning the robot angles (Due: 06/28)
    - Communicating with the robot controller (Due: 07/14)
    - Researching regarding how to calculate the navigation angle of the TeaBot robot
  - Development:**
    - Project Website (Due: 07/17)
    - Developing the emergency stop (Due: 11/06)
    - Program the motors with arduino (Due: 07/17)
    - Developing the MQTT for remote (Due: 07/05)
    - Developing the UNet model (Due: 07/03)
  - Documentation:**
    - Project Status Document 2 - IT20265410 (Due: 09/10)
    - Project Status Document 2 - IT20382476 (Due: 07/24)
    - Project Status Document 2 - IT20011970 (Due: 07/24)
    - Project Status Document 2 - IT19973470 (Due: 07/24)
    - Research Paper (Due: 06/27)
  - Presentation:**
    - Final Presentation and Viva (Due: 09/28)
    - Progress Presentation-II (Due: 07/24)
  - Testing:**
    - Testing the robot movements in different terrains (Due: 07/20)
    - Testing the ML models in the testing field (Due: 07/21)
- Completed tasks:**
  - Studying: 0
  - Development: 6
  - Documentation: 11
  - Presentation: 2
  - Testing: 4

**Bottom Screenshot:**

- Plan:** 2023 - 044 (TeaBot) (Linked plan)
- Views:** Grid, Board, Charts, Schedule
- Columns (Tasks):**
  - Studying:**
    - Connect arduino with RGS (Completed by Gunawardana I.I.E....)
    - Research about RGS (Completed by Bamuusinghe G....)
    - Designed the robot chassis (Completed by Gunawardana I.I.E....)
    - Hardware related to arduino (Completed by Bamuusinghe G....)
    - Researching about RGS with Raspberry Pi (Completed by Gunawardana I.I.E....)
    - Learning Ubuntu with raspberry pi (Completed by Gunawardana I.I.E....)
    - Research about spraying system
  - Development:**
    - Angular UI for water spraying (Completed by Bamuusinghe G....)
    - Development of robot arm controller (Completed by Bamuusinghe G....)
    - Developing the Twist readings to navigate the robot (Completed by Gunawardana I.I.E....)
    - Developing the robot controller (motors) (Completed by Gunawardana I.I.E....)
    - Developing the ResNet Model (Completed by Premathilake H. T....)
  - Documentation:**
    - Project Proposal Report - IT20265410 (Completed by Premathilake H. T....)
    - Project Proposal Report - IT20382476 (Completed by Premathilake H. T....)
    - Project Proposal Report - IT20011970 (Completed by Premathilake H. T....)
    - Project Proposal Report - IT19973470 (Completed by Premathilake H. T....)
    - Project Charter (Completed by Premathilake H. T....)
    - Topic Assessment Form (Completed by Premathilake H. T....)
  - Presentation:**
    - Final Presentation and Viva (Due: 09/28)
    - Progress Presentation-II (Due: 07/24)
    - Progress Presentation-I (Completed by Perera P.V.Y. it203...)
    - Proposal Presentation (Completed by Perera P.V.Y. it203...)
  - Testing:**
    - Testing the ML models in the testing field (Due: 07/21)
    - Testing robot arm movements (Completed by Bamuusinghe G....)
    - Testing the robot move forward: backward, left and right (Completed by Gunawardana I.I.E....)
    - Testing the Resnet Model (Completed by Perera P.V.Y. it203...)
    - UNet Model testing (Completed by Perera P.V.Y. it203...)
- Completed tasks:**
  - Studying: 7
  - Development: 5
  - Documentation: 6
  - Presentation: 4
  - Testing: 5

## 4 EMAILS, MEETINGS WITH SUPERVISOR, CO-SUPERVISOR

**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 +1 other

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)

**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  
Cc: Perera P.V.Y. it20382476; Premathilake H. T. M it20265410 +1 other

Wed 5/10/2023 5:48 PM

**[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)

GI

Gunawardana I.I.E. it19973470

To: Shashika Lokuliyana

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

Dear Madam,

Could you please give us a time to meet on 27<sup>th</sup> Saturday to discuss about our TeaBot project?

Thank you for your time and consideration.

Regards,

Gunawardana I.I.E (IT19973470)

Thu 5/25/2023 11:51 AM

SL

Shashika Lokuliyana <shashika.l@sliit.lk>



To: Gunawardana I.I.E. it19973470

Mon 5/29/2023 2:04 PM

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

Putha can you come on 2<sup>nd</sup> June around 10.00 am??

