The Amazing Race™: Robot Edition—Appendix

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I. Trial Results

Trial 1

Summary

Building: HAMP
Floor: 3
Volunteer: C
Goal: 3124
Floor plan: Figure 67
SLAM map: Figure 1
Result: Success

Sequence of Behaviors

1) Wander (68 s)
2) Approach_person (13 s)
3) Hold_conversation (24 s)
4) Follow_directions (56 s)
5) Wander (17 s)
6) Approach_person (2 s)
7) Wander (1 s)
8) Approach_person (10 s)
9) Hold_conversation (55 s)
10) Follow_directions (29 s)
11) Navigate_door (49 s)
12) Wander (14 s)
13) Approach_person (4 s)
14) Wander (0 s)
15) Approach_person (18 s)
16) Hold_conversation (76 s)
17) Follow_directions (66 s)
18) Wander (125 s)
19) Approach_person (1 s)
20) Wander (26 s)
21) Approach_person (26 s)
22) Hold_conversation (60 s)
23) Follow_directions (1 s)
24) Navigate_door (203 s)
25) Wander (46 s)
26) Approach_person (29 s)
27) Hold_conversation (103 s)
28) Follow_directions (1 s)
29) Navigate_door (84 s)
30) Achieve_goal (N/A)

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Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 3124?
Person:	turn around go to the end.
Robot:	What do I do after turning around and going forward?
Person:	hall turn left and then it's on.
Robot:	What do I do after I turn left?
Person:	it is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-L`]

Conversation 2

Robot:	Could you tell me how to navigate to 3124?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	it's on your left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	go back you misunderstood me.
Robot:	Sorry, I am a little confused. Could we start over? Could you tell me how to navigate to 3124?
Person:	turn around go straight turn left and then it is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-L`]

Conversation 3

Robot:	Could you tell me how to navigate to 3124?
Person:	turn around go to the end of the hall.
Robot:	What do I do after turning around and going forward?
Person:	go to the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn light.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	it is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `left`, `goal-L`]

Conversation 4

Robot:	Could you tell me how to navigate to 3124?
Person:	go straight and it's on your right.
Robot:	What do I do after I turn right?
Person:	you misunderstood
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3124?
Person:	go straight.
Robot:	What do I do after starting to go forward?
Person:	it is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Conversation 5	
Robot:	Could you tell me how to navigate to 3124?
Person:	go straight and it's on your right.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3124?
Person:	go straight.
Robot:	What do I do after starting to go forward?
Person:	go forward.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after starting to go forward?
Person:	it's on the right.
Robot:	What do I do after I turn right?
Person:	you misunderstood go back.
Robot:	Sorry, I am a little confused. Could we start over? Could you tell me how to navigate to 3124?
Person:	go straight.
Robot:	What do I do after starting to go forward?
Person:	it is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Navigate Door

