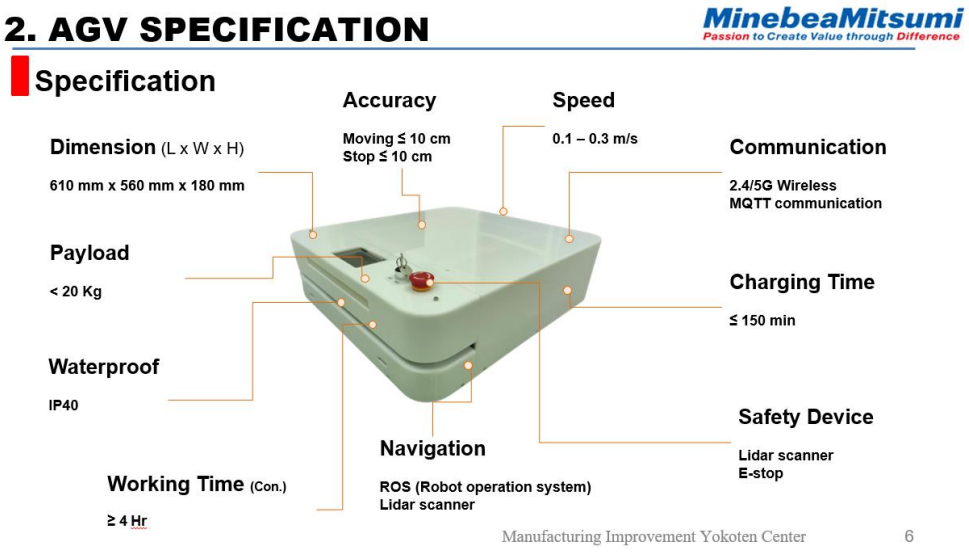
Objective: To test opportunity for AGV surveying in New ware-house LopBuri

Date: 8-9 July 2024

Location: New ware-house block 36

Equipment: AGV MICKY50

Specification:

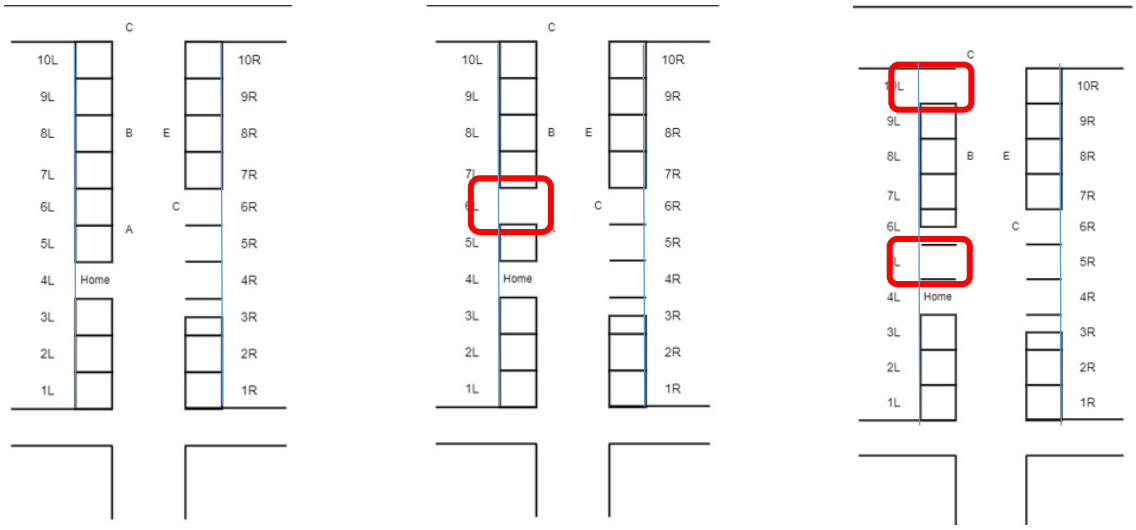


Topic:

1. Creating Map and difference map pattern for testing.
2. Testing condition and result.
3. Problem.
4. Conclusion.

1. Creating Map and difference map pattern for testing.

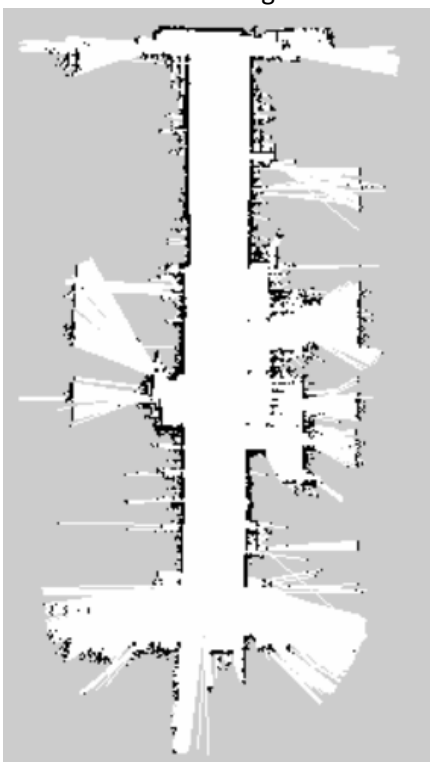
For this test, we tested at New-Warehouse. Which is always rack being moved therefore the test has different maps for different test times as follows:



(A) Morning 08-07-2024 (B) Evening 08-07-2024 (C) 09-07-2024

Picture 1 Map layout for New-Ware House Block 36

From the picture 1. Rack was moved from old state that rack 6L moved on evening 08-07-2024 and rack 5L moved on 09-07-2024 that effect to AGV moving and we explain in topic 3 problem. However, for this test we use map that created on Morning 08-07-2024 for data collection as below:



Picture 2. Map for AGV create on Morning 08-07-2024

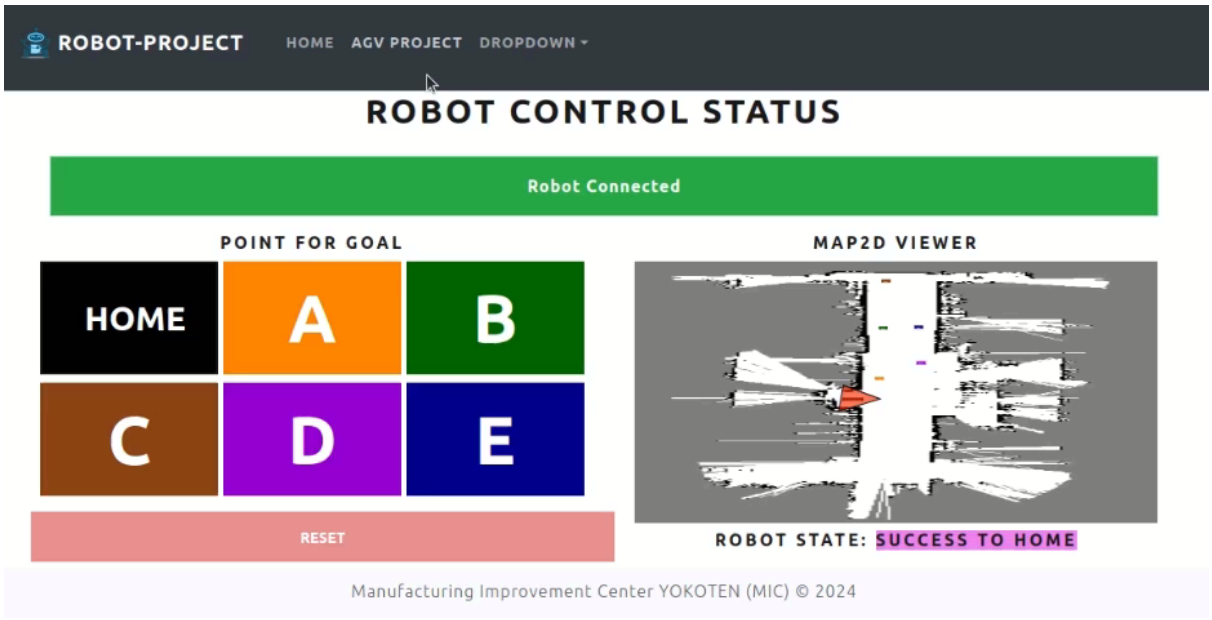
2. Testing condition and result.

2.1 Testing moving AGV to Position by using Web Application.

We use React for design Web Application using ROSLIB to communicate between React and ROS.

Testing condition:

- Control AGV by touch button on the screen for every button.
- Record moving data.



Picture 3. Web Application page for control AGV

Testing Result:

Start/Goal	Home	A	B	C	D	E
Home	✓	✓	✓	✓	✓	✓
A	✓	✓	✓	✓	✓	✓
B	✓	✓	✓	✓	✓	✓
C	✓	✓	✓	✓	✓	✓
D	✓	✓	✓	✓	✓	✓
E	✓	✓	✓	✓	✓	✓

Table 1. Testing result for moving from start point to goal point

From picture 3 and table 1. User can control AGV by touching button that need to be goal of AGV on the screen. For the result, we found that AGV is able to move to every point as the command from user (Video Link: https://youtu.be/6zdblH6UEzM)

2.2 Avoidance person standing in the front of AGV (AGV move to front direction of person).

Picture 4. Avoidance Person standing in the front of AGV
(Video Link: https://youtu.be/ZW2OfCaQo_c)

From the picture 3. AGV can avoid stationary person by moving around them from the rear direction effectively with distance about 10-30 cm that is acceptable distance for working.