Thanks in Advanced.



**Shashika L. Lokuliyana**

M.Sc. (IT) SLIIT, B.Sc.(Sp.) Hons in IT (Spec. in CSN) (SLIIT), MIEEE, MCSSL, MISOC

Senior Lecturer

CSNE Degree Program Coordinator

Secretary - IEEE Computer Society Sri Lanka Section

Committee Member - IEEE WIE Sri Lanka Section

Registrations Co-Chair - ICAC 2023

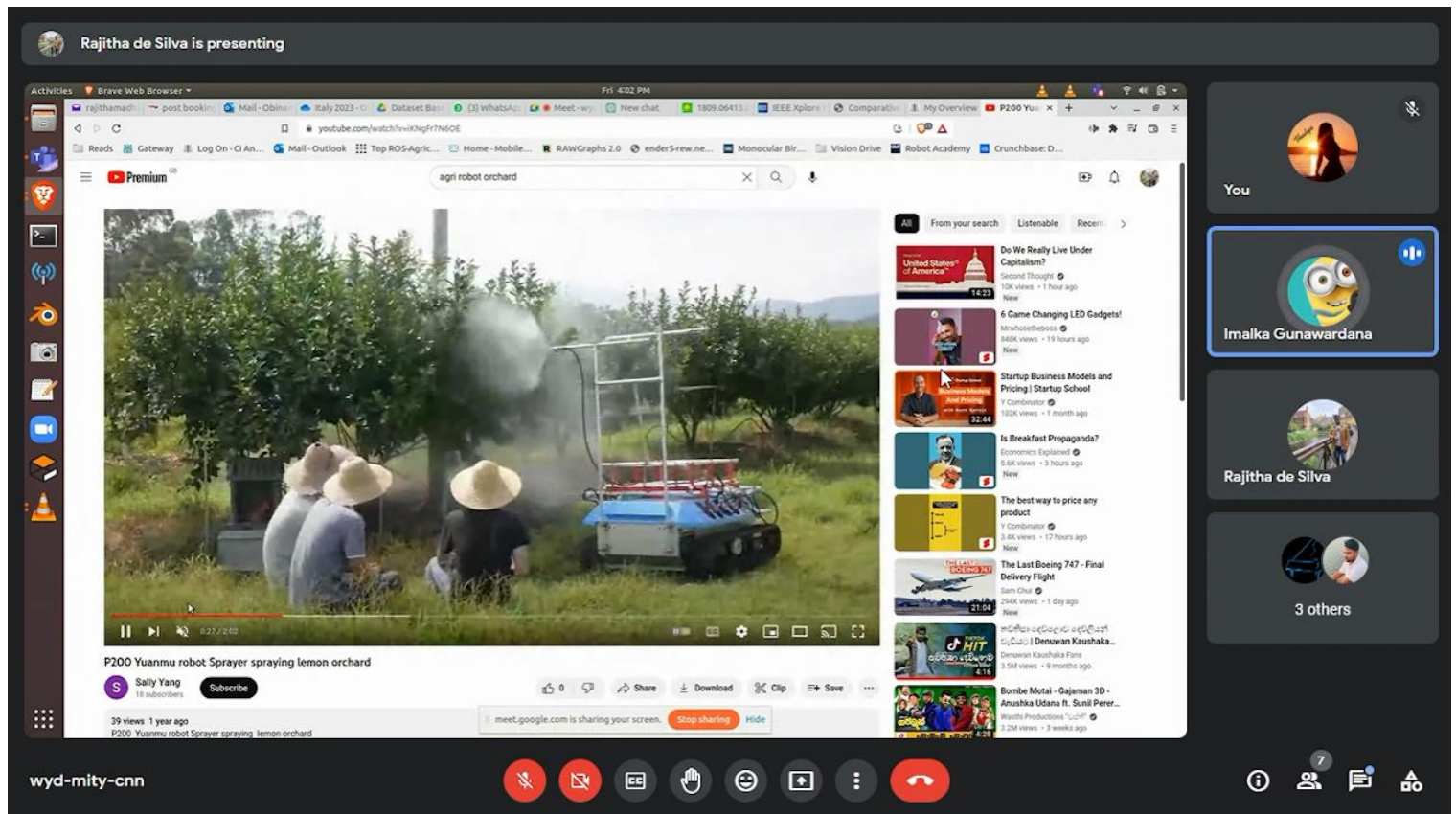
SLIIT, Malabe Campus, Sri Lanka.