Number of doors approached: 7
Number of doors labeled: 5

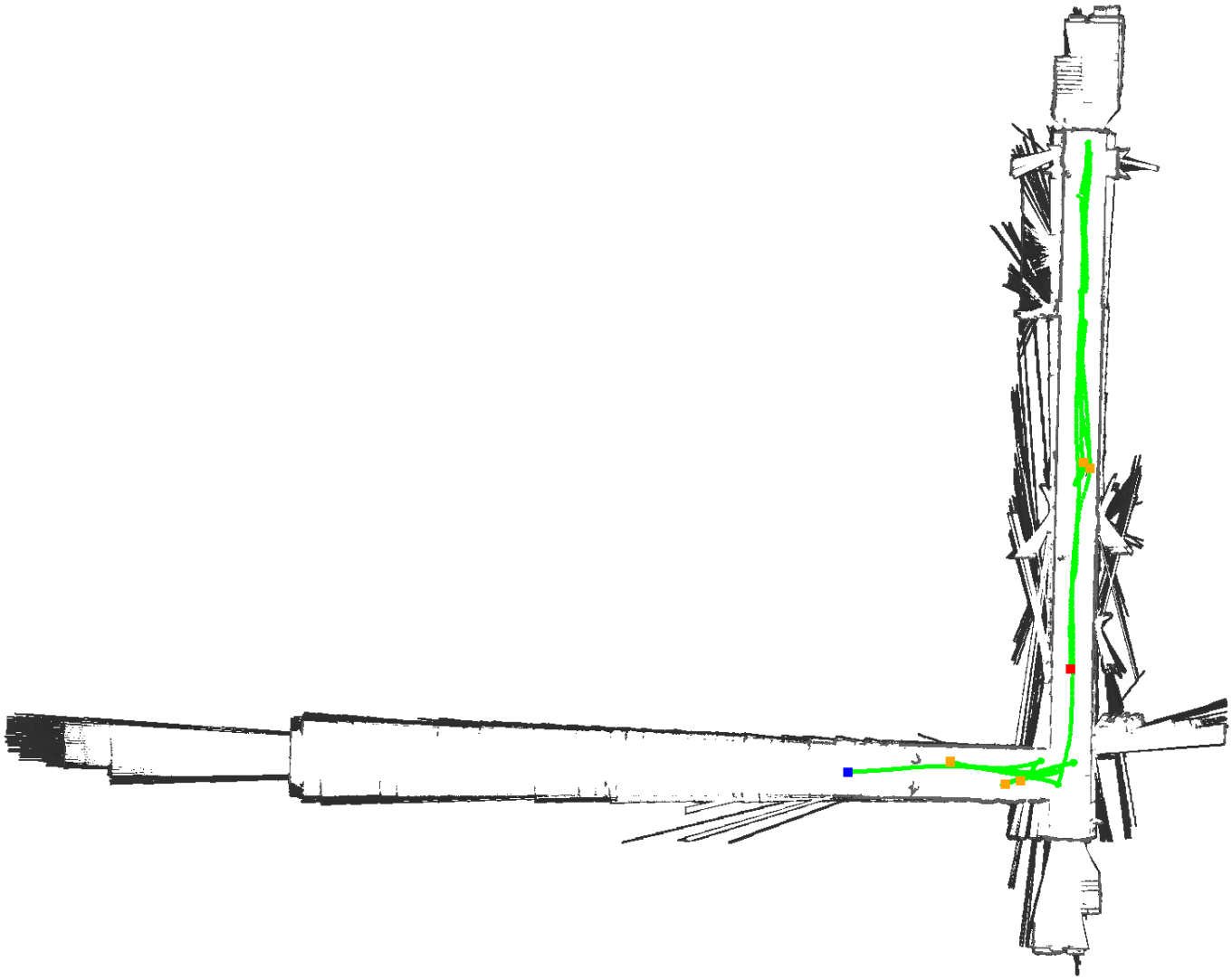

Fig. 1. Trial 1 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 2

Summary

Building: HAMP
Floor: 2
Volunteer: C
Goal: 2158
Floor plan: Figure 66
SLAM map: Figure 2
Result: Success

Sequence of Behaviors

1) WANDER (209 s)
2) APPROACH_PERSON (0 s)
3) WANDER (17 s)
4) APPROACH_PERSON (2 s)
5) HOLD_CONVERSATION (54 s)
6) FOLLOW_DIRECTIONS (8 s)
7) NAVIGATE_DOOR (51 s)
8) WANDER (55 s)
9) APPROACH_PERSON (1 s)
10) WANDER (29 s)
11) APPROACH_PERSON (2 s)
12) WANDER (19 s)
13) APPROACH_PERSON (26 s)
14) HOLD_CONVERSATION (23 s)
15) FOLLOW_DIRECTIONS (16 s)
16) NAVIGATE_DOOR (463 s)
17) WANDER (16 s)
18) APPROACH_PERSON (3 s)
19) WANDER (1 s)
20) APPROACH_PERSON (0 s)
21) WANDER (29 s)
22) APPROACH_PERSON (2 s)
23) WANDER (2 s)
24) APPROACH_PERSON (0 s)
25) WANDER (2 s)
26) APPROACH_PERSON (2 s)
27) WANDER (1 s)
28) APPROACH_PERSON (0 s)
29) WANDER (3 s)
30) APPROACH_PERSON (0 s)
31) WANDER (6 s)
32) APPROACH_PERSON (1 s)
33) WANDER (13 s)
34) APPROACH_PERSON (0 s)
35) WANDER (1 s)
36) APPROACH_PERSON (36 s)
37) HOLD_CONVERSATION (93 s)
38) FOLLOW_DIRECTIONS (7 s)
39) WANDER (127 s)
40) APPROACH_PERSON (6 s)
41) WANDER (2 s)
42) APPROACH_PERSON (48 s)
43) HOLD_CONVERSATION (40 s)
44) FOLLOW_DIRECTIONS (0 s)
45) NAVIGATE_DOOR (74 s)
46) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 2158?
Person:	going that way. are you directions to 2158 bright?
Robot:	Which direction do I start out going?
Person:	
Robot:	I did not hear you.
Robot:	Which direction do I start out going?
Person:	turn to your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`right`, `goal-F`]

