

STATUS DOCUMENT 2

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



STUDENT NAME: GUNAWARDANA I.I.E

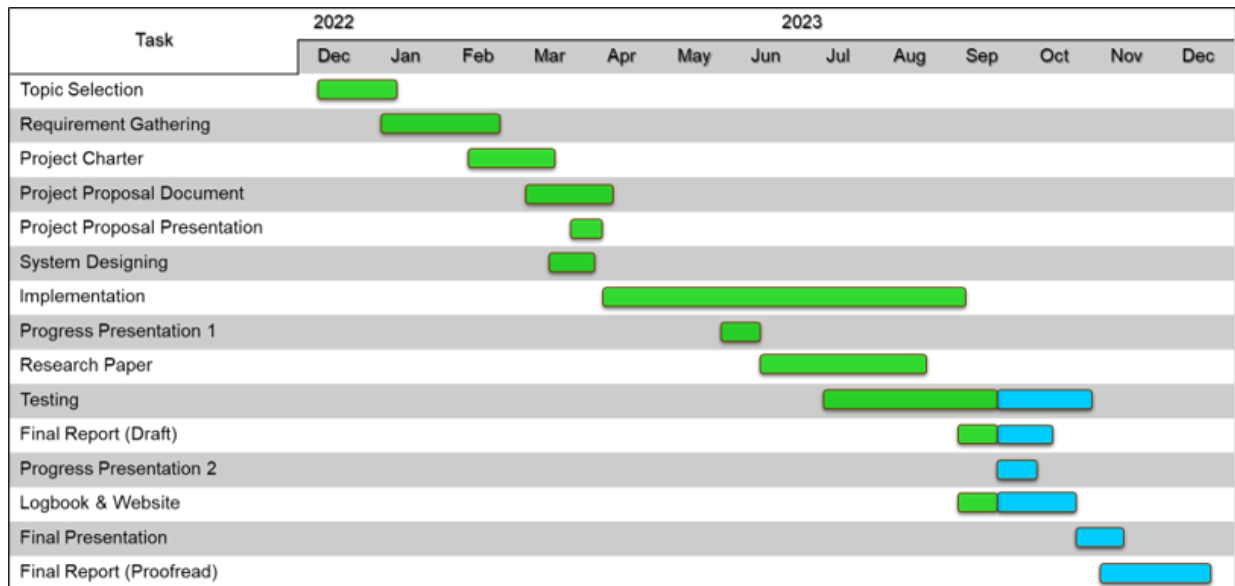
STUDENT NUMBER: IT19973470

GROUP ID: 2023-044

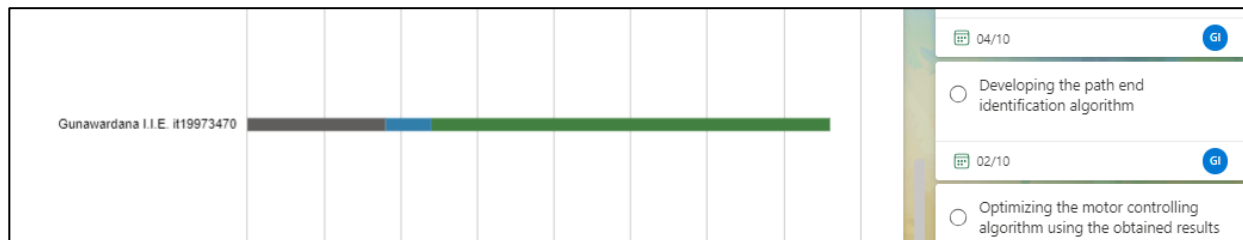
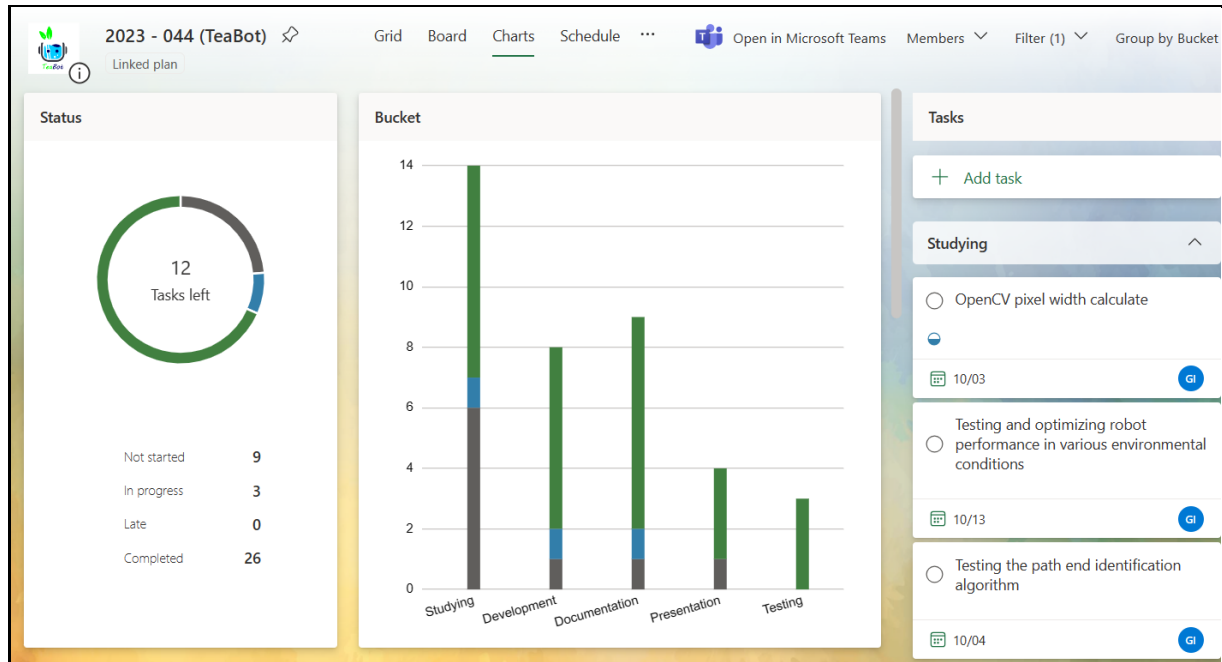
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1 GANNT CHART