shashika.l@sliit.lk | shashika0791@gmail.com

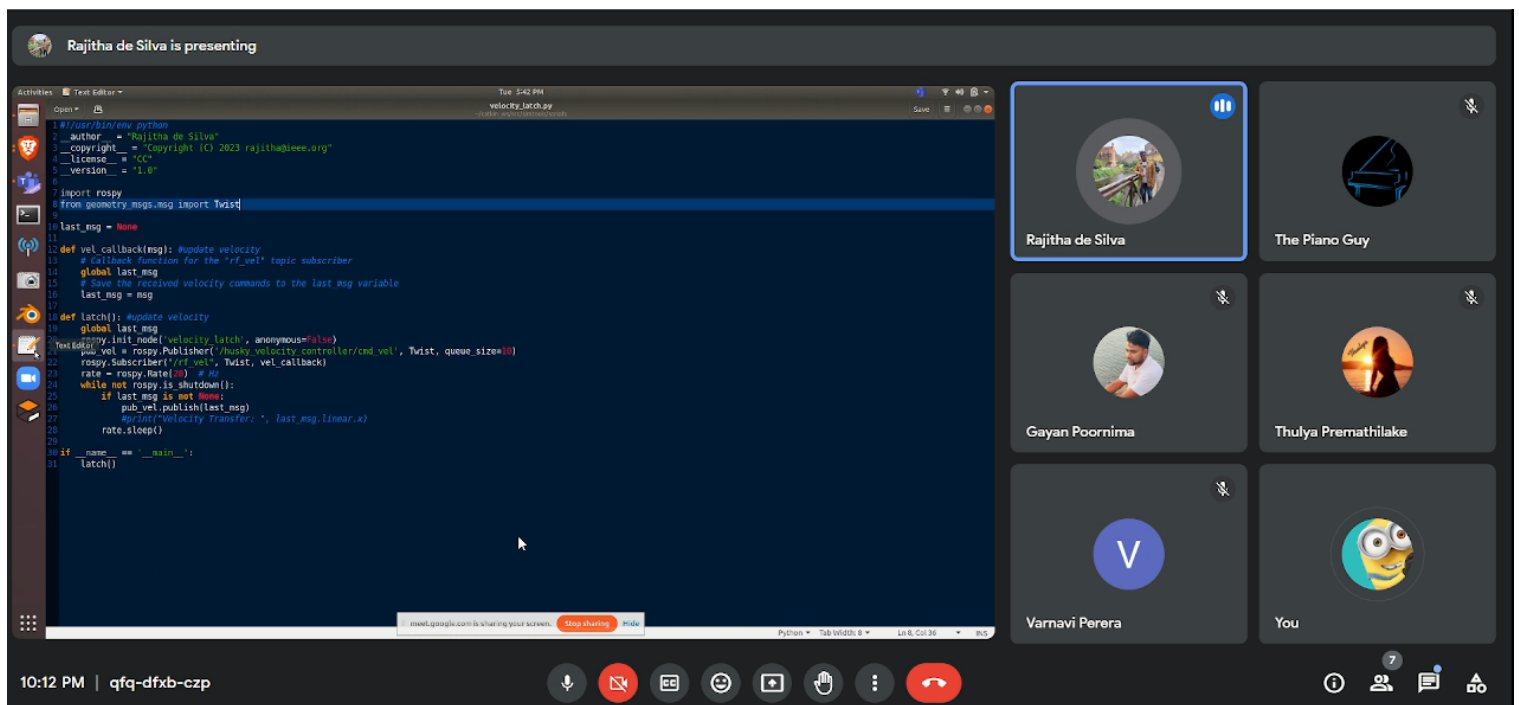
