ON CAMPUS DELIVERY ROBOT

by

MUHANNAD SAEED ALGHAMDI 1846525

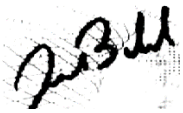
SULIMAN ABDULLAH ABBAS 1845862

WAEL RABAH ALDHAHERI 1846987

TEAM NO.:03 FALL-2021 INTAKE

Project Advisor

DR. MOHAMMED BILAL

CHECKED AND APPROVED (ADVISOR): 

Project Co-advisor: **N/A**

Project Customer: **DR. MOHAMMED BILAL**

SDP Evaluator: _____

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
FACULTY OF ENGINEERING
KING ABDULAZIZ UNIVERSITY
JEDDAH – SAUDI ARABIA

NOV. 2021 G – RABI' II 1443 H

EXECUTIVE SUMMARY

On Campus Delivery Robot

According to our information gathering, it is apparent that there is a need for an on-campus delivery solution. Which would benefit the administrators in efficiently completing their work and students by reducing time wasted going back and forth between buildings.

The university campus consists of different terrains which might make traversal more challenging for a ground robot. In addition to that, there are moving objects (people, cars) which might necessitate obstacle avoidance.

We want to create a unified and comprehensive delivery network across the KAU campus without human involvement.

Our lower-level objectives are connecting the whole university buildings into a single automated delivery network, improving productivity of employees/students by saving their time, reducing the use of fuel and manpower in the delivery process.

Our higher-level objectives are Pushing to increase development in the tech field industry in Saudi Arabia, raising awareness to decrease the carbon emission, by providing electrical alternatives., encouraging upcoming generations to R&D autonomous solutions.

For the alternative solutions, we started by brainstorming some ideas for possible solutions. We then generated some new alternatives using a morphological chart. We then ruled out some of the alternatives using a KTDA table. After the analysis, the alternatives that passed are the RoboDog, Robot Train and the Ground Robot.

We then compared the pros and cons of each alternative. The chosen solution was the Ground Robot. We picked the ground robot because it had the lowest cost, it is moderately complex, and the parts needed are easily obtained.

We then tried to further improve our baseline design. We made some adjustments, the most substantial one was replacing some of the parts (wheels, motors) with a hoverboard. In addition to that, we added ventilation holes and a hole for cable management.

Index Terms — Navigation, obstacle avoidance, delivery robot.

TEAM ACTIVITY PORTFOLIO CONTENTS

TEAM MEMBERS

Team-03					
Photograph	**Name**	**Computer Number**	**Phone Number**	**Email**	**Specialization**
	Muhannad Saeed Alghamdi	1846525	0555664661	Mhdghd2@gmail.com	Computer Engineering
	Sulaiman Abdullah Abbas	1845862	0504624355	Cursoldsulaiman@gmail.com	Computer Engineering
	Wael Rabah Aldhaheri	1846987	0506615899	WaAldhaheri@gmail.com	Biomedical Engineering

TEAM RULES, ROLES, AND CONTRIBUTIONS

Roles and Contributions			
Role	**Technical Role**	**Name**	**Responsibility**
Team leader/ Project manger	Navigating algorithms	Muhannad Saeed AlGhamdi	Planning and organizing the completion of tasks within the project.
Organizer, Gatekeeper	Obstacle avoidance algorithms	Sulaiman Abdullah Abbas	Organizes team meetings time and place and the meeting outcomes, ensures that all goals are achieved.
Idea Challenger, Recorder	Hardware & code Deployment	Wael Rabah Aldhaheri	Plays the role of the devil's advocate, types the meeting minutes

PROJECT TASKS AND TIMETABLE

	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**Component Gathering**	**14 days**	**Sun 1/16/22**	**Wed 2/2/22**	
2		Ordering a Jetson Nano	14 days	Sun 1/16/22	Wed 2/2/22	
3		Ordering Stereo camera	14 days	Sun 1/16/22	Wed 2/2/22	
4		Ordering DC-to-DC converter	14 days	Sun 1/16/22	Wed 2/2/22	
5		Ordering Hoverboard	5 days	Sun 1/16/22	Thu 1/20/22	
6		**Cart**	**12 days**	**Fri 1/21/22**	**Mon 2/7/22**	
7		Building the cart	10 days	Fri 1/21/22	Thu 2/3/22	5
8		Cart adjustments	2 days	Fri 2/4/22	Mon 2/7/22	7
9		**Required studying**	**10 days**	**Sun 1/16/22**	**Thu 1/27/22**	
10		MATLAB Revision	1 day	Sun 1/16/22	Sun 1/16/22	
11		Learning Simulink	2 days	Sun 1/16/22	Mon 1/17/22	
12		Learning ROS	10 days	Sun 1/16/22	Thu 1/27/22	
13		**Software**	**21 days**	**Fri 1/28/22**	**Fri 2/25/22**	
14		Navigation algorithims	21 days	Fri 1/28/22	Fri 2/25/22	9
15		Obstacle avoidance	21 days	Fri 1/28/22	Fri 2/25/22	9
16		**Final Phase**	**35 days**	**Mon 2/28/22**	**Fri 4/15/22**	
17		Hardware implementation	14 days	Mon 2/28/22	Thu 3/17/22	13,5
18		Testing & Troubleshooting	21 days	Mon 2/28/22	Mon 3/28/22	13
19		Finishing Term 2 report	14 days	Tue 3/29/22	Fri 4/15/22	18