Conversation 2

Robot:	Could you tell me how to navigate to 2158?
Person:	turn around and go straight.
Robot:	What do I do after turning around and going forward?
Person:	it is on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 3

Robot:	Could you tell me how to navigate to 2158?
Person:	turn around and it's on the
Robot:	What do I do after turning around and going forward?
Person:	it's on the right.
Robot:	What do I do after I turn right?
Person:	you misunderstood
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	you're incorrect.
Robot:	Sorry about that. Let me ask my previous question.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 2158?
Person:	turn around go straight and it is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 4

Robot:	Could you tell me how to navigate to 2158?
Person:	yeah, you keep going straight and it's the double glass doors on your right.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 2158?
Person:	go straight and it is on your right. it is double glass doors.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Navigate Door

Number of doors approached: 5
Number of doors labeled: 2

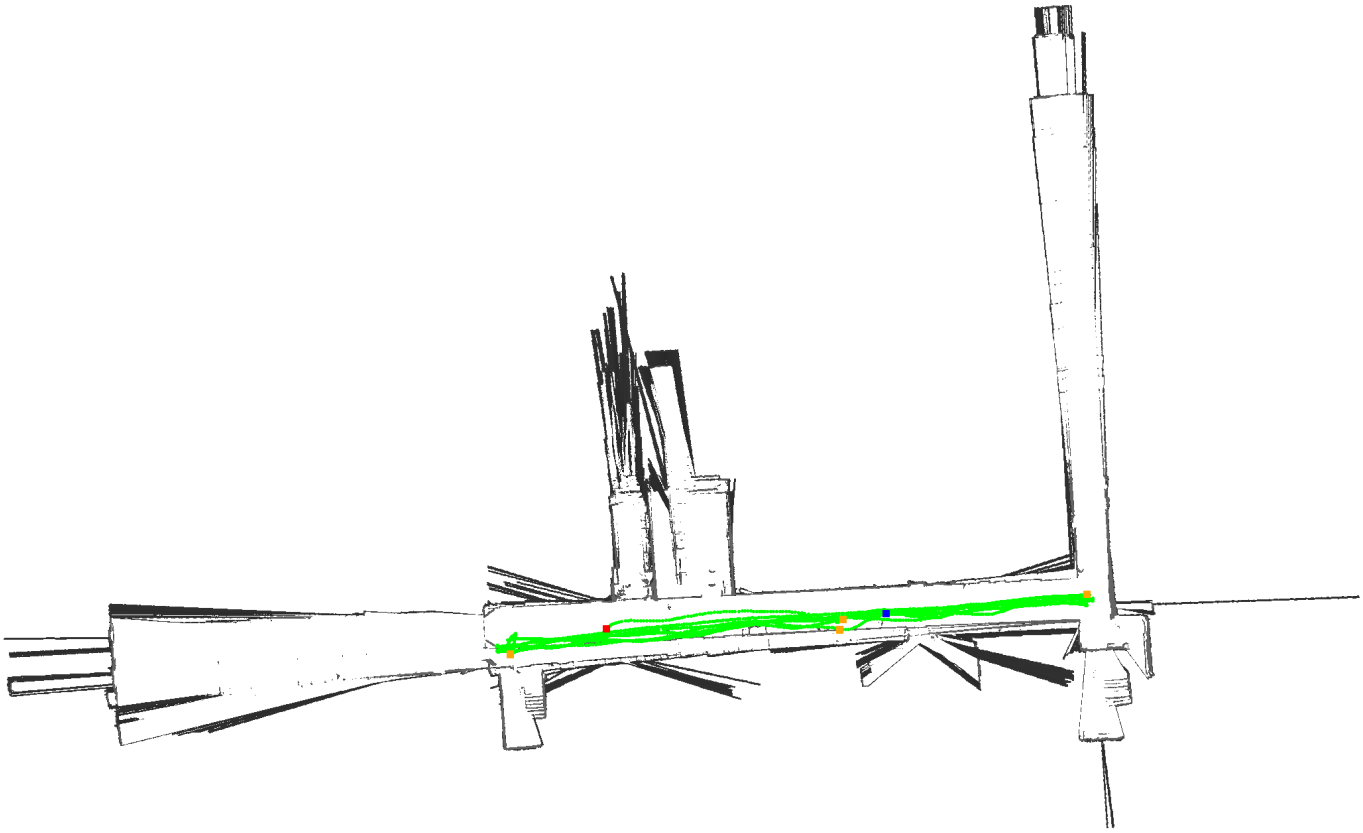

Fig. 2. Trial 2 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 3

Summary

Building: HAMP
Floor: 1
Volunteer: C
Goal: 1115
Floor plan: Figure 65
SLAM map: Figure 3
Result: Failure
Reason: The robot repeatedly failed to detect an intersection that was approximately 1.3 m wide near the end of the hallway, which is where the goal was. This was due to the hallway-width setting being ill-suited for this building.

Sequence of Behaviors

1) WANDER (7 s)
2) APPROACH_PERSON (3 s)
3) HOLD_CONVERSATION (123 s)
4) FOLLOW_DIRECTIONS (9 s)
5) WANDER (6 s)
6) APPROACH_PERSON (3 s)
7) HOLD_CONVERSATION (70 s)
8) FOLLOW_DIRECTIONS (9 s)
9) WANDER (91 s)
10) APPROACH_PERSON (0 s)
11) WANDER (48 s)