2 PROJECT VIEWS MS PLANNER



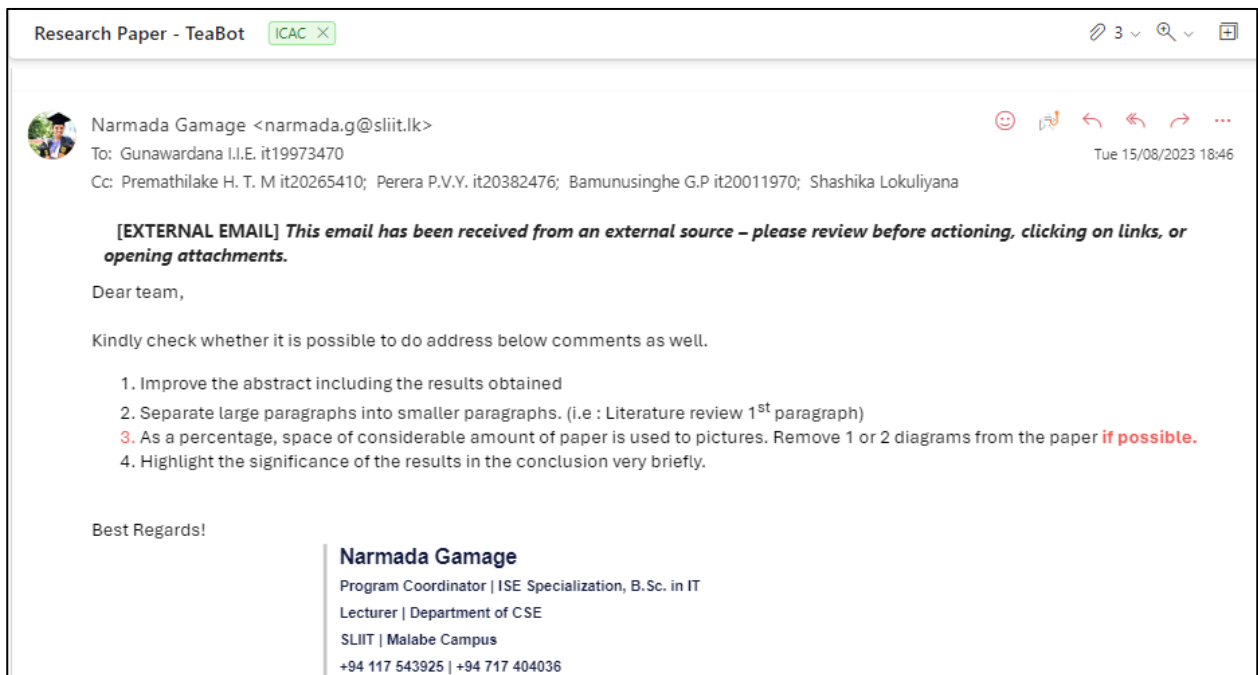
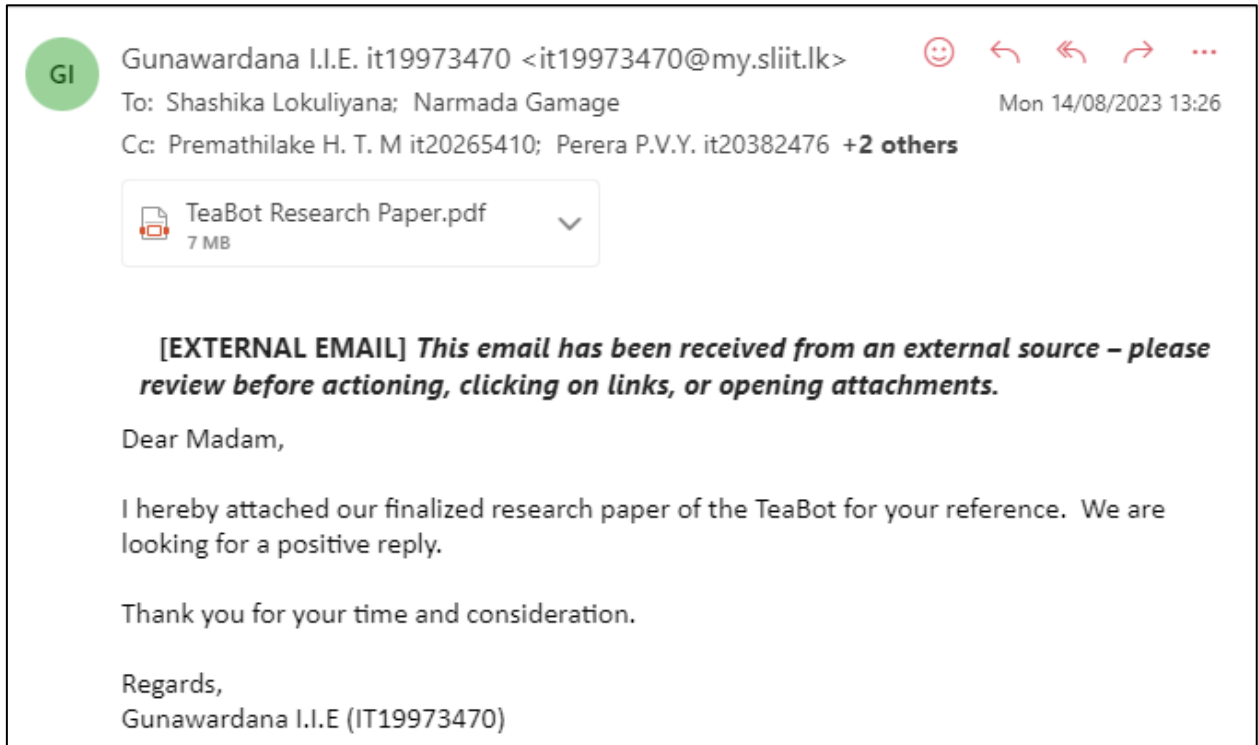
3 WORK BREAK DOWN STRUCTURE MS PLANNER

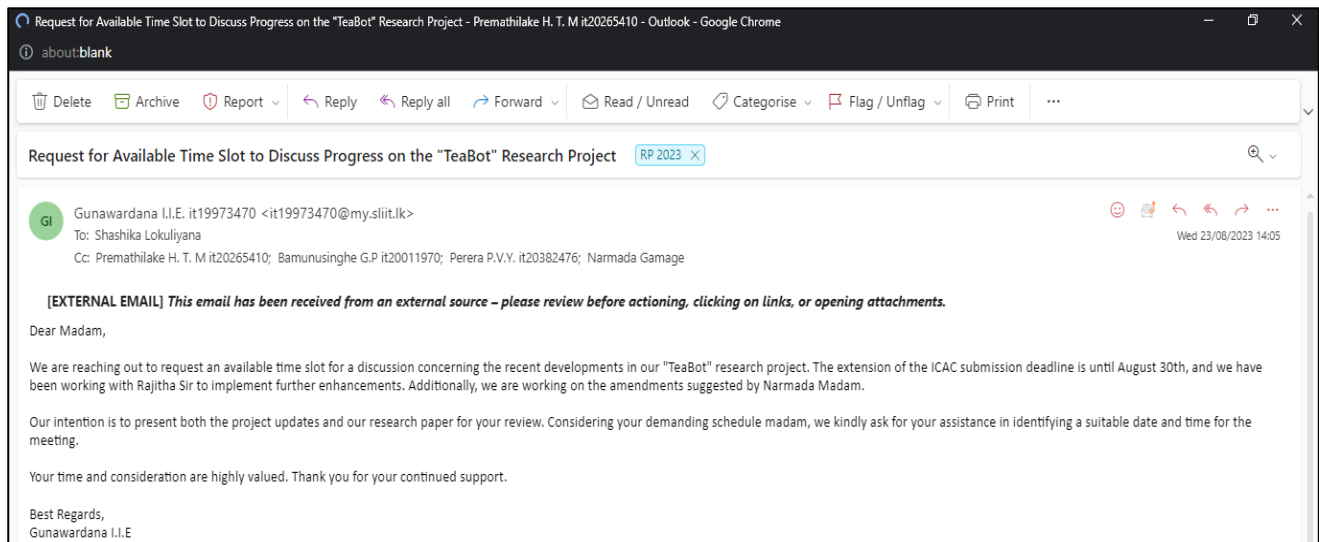
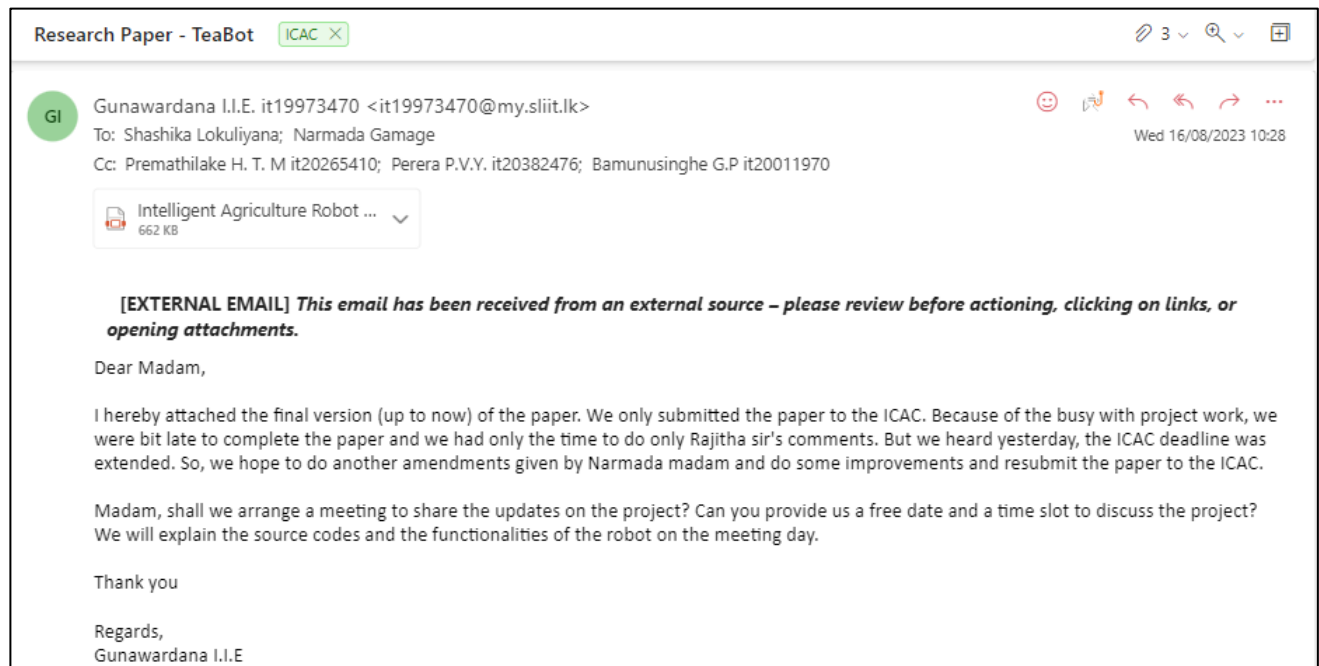
The screenshot displays the Microsoft Planner interface for a project titled "2023 - 044 (TeaBot)". The interface is organized into five main columns, each representing a different phase of the project: Studying, Development, Documentation, Presentation, and Testing. Each column has a header with a plus icon and the text "Add task".