Figure 1 - Tasks' list from MS Project

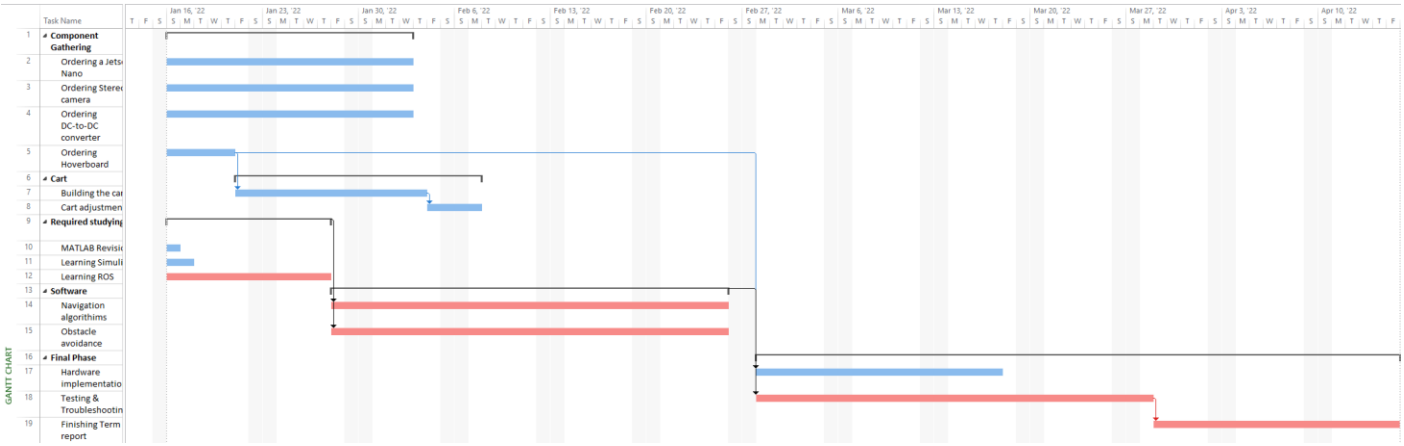


Figure 2 - Gantt chart (Red tasks are critical)

CURRICULAR RESOURCES

Muhannad Saeed:

NO.	Course title	Course link
1	**MATLAB**	https://www.youtube.com/watch?v=NSSTkkKRabI
2	**MATLAB plot**	https://www.youtube.com/watch?v=gDmpqn92s5U
3	**Simulink (*)**	https://www.youtube.com/watch?v=vxzR3W2BcRk
should be able to: - use the simple MATLAB commands & functions - build some (.m) file files for training - build Simulink models - include some MATLAB code in the Simulink model - construct 2D plots using MATLAB		
4	**Ros introduction(*)**	https://www.youtube.com/watch?v=96XsJ7xfsS8&t=214s
5	**Ros using MATLAB**	https://www.mathworks.com/help/ros/ug/get-started-with-ros.html
should be able to: - to distinguish the different ROS components - build simple projects include Nodes, Services, Messages etc. - train on building full, simple projects.		
6	**ROS using Simulink(*)**	https://www.youtube.com/watch?v=lictXPCP5M4&list=PLzP7tGk94hQWmr9052g6-UbRijg_zZsaD
should be able to: - drag and drop to use the ROS components - build full, simple projects using Simulink and ROS.		
7	**Power apps (*)**	https://www.youtube.com/watch?v=aVsWQgoWC0I&list=PLib8Q64STW-tLkyHqf_U4Gu7CWDz1E7kE&index=1
8	**Power apps portals(*)**	https://www.youtube.com/watch?v=mbn6-BPv34E
should be able to: - build a very detailed prototype		