12) APPROACH_PERSON (0 s)
13) WANDER (24 s)
14) APPROACH_PERSON (26 s)
15) HOLD_CONVERSATION (24 s)
16) FOLLOW_DIRECTIONS (48 s)
17) WANDER (16 s)
18) APPROACH_PERSON (1 s)
19) WANDER (6 s)
20) APPROACH_PERSON (9 s)
21) WANDER (0 s)
22) APPROACH_PERSON (2 s)
23) WANDER (1 s)
24) APPROACH_PERSON (4 s)
25) HOLD_CONVERSATION (22 s)
26) FOLLOW_DIRECTIONS (61 s)
27) WANDER (20 s)
28) APPROACH_PERSON (17 s)
29) HOLD_CONVERSATION (31 s)
30) FOLLOW_DIRECTIONS (58 s)
31) WANDER (17 s)
32) APPROACH_PERSON (–)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 1115?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 1115?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	Could you tell me how to navigate to 1115?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 2

Robot:	Could you tell me how to navigate to 1115?
Person:	did they replace with letters?
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 1115?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 1115?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 3

Robot:	Could you tell me how to navigate to 1115?
Person:	go to the end of the hall turn left go through the double doors. and then at the end of the hall destination is on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `left`, `goal-R`]

Conversation 4	
Robot:	Could you tell me how to navigate to 1115?
Person:	turn around go to the end of the hall turn left go through the double doors, you go to the end of the hall and the destination is on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Conversation 5	
Robot:	Could you tell me how to navigate to 1115?
Person:	turn around go to the end of the hall.
Robot:	What do I do after turning around and going forward?
Person:	turn left through the double doors go to the end of the hall and the destination is on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Navigate Door