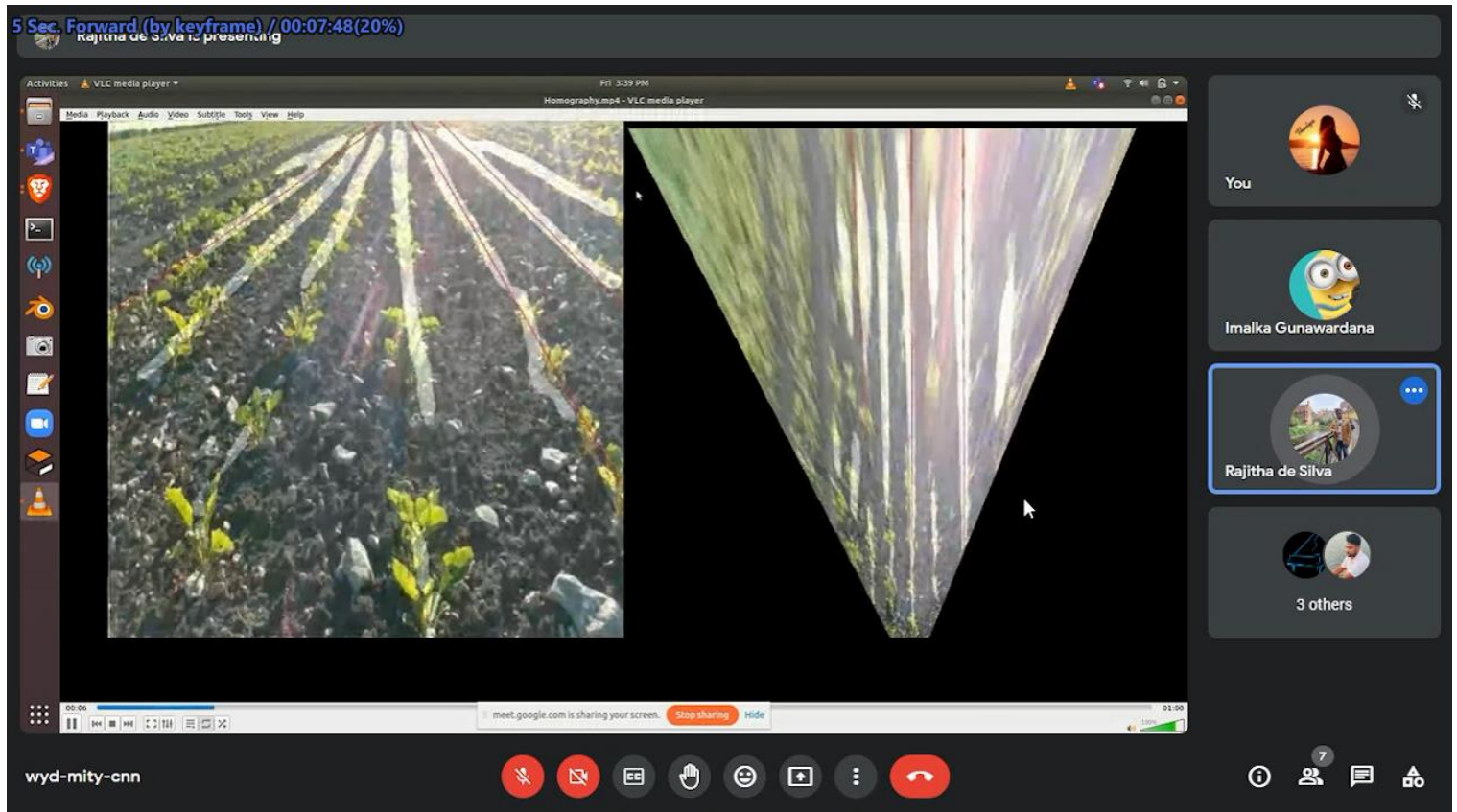
+94 77 2240 237