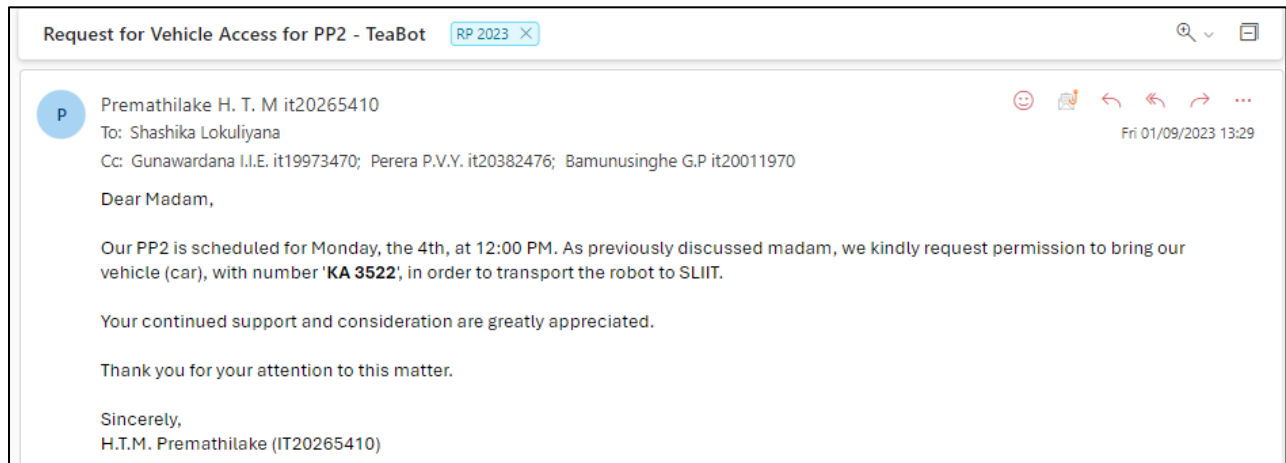
- Studying:** Contains tasks such as "OpenCV pixel width calculate" (due 10/03), "Testing and optimizing robot performance in various environmental conditions" (due 10/13), "Testing the path end identification algorithm" (due 10/04), "Developing the path end identification algorithm" (due 10/02), "Optimizing the motor controlling algorithm using the obtained results" (due 09/15), and "Testing the Motor controlling algorithm with various time frames" (due 09/21).
- Development:** Contains tasks such as "Path end detection" (due 10/31), "Project Website" (due 11/06), and a "Completed tasks" section showing 6 tasks, including "Developing the emergency stop" and "Program the motors with arduino".
- Documentation:** Contains tasks such as "Research Logbook" (due 10/30), "Final Report - IT19973470" (due 09/10), and a "Completed tasks" section showing 7 tasks, including "Project Status Document 2" and "Research Paper".
- Presentation:** Contains tasks such as "Final Presentation and Viva" (due 09/28), "Progress-Presentation-I", "Progress-Presentation-II", "Proposal-Presentation", and "Completed by Perera P.V.Y. it203...".
- Testing:** Contains a "Completed tasks" section showing 3 tasks, including "Testing the robot move forward: backward: left and right" and "Testing the robot movements in different terrains".

The interface also includes a top navigation bar with options like "Grid", "Board", "Charts", and "Schedule". A right sidebar shows "Open in Microsoft Teams", "Members", "Filter (1)", and "Group by Bucket".

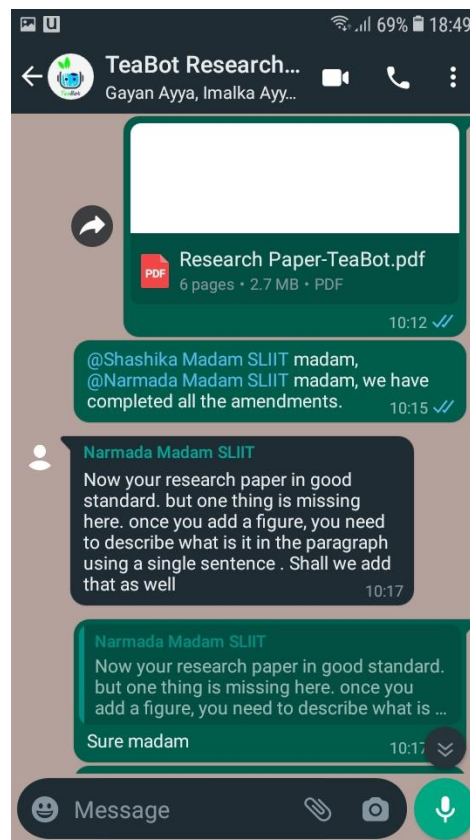
4 EMAILS, MEETINGS WITH SUPERVISOR, CO-SUPERVISOR