Number of doors approached: 0
Number of doors labeled: 0

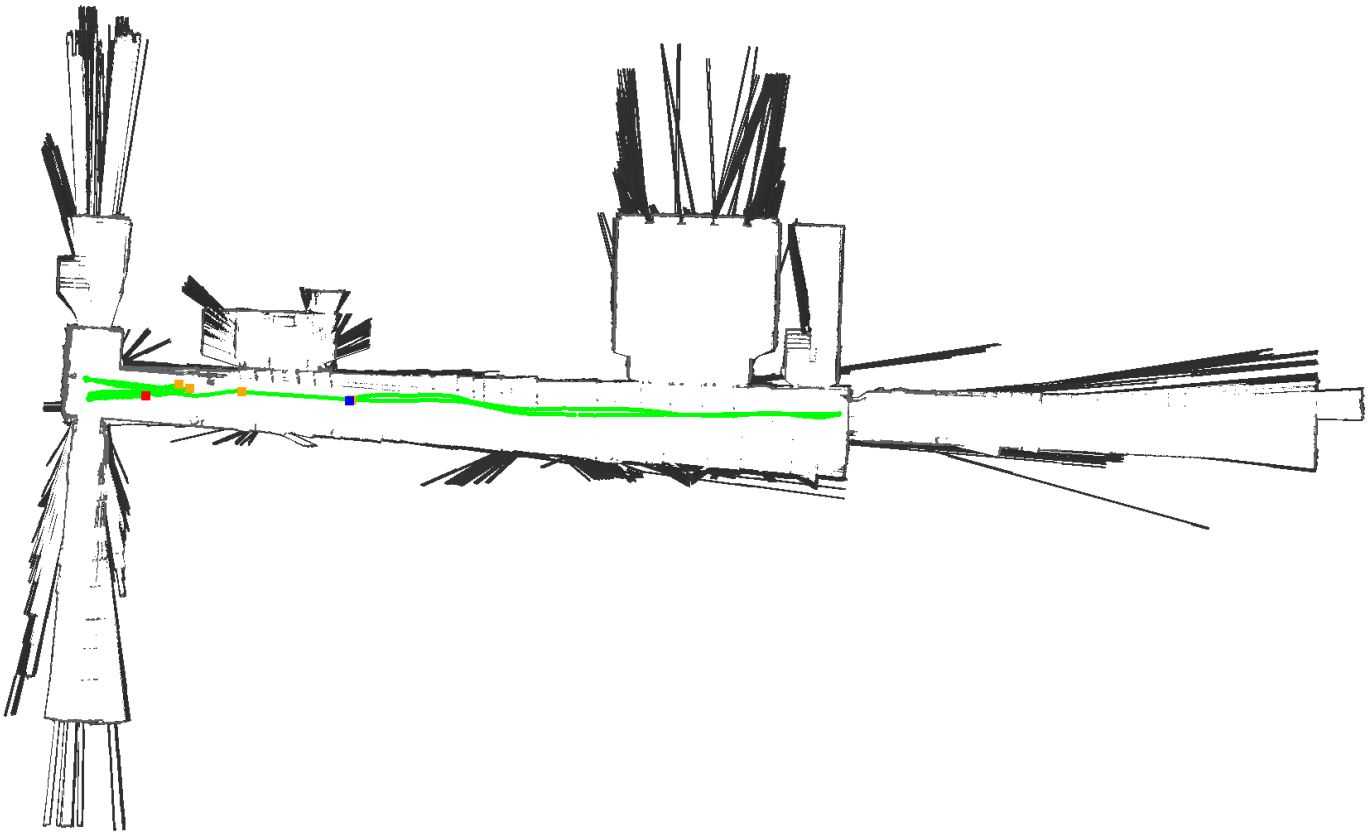

Fig. 3. Trial 3 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 4

Summary

Building: HAMP
Floor: 3
Volunteer: C
Goal: 3288
Floor plan: Figure 67
SLAM map: Figure 4
Result: Failure
Reason: When the robot returned to the NAVIGATE_DOOR behavior, it should have reset the data structures holding previous door detections, which it was not doing. This could have prevented new doors from being correctly detected, localized, and investigated.