Screenshots of meetings about automatic navigation, dataset collection, and data labeling methods for & spraying with external supervisor Dr Rajitha De Silva

Discussions regarding Robot Controller Development.







## 5 MS TEAMS AND CALLS

The screenshot shows a Microsoft Teams chat window with a dark theme. At the top, there are tabs for 'General', 'Posts', 'Files', and 'Tasks'. A 'Meet' button is visible in the top right corner. The chat history shows a post titled 'proportional-integral-derivative' by a user with a profile picture of a person with glasses. Below this, there are two posts from 'Hettiarachchi T. C. D. S. it19206806' and 'Bamunusinghe G.P. it20011970'. The first post is a link to a Wikipedia page about the 'proportional-integral-derivative' control system. The second post is a link to a research paper titled 'Design and development an Agriculture robot for Seed sowing, Water spray and Fertigation' from IEEE Xplore. The post includes a snippet of the abstract and a link to the full text. Below this, there is another link to a research paper titled 'Agricultural electrostatic spray application: a review of significant research and development during the...' from ScienceDirect. The post includes a snippet of the abstract and a link to the full text.

proportional-integral-derivative

Hettiarachchi T. C. D. S. it19206806 2/8 10:51 AM  
PhD Candidate at University of Lincoln

Bamunusinghe G.P. it20011970 2/8 10:52 AM  
Water is sprayed to the tree root using a water spraying mechanism. Basically, physics governs everything. Using computer visualization, we must determine the location of the tree's root and its distance from the surface. After determining the speed of the moving object, the water must be accurately sprayed at the root by adjusting the angle of the water prayer nozzle. There are numerous variables in this mathematical parabolic water spryng system. Vehicle speed, root distance, water mixrure density, water

See more

<https://onlinelibrary.wiley.com/doi/abs/10.1002/ps.2780330403>

[https://ieeexplore.ieee.org/abstract/document/9844341?casa\\_token=hj5eKL8-ldQAAAAA:KWCKZCBzKXHjEmFi\\_nigpjp5Mpw5h316oVitO-pBNov0rOjVnyUdpqAHszfX\\_veeJKQ24hT8F5tSU4](https://ieeexplore.ieee.org/abstract/document/9844341?casa_token=hj5eKL8-ldQAAAAA:KWCKZCBzKXHjEmFi_nigpjp5Mpw5h316oVitO-pBNov0rOjVnyUdpqAHszfX_veeJKQ24hT8F5tSU4)

**IEEE Xplore®**  
**Design and development an Agriculture robot for Seed sowing, Water spray and Fertigation**  
Agriculture is one of the oldest activities practiced by man. Due to its importance in our daily life and reliance on it, many technologists try to update a new development based on agricultural ro...

<https://www.sciencedirect.com/science/article/abs/pii/S0304388601000407>

**ELECTROSTATICS**  
**Agricultural electrostatic spray application: a review of significant research and development during the...**  
Electrostatic force fields are currently exploited for beneficially increasing the deposition efficiency of finely divided particulate matter used as ...

<https://www.sciencedirect.com/science/article/pii/S0048969721061805>

The screenshot shows a Microsoft Teams chat window with a dark theme. At the top, there are tabs for 'General', 'Posts', 'Files', and 'Tasks'. A 'Meet' button is visible in the top right corner. The chat history shows a post from 'Perera P.V.Y. it20382476' with a timestamp of '2/8 1:17 PM'. The post includes two files: 'TA (1).docx' and 'agri robot.pdf'. Below the files, there is a section titled 'Meeting ended: 3h 54m' with a download icon and a link to 'Attendance report'. The bottom of the chat shows a 'Reply' button.

Perera P.V.Y. it20382476 2/8 1:17 PM

TA (1).docx

agri robot.pdf

Meeting ended: 3h 54m

Attendance report  
Click here to download attendance report

Reply

## 6 Prototype

Screenshot for the development of the robot controller

```
34 rospyspin()
35
36
37 def robot_controller_pwm_subscriber(robot_coordinates):
38     global pwmDelay, pwmDelayLevel, robotGo, highSpeed, left, right
39     robot_coords_json = json.loads(robot_coordinates.data)
40
41     left = int(robot_coords_json["left"])
42     right = int(robot_coords_json["right"])
43     highSpeed = int(robot_coords_json["highSpeed"])
44     robotGo = int(robot_coords_json["robotGo"])
45     pwmDelay = int(robot_coords_json["pwmDelay"])
46     pwmDelayLevel = int(robot_coords_json["pwmDelayLevel"])
47     send_to_arduino()
48
49
50 def robot_controller_twist_subscriber(move):
51     global pwmDelay, pwmDelayLevel, robotGo, highSpeed, left, right
52
53     linear_x = move.linear.x
54     angular_z = move.angular.z
55
56     velocity = linear_x
57     if velocity < 0:
58         velocity = -velocity
59     min_velocity = 0
60     max_velocity = 0.3
61     max_pwm = 255
62     min_pwm = 45
63     min_angle = min_pwm
64
65     pwm_val = int((velocity - min_velocity) / (max_velocity - min_velocity) * (max_pwm - min_pwm) + min_pwm)
66     left = pwm_val
67     right = pwm_val
68
69     pwm_val_ang = 0
70     if angular_z < min_angle:
71         pwm_val_ang = pwm_val / min_angle
72         temp_angular_z = angular_z
73         if angular_z < 0:
74             temp_angular_z = -angular_z
75
76     pwm_val_ang = int(pwm_val_ang * temp_angular_z)
77
78 if __name__ == '__main__': try
```

```

1  #!/usr/bin/env python3
2  import rospy
3  from std_msgs.msg import String
4  from std_msgs.msg import Empty
5  import paho.mqtt.client as mqtt
6  from geometry_msgs.msg import Twist
7  import json
8  import subprocess
9  from getpass import getpass
10
11 broker_address = "localhost" # Broker address
12 port = 9001 # Broker port 1883
13 # user = "yourUser" #Connection username
14 # password = "yourPassword" #Connection password
15
16 message_publisher = None
17 move = Twist()
18 no_read_init_msg = 0
19
20
21 def on_connect(client, userdata, flags, rc):
22     global message_publisher
23     rospy.init_node('remote_controller_node_pub', anonymous=True)
24     rospy.loginfo('Pub Started')
25     client.subscribe(["robot_mqtt/remote_controller", 1], ("ep_mqtt/topic2", 1), ("ep_mqtt/topic3", 1))
26     message_publisher = rospy.Publisher('/robot_controller_twist_topic', Twist, queue_size=10)
27
28
29 def on_message(client, userdata, message):
30     global move, no_read_init_msg
31     # print("Message received: " + message.topic + " : " + str(message.payload))
32     if message.topic == 'robot_mqtt/remote_controller':
33         message.payload = message.payload.decode("utf-8")
34         remote_coords = str(message.payload)
35         print(remote_coords)
36         robot_coords_json = json.loads(remote_coords)
37         # try:
38         if no_read_init_msg == 1:
39             if robot_coords_json["shutdown"] == 0:
40
41                 move.linear.x = robot_coords_json["linearX"]
42                 move.angular.z = robot_coords_json["angularZ"]
43
44         on_message()
45         print("velocity linear x = " + str(move.linear.x))