- convert that protype to a real power app project - use/test the project on r phone		
9	**Solidworks revision**	https://www.youtube.com/watch?v=qtgmGkEPXs8
should be able to: - build basic components using solidworks - build some expected components for training purposes		

Suliman Abbas :

NO.	Course title	Course link
1	**Power apps (*)**	https://www.youtube.com/watch?v=aVsWQgoWC0I&list=PLib8Q64STW-tLkyHqf_U4Gu7CWDz1E7kE&index=1
2	**Power apps portal**	https://www.youtube.com/watch?v=mbn6-BPv34E
should be able to: - build a very detailed prototype - convert that protype to a real power app project - use/test the project on r phone		
3	**Solidworks revision**	https://www.youtube.com/watch?v=qtgmGkEPXs8
should be able to: - build basic components using solidworks - build some expected components for training purposes		
4	**MATLAB**	https://www.youtube.com/watch?v=NSSTkkKRabI
5	**MATLAB plot**	https://www.youtube.com/watch?v=gDmpqn92s5U
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8	**Ros using MATLAB**	https://www.mathworks.com/help/ros/ug/get-started-with-ros.html
should be able to: - to distinguish the different ROS components - build simple projects include Nodes, Services, Messages etc. - train on building full, simple projects.		
9	**ROS using Simulink(*)**	https://www.youtube.com/watch?v=IictXPCP5M4&list=PLzP7tGk94hQWmr9052g6-UbRijg_zZsaD
should be able to:		

- drag and drop to use the ROS components - build full, simple projects using Simulink and ROS.

Wael Aldhaheri:

NO.	Course title	Course link
1	**MATLAB**	https://www.youtube.com/watch?v=NSSTkkKRabI
2	**MATLAB plot**	https://www.youtube.com/watch?v=gDmpqn92s5U
3	**Simulink (*)**	https://www.youtube.com/watch?v=vxzR3W2BcRk
should be able to: - use the simple MATLAB commands & functions - build some (.m) file files for training - build Simulink models - include some MATLAB code in the Simulink model - construct 2D plots using MATLAB		
4	**Solidworks revision**	https://www.youtube.com/watch?v=qtgmGkEPXs8
should be able to: - build basic components using solidworks - build some expected components for training purposes		
5	**Ros introduction(*)**	https://www.youtube.com/watch?v=96XsJ7xfsS8&t=214s
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should be able to: - to distinguish the different ROS components - build simple projects include Nodes, Services, Messages etc. - train on building full, simple projects.		
7	**ROS using Simulink(*)**	https://www.youtube.com/watch?v=IictXPCP5M4&list=PLzP7tGk94hQWmr9052g6-UbRijg_zZsaD
should be able to: - drag and drop to use the ROS components - build full, simple projects using Simulink and ROS.		
8	**Power apps (*)**	https://www.youtube.com/watch?v=aVsWQgoWC0I&list=PLib8Q64STW-tLkyHqf_U4Gu7CWDz1E7kE&index=1
9	**Power apps portals(*)**	https://www.youtube.com/watch?v=mbn6-BPv34E
should be able to: - build a very detailed prototype - convert that protype to a real power app project - use/test the project on r phone		