Sequence of Behaviors

1) WANDER (114 s)
2) APPROACH_PERSON (9 s)
3) HOLD_CONVERSATION (27 s)
4) FOLLOW_DIRECTIONS (91 s)
5) WANDER (19 s)
6) APPROACH_PERSON (3 s)
7) WANDER (1 s)
8) APPROACH_PERSON (3 s)
9) WANDER (2 s)
10) APPROACH_PERSON (3 s)
11) WANDER (1 s)
12) APPROACH_PERSON (5 s)
13) WANDER (0 s)
14) APPROACH_PERSON (20 s)
15) HOLD_CONVERSATION (76 s)
16) FOLLOW_DIRECTIONS (112 s)
17) WANDER (27 s)
18) APPROACH_PERSON (1 s)
19) WANDER (2 s)
20) APPROACH_PERSON (3 s)
21) WANDER (1 s)
22) APPROACH_PERSON (29 s)
23) HOLD_CONVERSATION (19 s)
24) FOLLOW_DIRECTIONS (11 s)
25) WANDER (12 s)
26) APPROACH_PERSON (1 s)
27) HOLD_CONVERSATION (57 s)
28) FOLLOW_DIRECTIONS (59 s)
29) NAVIGATE_DOOR (101 s)
30) WANDER (1 s)
31) APPROACH_PERSON (24 s)
32) WANDER (1 s)
33) APPROACH_PERSON (10 s)
34) WANDER (1 s)
35) APPROACH_PERSON (10 s)
36) HOLD_CONVERSATION (38 s)
37) FOLLOW_DIRECTIONS (16 s)
38) NAVIGATE_DOOR (276 s)
39) WANDER (18 s)
40) APPROACH_PERSON (0 s)
41) WANDER (31 s)
42) APPROACH_PERSON (2 s)
43) WANDER (6 s)
44) APPROACH_PERSON (0 s)
45) WANDER (1 s)
46) APPROACH_PERSON (0 s)
47) WANDER (1 s)
48) APPROACH_PERSON (3 s)
49) WANDER (4 s)
50) APPROACH_PERSON (2 s)
51) WANDER (1 s)
52) APPROACH_PERSON (23 s)
53) HOLD_CONVERSATION (19 s)
54) FOLLOW_DIRECTIONS (80 s)
55) WANDER (18 s)
56) APPROACH_PERSON (1 s)
57) WANDER (1 s)
58) APPROACH_PERSON (23 s)
59) HOLD_CONVERSATION (–)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 3288?
Person:	go to go straight and then turn right at the first intersection go to the end of the hallway turn right and then it will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `end`, `right`, `goal-R`]

Conversation 2

Robot:	Could you tell me how to navigate to 3288?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	and ghosts
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after turning around and going forward?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	go to the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn right and the destination will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `end`, `right`, `goal-R`]

Conversation 3

Robot:	Could you tell me how to navigate to 3288?
Person:	turn around go to the end of the hall turn. right and the destination is on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-R`]

Conversation 4

Robot:	Could you tell me how to navigate to 3288?
Person:	turn around go to end.
Robot:	What do I do after turning around and going forward?
Person:	go to the end of the hall turn, right and the destination is on your right.
Robot:	When I am at end, which direction will I go to get to end?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3288?
Person:	turn around go to the end of the hall turn. right and the destination will be on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-R`]

Conversation 5

Robot:	Could you tell me how to navigate to 3288?
Person:	turn around and the destination of your right.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3288?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	the destination is on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 6

Robot:	Could you tell me how to navigate to 3288?
Person:	turn around turn left at the first intersection.
Robot:	What do I do after I turn left?
Person:	go down, and the destination is up.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-F`]

Conversation 7

Robot:	Could you tell me how to navigate to 3288?
Plan:	[]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 1