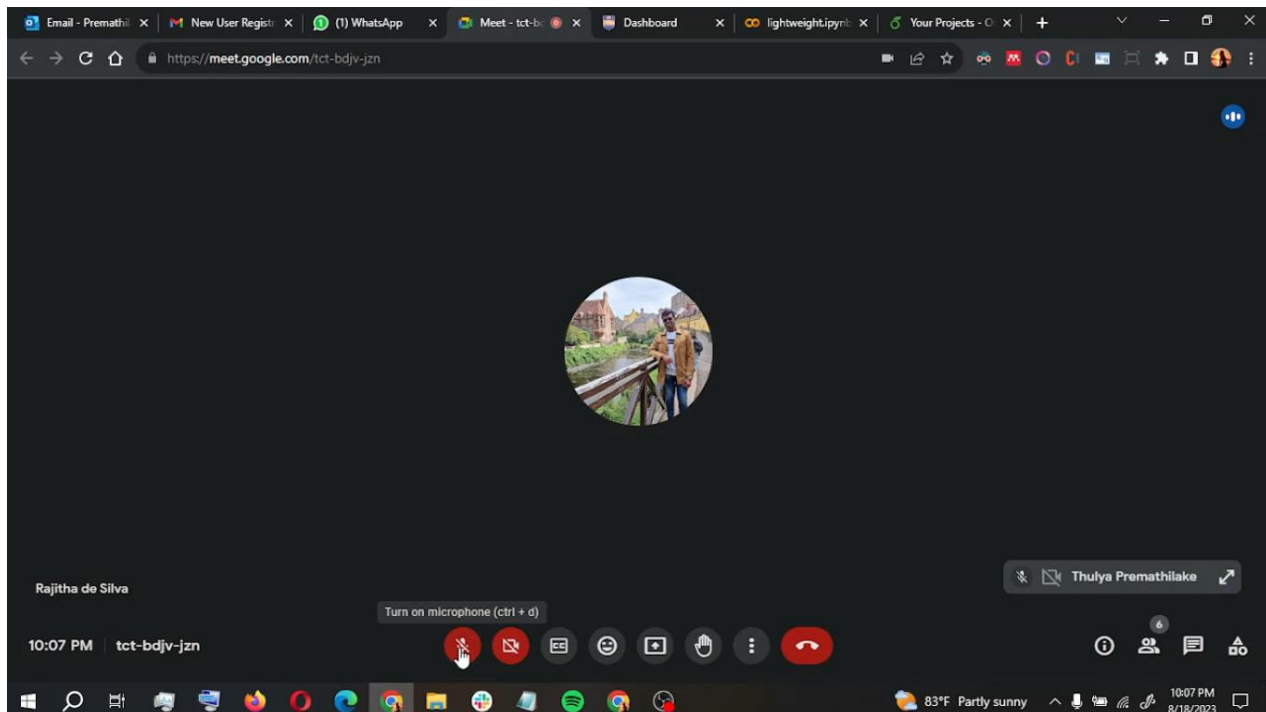
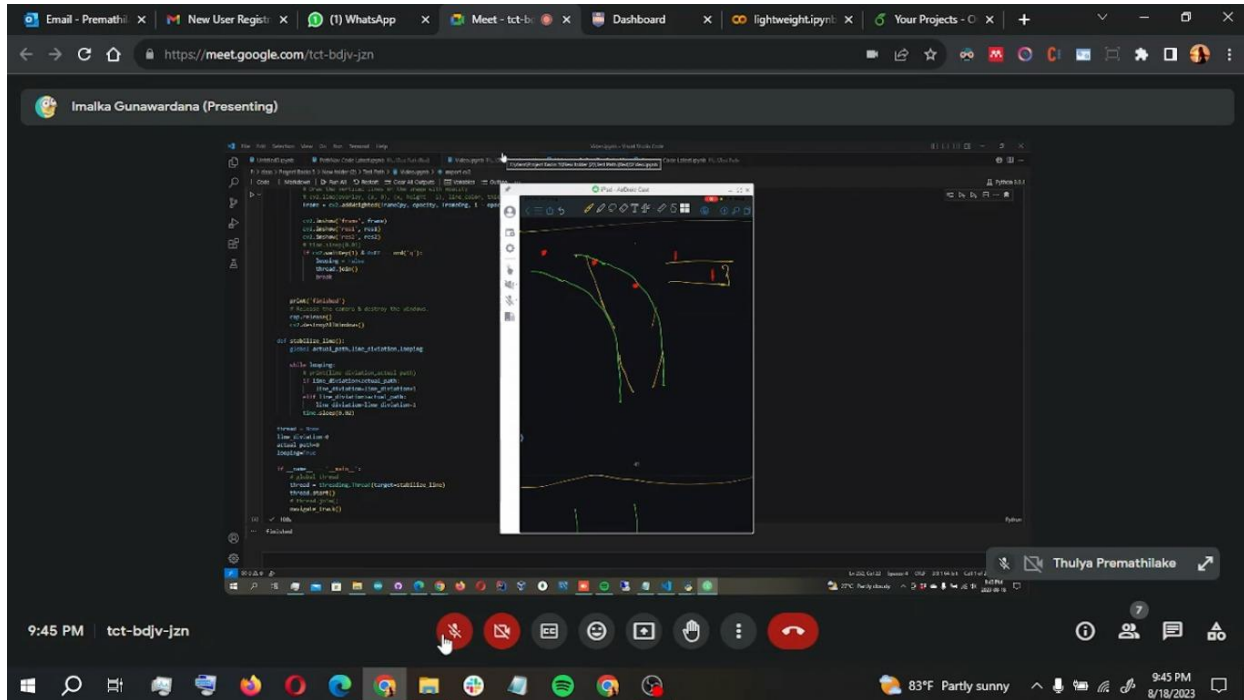




WhatsApp conversations with the supervisor and co-supervisor



5 EMAILS, MEETINGS WITH EXTERNAL SUPERVISOR



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

Research Paper - TeaBot

ICAC

3

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 3600? 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

← → ↺ 🏠 🔒 https://www.overleaf.com/project/64d6026f474d6c9b5dee073f

Menu Upgrade Research Paper - TeaBot Review Share Submit History Layout Chat

📁 Images

IEEEabrv.bib

IEEEconf.cls

IEEEtran.bst

IEEEtran.cls

main.tex

MyReferences.bib

File outline

Introduction

Literature Review

Methodology

Robot Controller

Robot Arm Hardware Setup

Robotic Arm Software Setup

Remote Controller Web Inter...

Robot Arm Stabilization

Practical Implementation

Automatic Navigation

Stem Identification

Result & Discussion

Conclusion

proposed coordinates, the robot arm is controlled by a microcontroller using a gyroscope sensor to keep the arm steady. The symbols in the equations \ref{eq:spraying} represent specific angles: \theta represents the Stabilized angle, \beta corresponds to the Robot tilted angle, and \gamma indicates the water spraying angle.

125 \begin{equation}

126 \quad \text{\label{eq:spraying}}

127 \quad \theta = 90^\circ - \beta + \gamma

128 \end{equation}

129 \begin{align}

130 \quad \theta &= \text{\text{Stabilized Angle}}

131 \quad \beta &= \text{\text{Robot Tilted Angle}}

132 \quad \gamma &= \text{\text{Water Spraying Angle}}

133 \end{align}

134

135 \subsection{Practical Implementation}

136 The primary controller of the system is the Arduino Nano. Jumper cables are used to connect each of the other servo motors to the Arduino Nano. Through the ROS Framework, the Arduino Nano can communicate with the stem detection component. The Arduino robot arm is connected to these servo motors. Stabilizing algorithms and the MPU 6050 are attached to the arm to stabilize its y-axis. Several relays are utilized with the R385 water pump to maintain a constant water pressure in the arm, and rubber vibration controls are employed to reduce the vibration of the water pump. Figure \ref{fig:Root arm controller} shows the implementation of the robot arm.

137

138 \text{\label{Root arm controller}}

139 \begin{figure}[b]

140 \quad \centering

141 \quad \includegraphics[width=90mm,height=45mm]{images/Arm.jpeg}

142 \quad \caption{Root arm controller.}

143 \text{\label{fig:Root arm controller}}

144 \end{figure}

145

Track changes is off

rajithamadawaz: Put these in a sentence.
Aug 25, 2023 3:18 PM

You: Sir, added as the last sentence of the 124 line.
Aug 25, 2023 3:53 PM • Edit • Delete