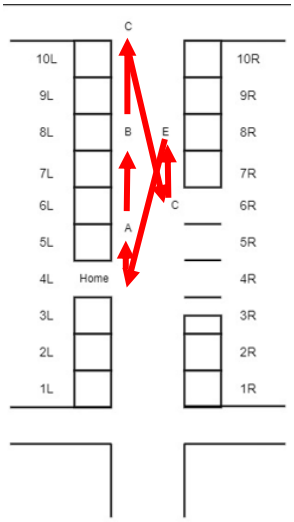
2.3 Avoidance person moving to the front of AGV (AGV move to front direction of person).

Picture 5. Avoidance Person moving to the front of AGV
(Video Link: https://youtu.be/vzY4oO30h_Q)

From the picture 5. AGV can avoid stationary person by moving around them from the rear direction effectively with distance about 10-30 cm that is acceptable distance for working. But worker has to stop in the front of AGV for AGV avoid pass worker.

2.4 Record data on database

For testing record data into data base, we tested by sent command to AGV move in the loop (Home -> A -> B -> C -> D -> E -> Home) as picture 6.



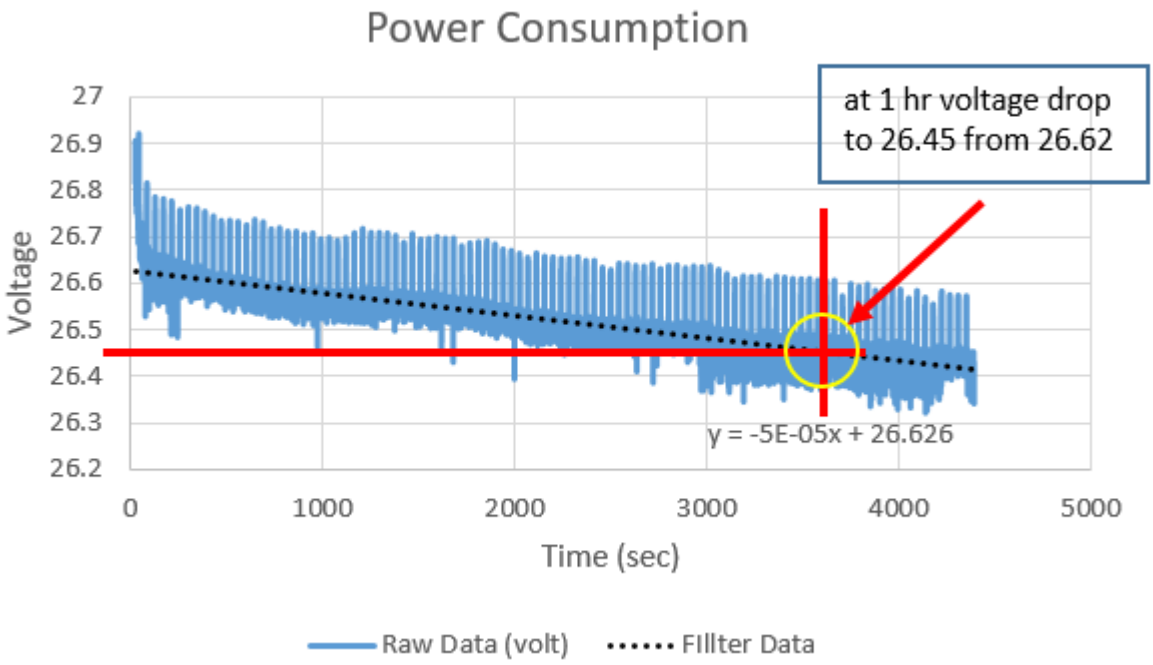
Picture 6. Moving path for AGV

The result shown in table below:

No	Point	Duration (sec)	Distance (m)	Speed (m/s)	Battery Usage (Volt)
1	H -> A -> B -> C -> D -> E -> H	195	47.4748	0.243461	0.0088252
2	H -> A -> B -> C -> D -> E -> H	198	48.25178	0.243696	0.0088252
3	H -> A -> B -> C -> D -> E -> H	160	47.25153	0.295322	0.0087252
4	H -> A -> B -> C -> D -> E -> H	158	47.22039	0.298863	0.008722
5	H -> A -> B -> C -> D -> E -> H	163	47.33342	0.290389	0.0087333
6	H -> A -> B -> C -> D -> E -> H	152	44.18583	0.290696	0.0084186
7	H -> A -> B -> C -> D -> E -> H	157	47.07347	0.299831	0.0087073
8	H -> A -> B -> C -> D -> E -> H	157	47.16607	0.300421	0.0087166
9	H -> A -> B -> C -> D -> E -> H	165	48.33975	0.292968	0.008834
10	H -> A -> B -> C -> D -> E -> H	155	47.12492	0.304032	0.0087125
11	H -> A -> B -> C -> D -> E -> H	156	47.18808	0.302488	0.0087188
12	H -> A -> B -> C -> D -> E -> H	157	47.16187	0.300394	0.0087162
13	H -> A -> B -> C -> D -> E -> H	156	47.14883	0.302236	0.0087149
14	H -> A -> B -> C -> D -> E -> H	155	46.91258	0.302662	0.0086913
15	H -> A -> B -> C -> D -> E -> H	157	47.13765	0.30024	0.0087138
16	H -> A -> B -> C -> D -> E -> H	162	47.08385	0.290641	0.0087084
17	H -> A -> B -> C -> D -> E -> H	158	47.10374	0.298125	0.0087104
18	H -> A -> B -> C -> D -> E -> H	155	47.00343	0.303248	0.0087003
19	H -> A -> B -> C -> D -> E -> H	166	47.98152	0.289045	0.0087982
20	H -> A -> B -> C -> D -> E -> H	157	47.03757	0.299602	0.0087038
21	H -> A -> B -> C -> D -> E -> H	158	47.57304	0.301095	0.0087573
22	H -> A -> B -> C -> D -> E -> H	176	48.56578	0.275942	0.0088566
23	H -> A -> B -> C -> D -> E -> H	162	47.0709	0.290561	0.0087071
24	H -> A -> B -> C -> D -> E -> H	175	48.46345	0.276934	0.0088463
25	H -> A -> B -> C -> D -> E -> H	201	52.35454	0.26047	0.0082355
26	H -> A -> B -> C -> D -> E -> H	177	48.40992	0.273502	0.008841

27	H -> A -> B -> C -> D -> E -> H	163	46.94986	0.288036	0.008695
28	H -> A -> B -> C -> D -> E -> H	161	47.29936	0.293785	0.0087299
29	H -> A -> B -> C -> D -> E -> H	161	47.26748	0.293587	0.0087267
30	H -> A -> B -> C -> D -> E -> H	159	47.22845	0.297034	0.0087228
31	H -> A -> B -> C -> D -> E -> H	158	47.13038	0.298294	0.008713
32	H -> A -> B -> C -> D -> E -> H	158	47.05443	0.297813	0.0087054
33	H -> A -> B -> C -> D -> E -> H	166	47.41601	0.285639	0.0087416
34	H -> A -> B -> C -> D -> E -> H	162	47.14916	0.291044	0.0087149
35	H -> A -> B -> C -> D -> E -> H	162	47.14375	0.291011	0.0087144
36	H -> A -> B -> C -> D -> E -> H	159	47.08354	0.296123	0.0087084
37	H -> A -> B -> C -> D -> E -> H	175	48.52739	0.277299	0.0088527
38	H -> A -> B -> C -> D -> E -> H	163	47.36106	0.290559	0.0087361
39	H -> A -> B -> C -> D -> E -> H	160	46.8898	0.293061	0.008689
40	H -> A -> B -> C -> D -> E -> H	162	47.14685	0.29103	0.0087147
41	H -> A -> B -> C -> D -> E -> H	169	47.08771	0.278626	0.0087088
42	H -> A -> B -> C -> D -> E -> H	178	47.73237	0.268159	0.0087732
43	H -> A -> B -> C -> D -> E -> H	170	49.01134	0.288302	0.0089011
44	H -> A -> B -> C -> D -> E -> H	166	48.20652	0.290401	0.0088207
Average		165.3953	47.48419	0.28947	0.008750184