```

```

34 # i += 1
35 # message = "Hello : " + str(i)
36 # rate.sleep()
37 # message_publisher.publish(message)
38
39
40 def on_connect(client, userdata, flags, rc):
41     # print("Connected with result code " + str(rc))
42     # Subscribing in on_connect() means that if we lose the connection and
43     # reconnect then subscriptions will be renewed.
44     global message_publisher
45     rospy.init_node('remote_test_node_pub', anonymous=True)
46     rospy.loginfo('Pub Started')
47     message_publisher = rospy.Publisher('/robot_controller_pwm_topic', String, queue_size=10)
48     client.subscribe(["robot_mqtt/test", 1], ("ep_mqtt/topic2", 1), ("ep_mqtt/topic3", 1))
49
50
51 def on_message(client, userdata, message):
52     # print("Message received: " + message.topic + " : " + str(message.payload))
53     if message.topic == 'robot_mqtt/test':
54         message.payload = message.payload.decode("utf-8")
55         remote_coords = str(message.payload)
56         print(remote_coords)
57         message_publisher.publish(remote_coords)
58         # remote_coords_json = json.loads(message.payload)
59         # print(str(message.payload))
60
61
62 client = mqtt.Client(transport="websockets") # create new instance
63 # client.username_pw_set(user, password=password) #set username and password
64 client.on_connect = on_connect # attach function to callback
65 client.on_message = on_message # attach function to callback
66
67 client.connect(broker_address, port=port) # connect to broker
68
69 client.loop_forever()
70
71 if __name__ == '__main__':
72     try:
73         rospy.loginfo('Pub Started')
74         rospy.init_node('robotControllerNodePub', anonymous=True)
75         setup_env()
76     except rospy.ROSInterruptException:
77         pass
78
79 on_message() # if message.topic == 'robot_mqtt...

```



sketch\_feb04a

```
if (loopCountCur < rightCount) {
  if (rightIsIncrementing) {
    rightSet++;
    if (rightSet > 0) {
      analogWrite(R_F_PWM, rightSet);
      if (rightSet < pwmDelayLevel) {
        delay(pwmDelay);
      }
    }
    if (rightSet <= 0) {
      analogWrite(R_B_PWM, -rightSet);
      if (-rightSet < pwmDelayLevel) {
        delay(pwmDelay);
      }
    }
  } else {
    rightSet--;
    if (rightSet >= 0) {
      analogWrite(R_F_PWM, rightSet);
      if (rightSet < pwmDelayLevel) {
        delay(pwmDelay);
      }
    }
    if (rightSet < 0) {
      analogWrite(R_B_PWM, -rightSet);
      if (-rightSet < pwmDelayLevel) {
        delay(pwmDelay);
      }
    }
  }
  loopCountCur++;
}
// Serial.println("leftSet = " + String(leftSet) + ", rightSet = " + String(rightSet));
}

void loop() {
}
```



## Development of the robot chassis