DESIGN NOTES AND DRAFTS

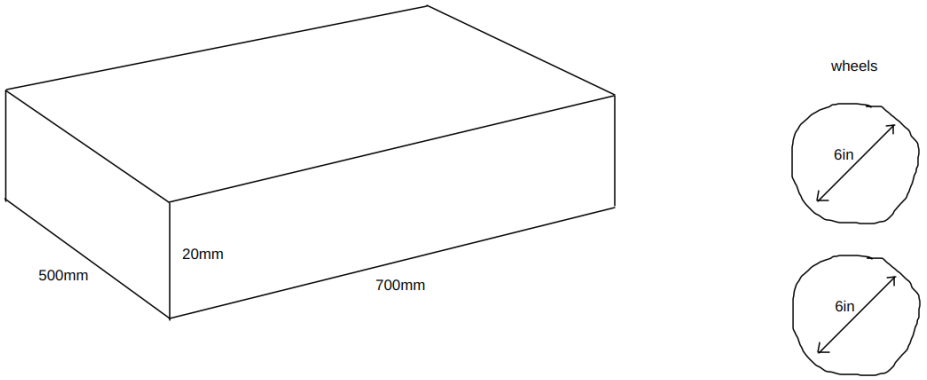


Figure 4 - Cart Sketch

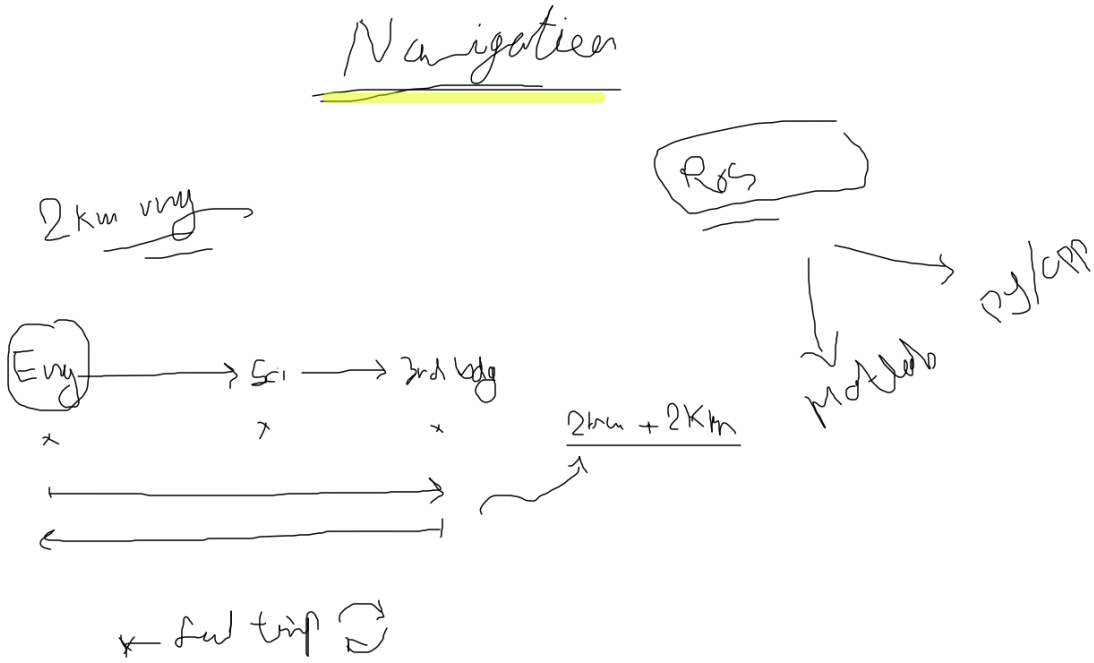


Figure 3 - Navigation handwritten notes

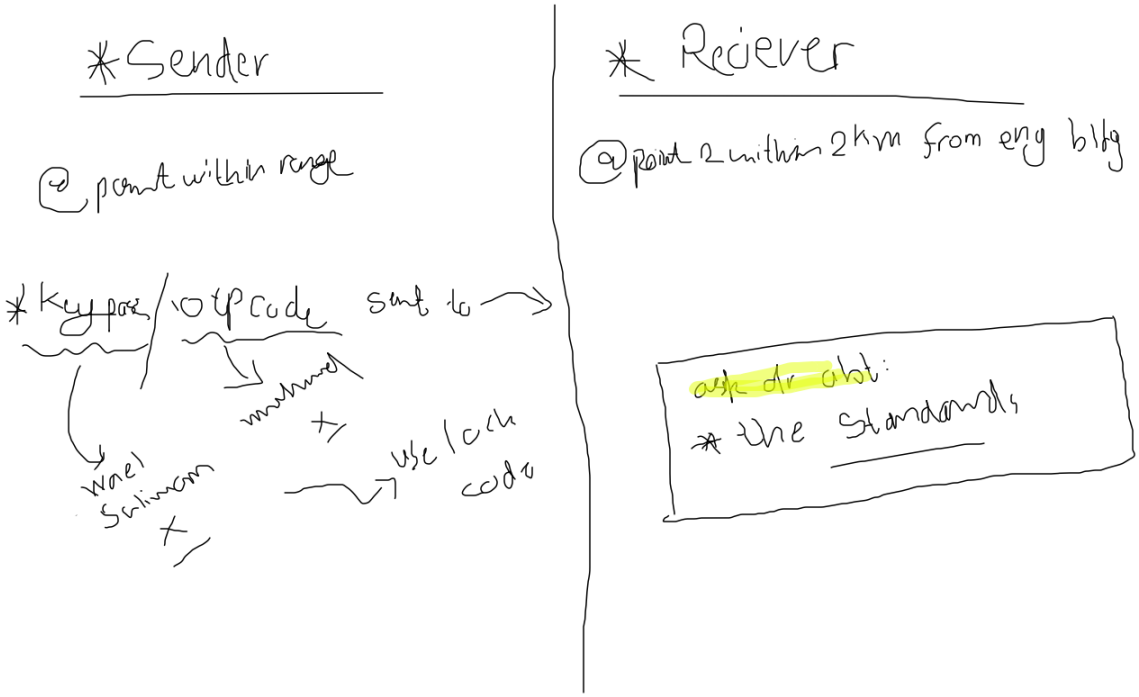


Figure 5 - Project scope notes

MEETING MINUTES

Meeting #1

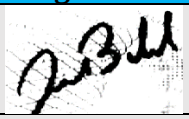
Meeting Time: 31 August, Tuesday at 9:30 PM