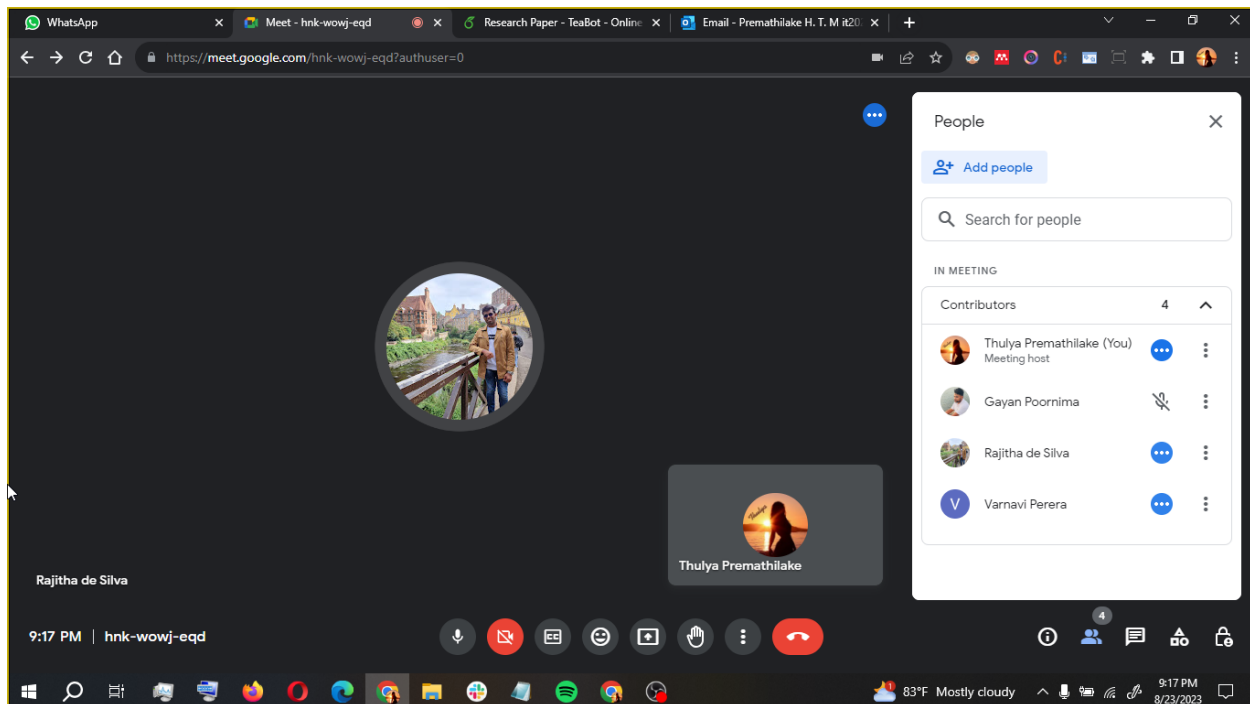
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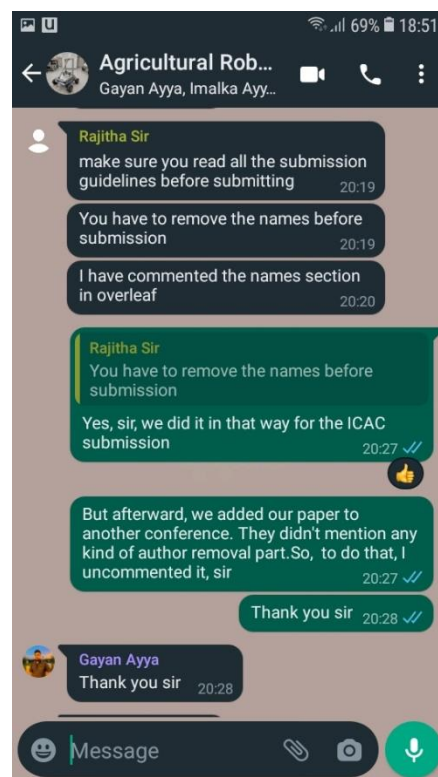
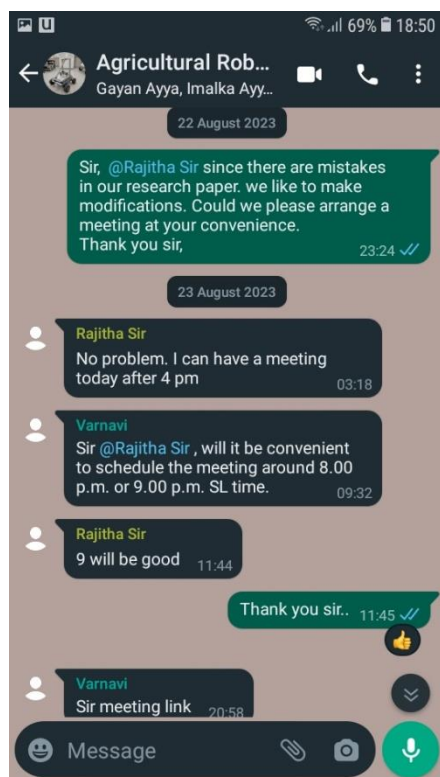
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82°F Mostly clear

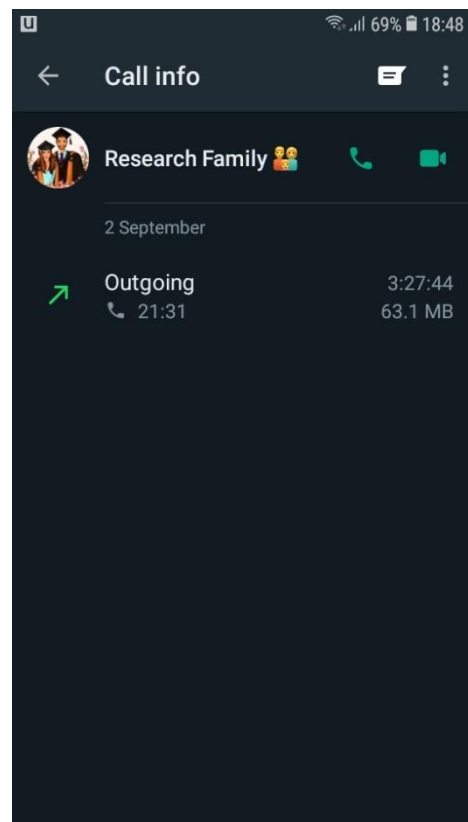
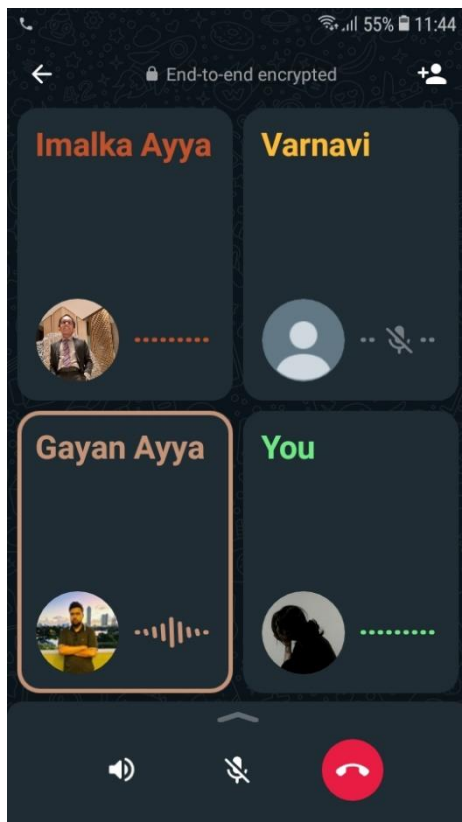
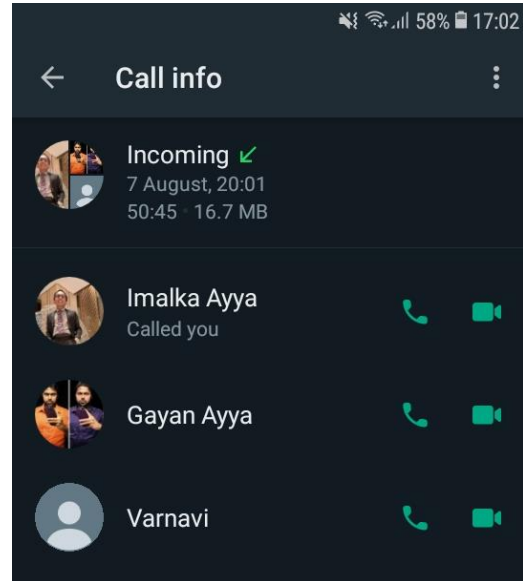
8:01 PM 8/25/2023



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

GI

PI

Reply

General

Posts

Files

Tasks

+

Meet

PP2 Slide Deck ended: 1h 16m

Reply

PP2 Slides started

Collapse all

PI

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

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

See less

Meeting ended: 1h 32m

PI

PI

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

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All Documents*

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

Name

Modified

Modifie...