Table 2 Data for data collection



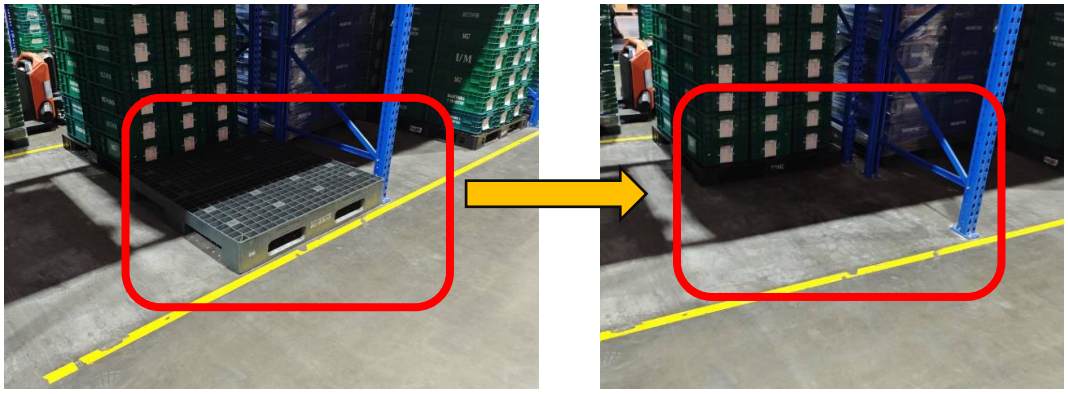
Picture 7 voltage remain VS Time

From Table 2 and picture 7., it is shown that within one moving loop, the AGV has an average distance of 47.48 meters, using 164.54 seconds per round and power consuming 0.00875 volts (approximately 15 Ah) with an average speed of 0.289 m/s, which is less than the worker's speed (approximately 0.5-1 m/s). For continuous operation with one battery change, the total distance the AGV can cover is about 4,134.30 meters or about 4 hours. Additionally, for continuous operation over one day (8 hours), the AGV can move a distance of about 8268.6 meters and requires two battery changes per day (150 minutes total changing time).

From table 2, data recorded and added into database.

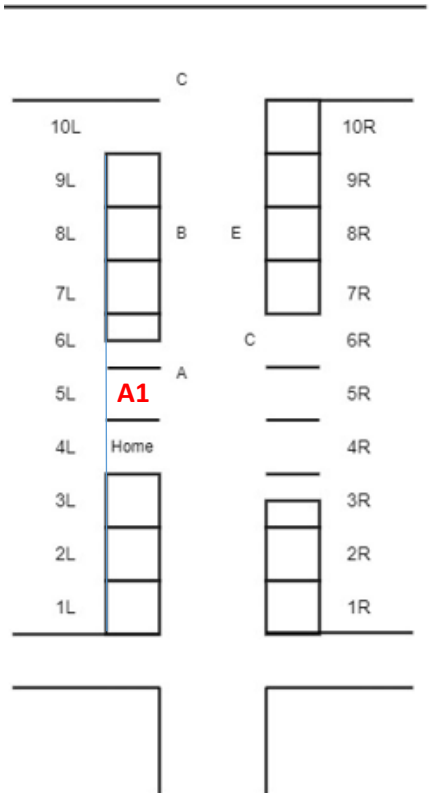
3. **Problem**

While testing we found problem for difference map below:



Picture 10 rack at area 5L

As picture 1 (B) and (C), the rack 5L was removed from that area, testing result shown that 2/5 (40%) times. AGV will move to point A1 instead of A (Picture 11) because the reference area on the left is missing causing the Lidar to malfunction that mistake and make AGV collision with obstacles.



Picture 11 mistake Area

4. Conclusion

The AGV MICKY50 demonstrated reliable performance under controlled conditions using the created map from the morning of 08-07-2024. It successfully navigated between predefined points (Home, A, B, C, D, E) using a web application interface integrated with ROSLIB for communication with ROS. The tests confirmed:

Mapping and Navigation: The AGV effectively utilized the morning map of 08-07-2024 to navigate through the warehouse, demonstrating flexibility in adapting to different layouts.

Obstacle Avoidance: It demonstrated effective obstacle avoidance when encountering stationary and moving persons, maintaining a safe distance of 10-30 cm, which is suitable for operational safety.

Data Collection and Analysis: Recorded data on movement points, duration, and distance for both testing days were logged into the database, providing valuable insights into operational metrics.

Within one moving loop, the AGV has an average distance of 47.48 meters, using 164.54 seconds per round and consuming 0.00475 volts (approximately 15 Ah) with an average speed of 0.289 m/s, which is less than the worker's speed (approximately 0.5-1 m/s). For continuous operation with one battery change, the total distance the AGV can cover is about 4,134.30 meters or about 4 hours. Additionally, for continuous operation over one day (8 hours), the AGV can move a distance of about 8268.6 meters and requires two battery changes per day (150 minutes total changing time)

The primary challenge observed was the sensitivity of AGV navigation to changes in the environment, specifically when racks were moved (as observed with Rack 5L). This led to navigation errors due to outdated map references, resulting in potential collisions or navigation to incorrect points