Meeting's Agenda:

- Introduce the team and get to know each other
- Briefly discuss the problem
- Briefly discuss the ability to solve the problem within the time

Meeting Outcomes:

- Get to know the teammates and the advisor
- Formed the basic understanding of the problem
- The need of a detailed discussion within the next week

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #2

Meeting Time: 8 September, Wednesday at 9:30 PM

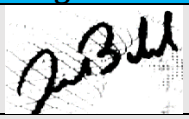
Meeting's Agenda:

- Detailed discussion about the problem
- Discuss the expectations during both semesters

Meeting Outcomes:

- A clearer understanding of the problem
- Cleared the expectations during the two semesters

Meeting minutes: 60 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #3

Meeting Time: 16 September, Thursday at 8:00 PM

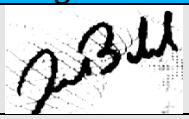
Meeting's Agenda:

- Discuss the exact project objectives
- Discuss the scope and what to turn in by the end of it
- Discuss the scope of the project

Meeting Outcomes:

- Discussed the objectives
- Discussed and agreed on the some listed wants and musts
- Discussed the scope

Meeting minutes: 60 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #4

Meeting Time: 21 September, Thursday at 1:00 PM

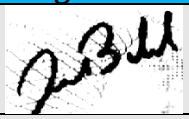
Meeting's Agenda:

- Discuss some standards related to the project
- view some literatures related to the project and discuss them

Meeting Outcomes:

- formed a good knowledge basis required to

Meeting minutes: 45 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #5

Meeting Time: 19 September, Sunday at 5:00 PM

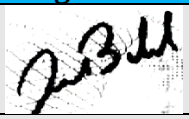
Meeting's Agenda:

- Discuss few points related to the assumptions
- Discuss the team members roles

Meeting Outcomes:

- Cleared the points in assumptions
- Agreed on the team members roles

Meeting minutes: 50 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #6

Meeting Time: 26 September, Sunday at 7:00 PM

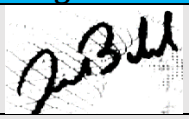
Meeting's Agenda:

- Discuss the milestones
- Discuss some related resources for the project

Meeting Outcomes:

- Agreed on the discussed milestones for both term one and two
- Viewed some related resources in the project topic

Meeting minutes: 45 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #7

Meeting Time: 3 November, Wednesday at 8:00 PM

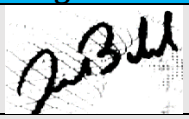
Meeting's Agenda:

- Discuss the initial alternatives
- Discuss the related block diagrams

Meeting Outcomes:

- Rejected few alternatives and accept the others
- Modified the related block diagrams

Meeting minutes: 60 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #8

Meeting Time: 7 November, Sunday at 8:00 PM

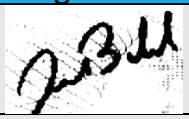
Meeting's Agenda:

- Discuss the selected alternative
- Discuss the baseline design
- Mature the design

Meeting Outcomes:

- Agreed on the selected alternative
- Improved the initial design

Meeting minutes: 50 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #9

Meeting Time: 9 November, Tuesday at 1:00 PM

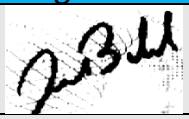
Meeting's Agenda:

- Discuss the required hardware
- Discuss some adjustment on the baseline design

Meeting Outcomes:

- Listed the main hardware components
- Changed the sketched design of the platform

Meeting minutes: 45 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri	

Meeting #10

Meeting Time: 12 November, Thursday at 1:00 PM

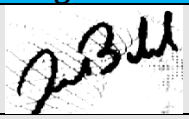
Meeting's Agenda:

- Discuss the initial implementation
- Discuss the electrical & mechanical specifications

Meeting Outcomes:

- Agreed on the final version of the mechanical specification
- Added some parts to the hardware list

Meeting minutes: 50 mins

Name	Signature
Dr. Muhammad Bilal	
Muhannad Saeed	
Suliman Abbas	
Wael Aldhaheri