+ Add column

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

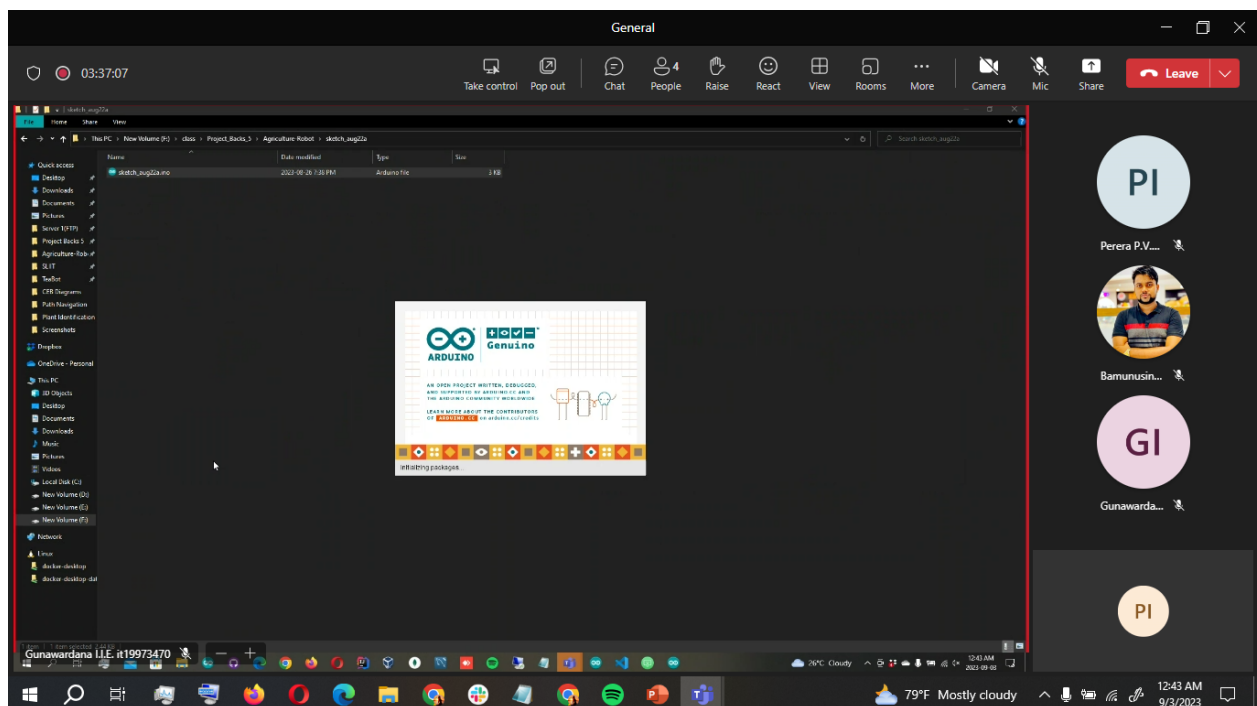
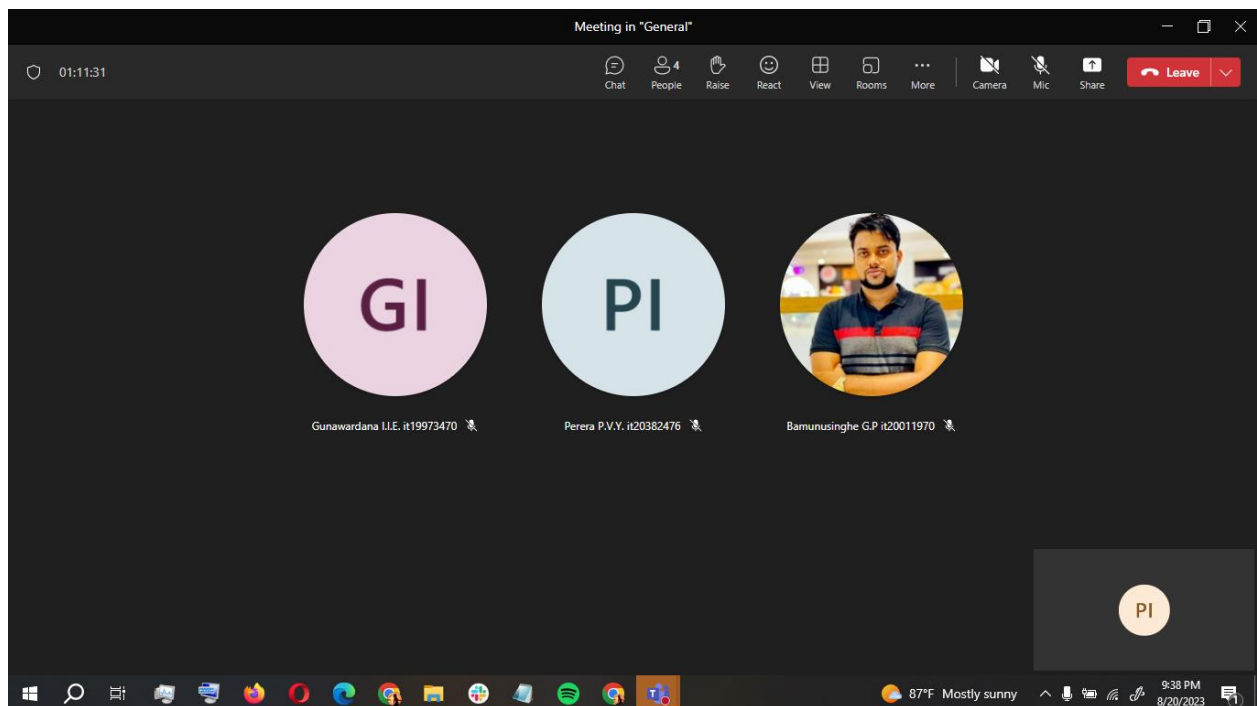
Perera P.V.Y. it2038...

Modified By : Bamunusinghe G.P it20011970 (1)

Submitted Docs

March 13

Bamunusinghe G.P...



Meeting in "General"

04:04:55

Take control Pop out Chat People Raise React View More Camera Mic Share Leave

File Home Insert Draw Design Transitions Animations Slide Show Record Review View Help Storyboarding

Perera P.V.Y. it20382476

Record Present in Teams Share

Find Replace Select Dictate Voice Security Add-ins Designer

Hardware - Robot Chassis

- Move forward or backward
- Set the speed to drive (Twist)
- Steering according to the given angles
- Turn left or right while driving forward or backward (Twist)
- Skid steer to left or right
- Smooth driving
- Optimized to protect the motors from sudden start or stop
- One dedicated battery for the motors for the maximum power
- Another dedicated battery for the drivers + Arduino + raspberry for a better performance
- Tested in a hard environment

SLIST FACULTY OF COMPUTING IT19973470 | Gunawardana I.I.E | 2023-044

Click to add notes

Perera P.V.Y. it20382476

Notes 79°F 1:27 AM 9/4/2023 Rain coming

Perera P.V.Y. it20382476

Bamunusinghe G.P. it20011970

Gunawardana I.I.E

SD2

01:11:00

Chat People Raise React View Rooms More Camera Mic Share Leave

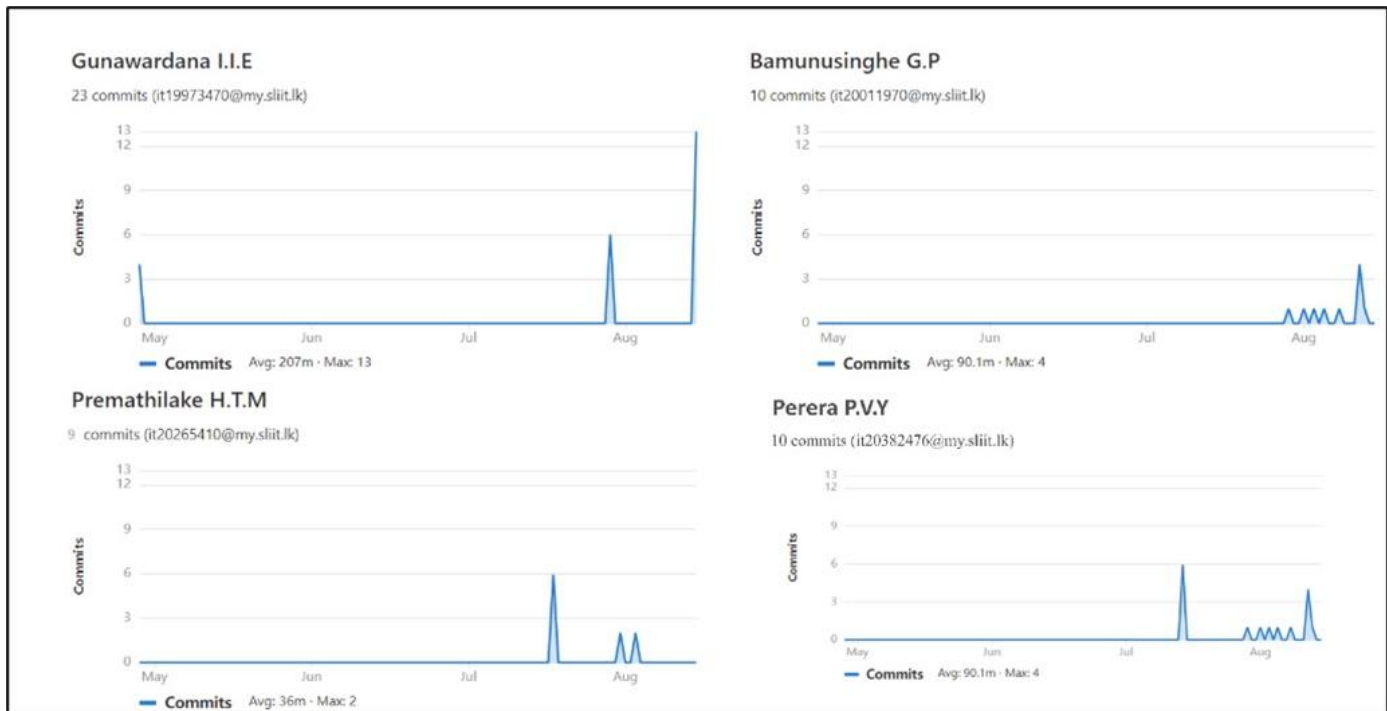
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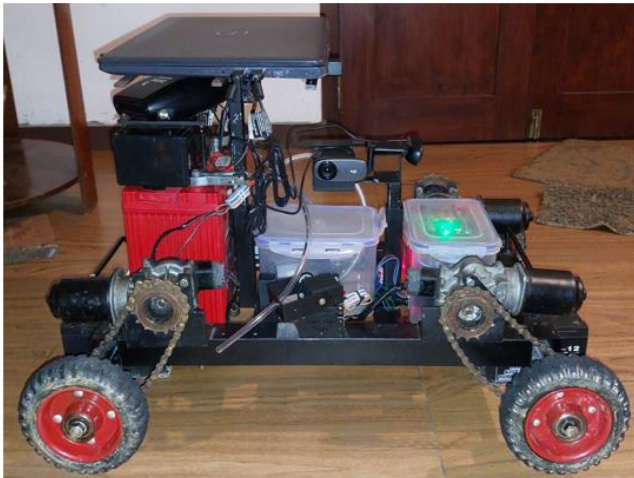
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7 GITLAB GRAPHS

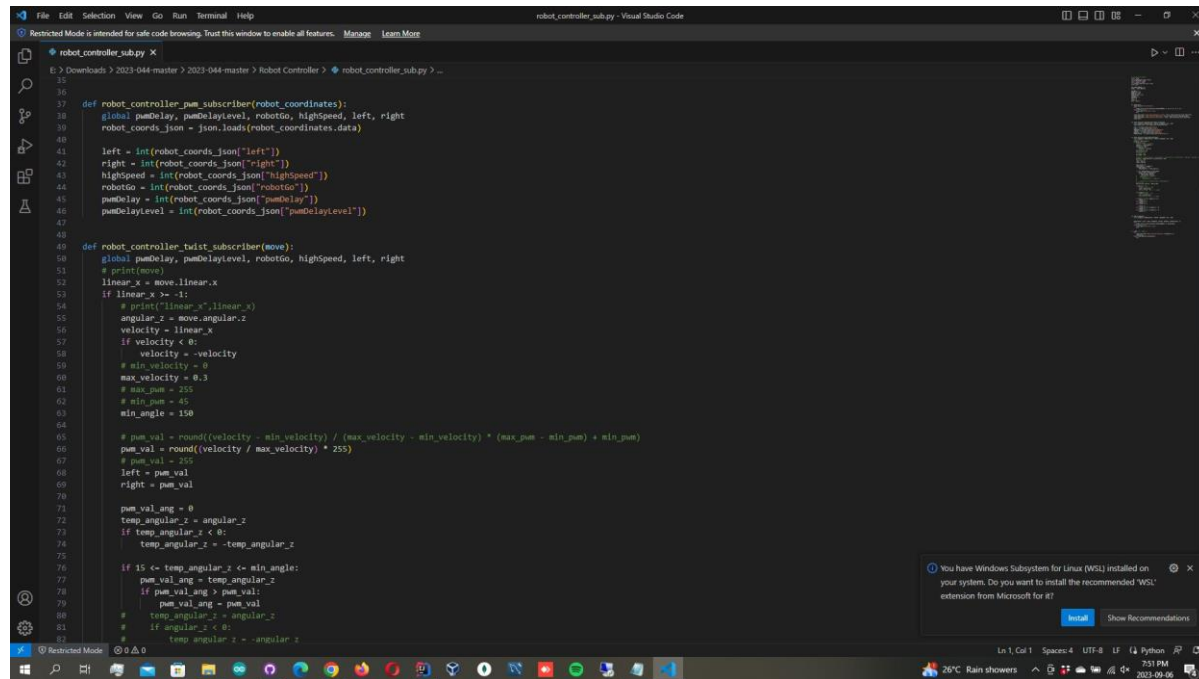


8 DEVELOPED PROTOTYPE

Robot chassis development.

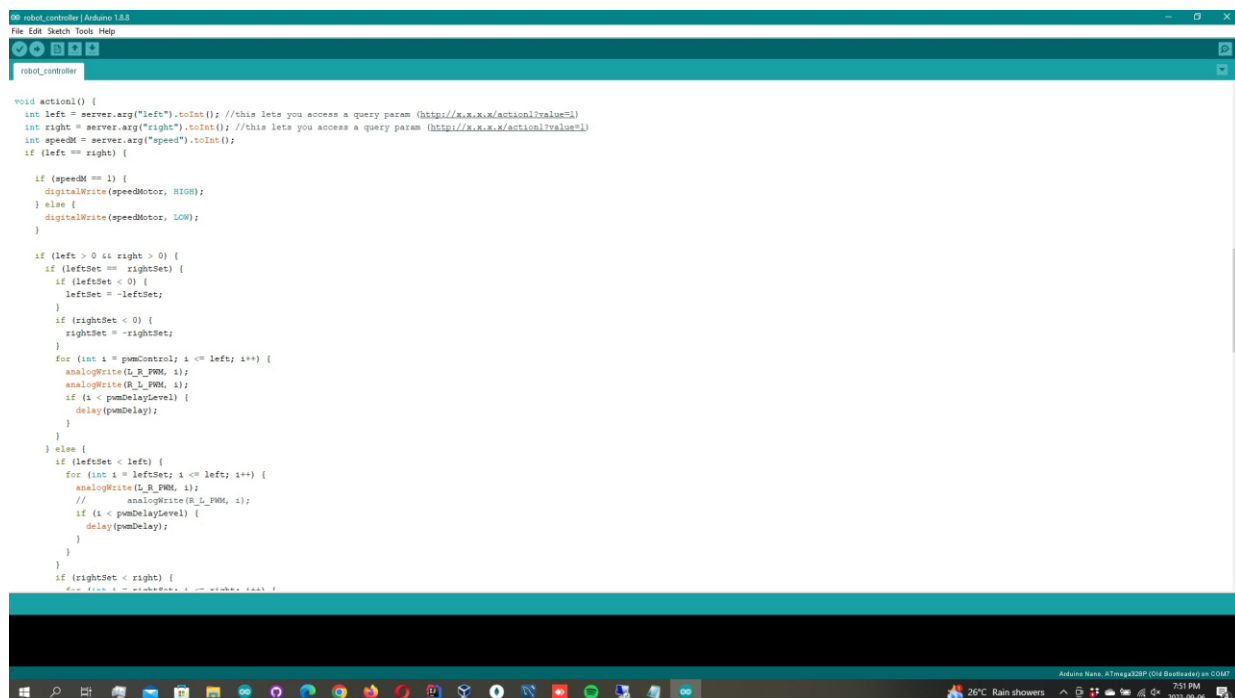


ROS motor controlling algorithm development.



```
15
16
17 def robot_controller_pwm_subscriber(robot_coordinates):
18     global pwmDelay, pwmDelayLevel, robotGto, highSpeed, left, right
19     robot_coords_json = json.loads(robot_coordinates.data)
20
21     left = int(robot_coords_json["left"])
22     right = int(robot_coords_json["right"])
23     highSpeed = int(robot_coords_json["highSpeed"])
24     robotGto = int(robot_coords_json["robotGto"])
25     pwmDelay = int(robot_coords_json["pwmDelay"])
26     pwmDelayLevel = int(robot_coords_json["pwmDelayLevel"])
27
28
29 def robot_controller_twist_subscriber(move):
30     global pwmDelay, pwmDelayLevel, robotGto, highSpeed, left, right
31     # print(move)
32     linear_x = move.linear.x
33     if linear_x >= -1:
34         # print("linear_x", linear_x)
35         angular_z = move.angular.z
36         velocity = linear_x
37         if velocity < 0:
38             velocity = -velocity
39         # min_velocity = 0
40         max_velocity = 0.3
41         # max_pwm = 255
42         # min_pwm = 45
43         min_angle = 150
44
45         # pwm_val = round((velocity - min_velocity) / (max_velocity - min_velocity) * (max_pwm - min_pwm) + min_pwm)
46         # pwm_val = round((velocity / max_velocity) * 255)
47         # pwm_val = 255
48         left = pwm_val
49         right = pwm_val
50
51         pwm_val_ang = 0
52         temp angular_z = angular_z
53         if temp angular_z < 0:
54             temp angular_z = -temp angular_z
55
56         if 15 <= temp angular_z <= min_angle:
57             pwm_val_ang = temp angular_z
58             if pwm_val_ang > pwm_val:
59                 pwm_val_ang = pwm_val
60             # temp angular_z = angular_z
61             # if angular_z < 0:
62                 # temp angular_z = -angular_z
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Arduino Motor Controller algorithm.



```
1 // robot_controller | Arduino 1.8.5
2
3 File Edit Sketch Tools Help
4
5 robot_controller
6
7 void action1() {
8     int left = server.arg("left").toInt(); //this lets you access a query param (http://x.x.x.x/action1?value=1)
9     int right = server.arg("right").toInt(); //this lets you access a query param (http://x.x.x.x/action1?value=1)
10    int speedBt = server.arg("speed").toInt();
11    if (left == right) {
12
13        if (speedBt == 1) {
14            digitalWrite(speedMotor, HIGH);
15        } else {
16            digitalWrite(speedMotor, LOW);
17        }
18
19        if (left > 0 && right > 0) {
20            if (leftSet == rightSet) {
21                if (leftSet < 0) {
22                    leftSet = -leftSet;
23                }
24                if (rightSet < 0) {
25                    rightSet = -rightSet;
26                }
27                for (int i = pwmControl; i <= left; i++) {
28                    analogWrite(L_R_PWM, i);
29                    analogWrite(R_L_PWM, i);
30                    if (i < pwmDelayLevel) {
31                        delay(pwmDelay);
32                    }
33                }
34            } else {
35                if (leftSet < left) {
36                    for (int i = leftSet; i <= left; i++) {
37                        analogWrite(L_R_PWM, i);
38                        // analogWrite(R_L_PWM, i);
39                        if (i < pwmDelayLevel) {
40                            delay(pwmDelay);
41                        }
42                    }
43                }
44            }
45            if (rightSet < right) {
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```

robot_controller(Arduno 1.8.8)
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robot_controller

    leftSet = left;
    rightSet = right;
}

} else if (left > 0 is left == -right) {

    stopMotors(left, right);
    for (int i = pwmControl; i <= left; i++) {
        analogWrite(L_PWM, i);
        analogWrite(R_PWM, i);
        if (i < pwmDelayLevel) {
            delay(pwmDelay);
        }
    }
    leftSet = left;
    rightSet = right;

} else if (left < 0 is -left == right) {

    stopMotors(left, right);
    for (int i = pwmControl; i <= -left; i++) {
        analogWrite(L_PWM, i);
        analogWrite(R_PWM, i);
        if (i < pwmDelayLevel) {
            delay(pwmDelay);
        }
    }
    leftSet = left;
    rightSet = right;

}

server.send(200, "text/plain", "{\"reply\":\"Hello Robot\"}");
// digitalWrite(LED_BUILTIN, HIGH);
// delay(500);
// digitalWrite(LED_BUILTIN, LOW);

// val = String(left) + " " + String(right);
// Serial.println(val);

```

Auto/Manual Remote Controller algorithm.

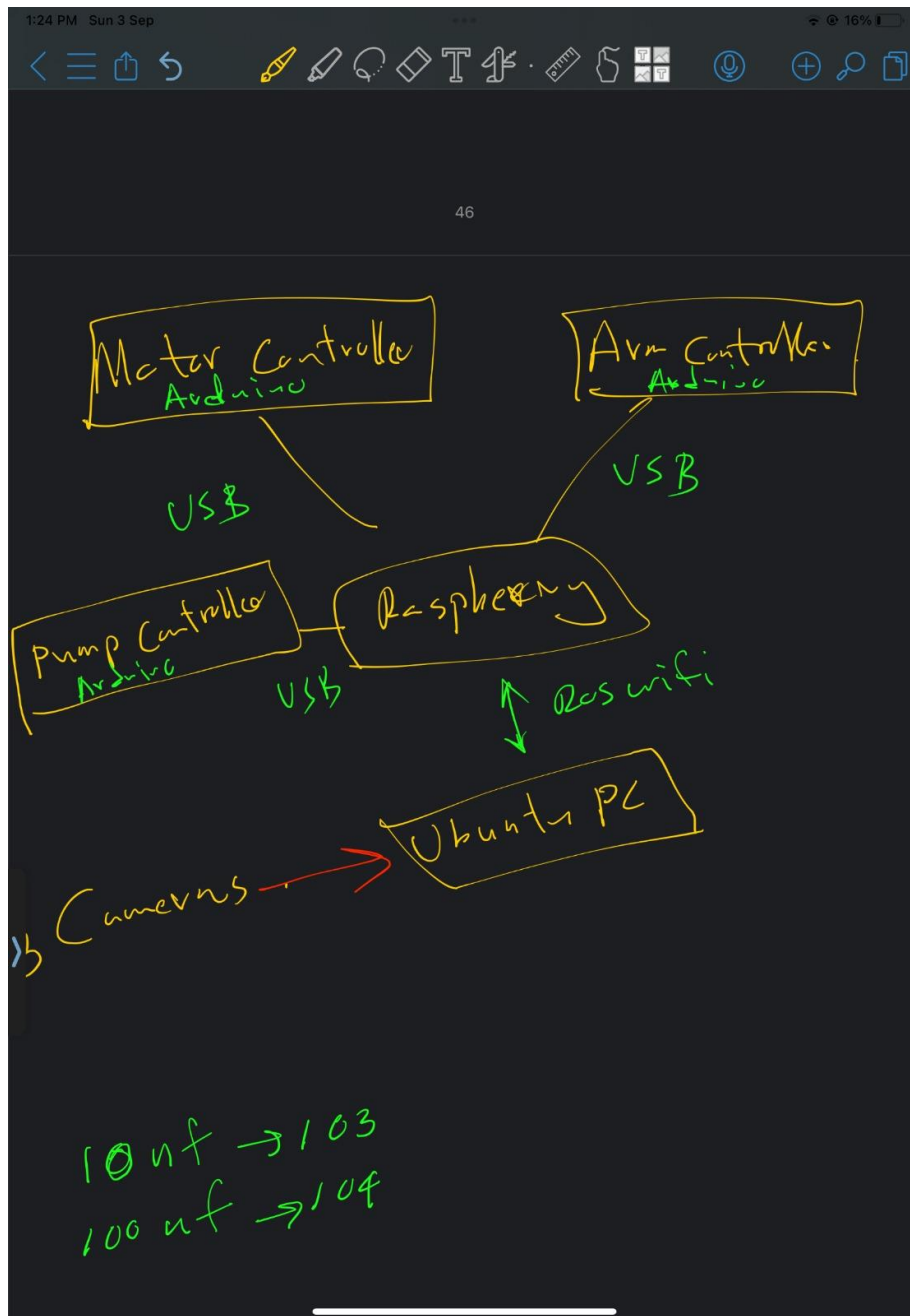
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remote_controller_pub.py - Visual Studio Code
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remote_controller_pub.py X
E:\Downloads> 2023-044-master> 2023-044-master> Robot Controller> remote_controller_pub.py
35 # # message = "Hello : " + str(i)
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

```

Overall architecture design



11:22 PM Wed 6 Sep

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Robot testing motor controller