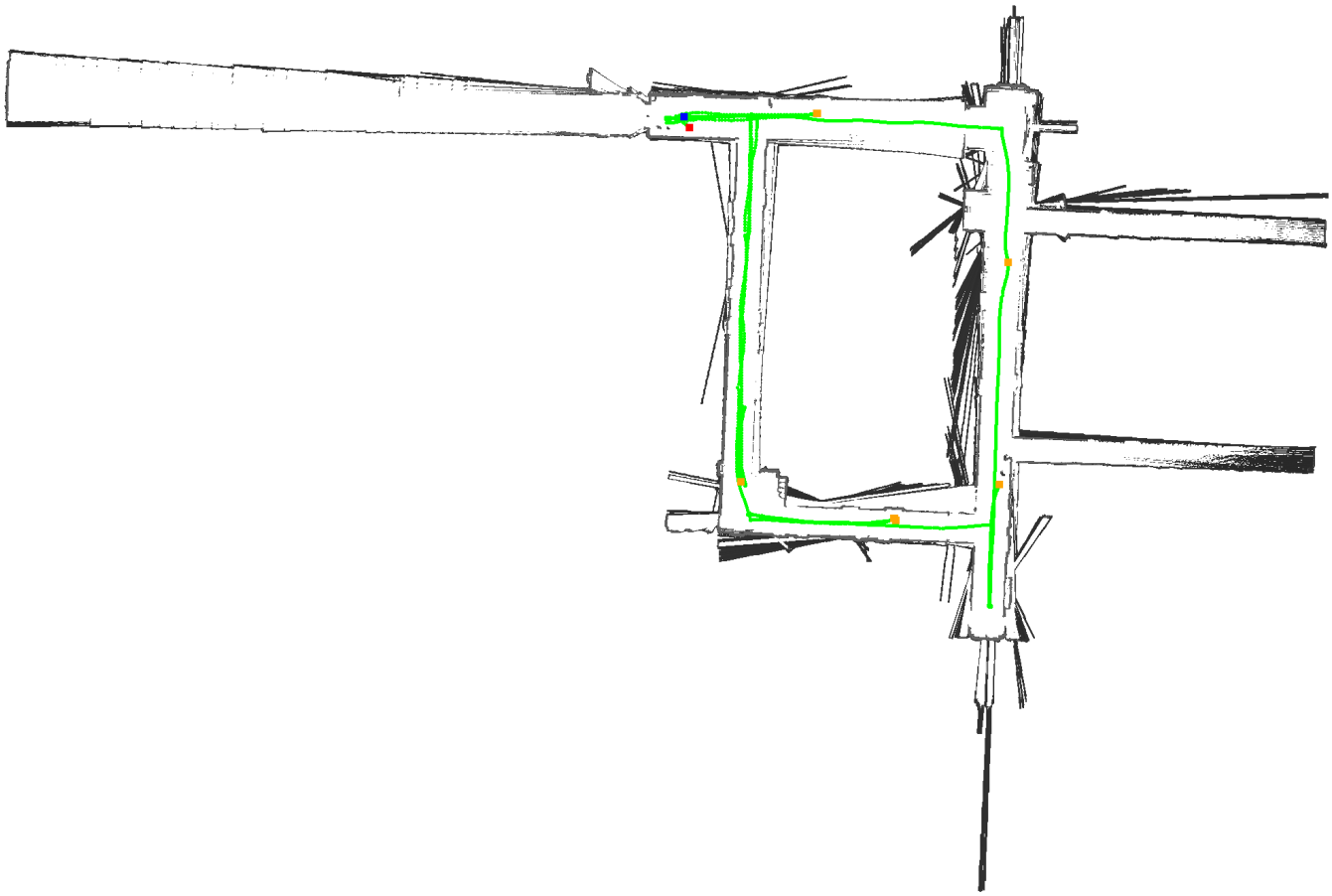

Fig. 4. Trial 4 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 5

Summary

Building: HAMP
Floor: 4
Volunteer: D
Goal: 4251
Floor plan: Figure 68
SLAM map: Figure 5
Result: Success

Sequence of Behaviors

1) WANDER (42 s)
2) APPROACH_PERSON (0 s)
3) WANDER (1 s)
4) APPROACH_PERSON (3 s)
5) WANDER (2 s)
6) APPROACH_PERSON (3 s)
7) WANDER (1 s)
8) APPROACH_PERSON (33 s)
9) HOLD_CONVERSATION (98 s)
10) FOLLOW_DIRECTIONS (18 s)
11) WANDER (12 s)
12) APPROACH_PERSON (4 s)
13) WANDER (2 s)
14) APPROACH_PERSON (0 s)
15) WANDER (1 s)
16) APPROACH_PERSON (3 s)
17) HOLD_CONVERSATION (105 s)
18) FOLLOW_DIRECTIONS (36 s)
19) NAVIGATE_DOOR (305 s)
20) WANDER (50 s)
21) APPROACH_PERSON (0 s)
22) WANDER (1 s)
23) APPROACH_PERSON (0 s)
24) WANDER (22 s)
25) APPROACH_PERSON (2 s)
26) HOLD_CONVERSATION (31 s)
27) FOLLOW_DIRECTIONS (16 s)
28) NAVIGATE_DOOR (27 s)
29) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 4251?
Person:	yes.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 4251?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	go to the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	go straight.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go down the hall.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go straight.
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `right`, □]

Conversation 2	
Robot:	Could you tell me how to navigate to 4251?
Person:	yes.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 4251?
Person:	yes, go straight.
Robot:	What do I do after starting to go forward?
Person:	end of the hall
Robot:	What do I do after getting to the first end of the hall?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	go straight down the hall.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go down the hall.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go halfway down will be on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `right`, `goal-L`]

Conversation 3	
Robot:	Could you tell me how to navigate to 4251?
Person:	yes, turn around.
Robot:	What do I do after turning around and going forward?
Person:	go forward it will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 6
Number of doors labeled: 3

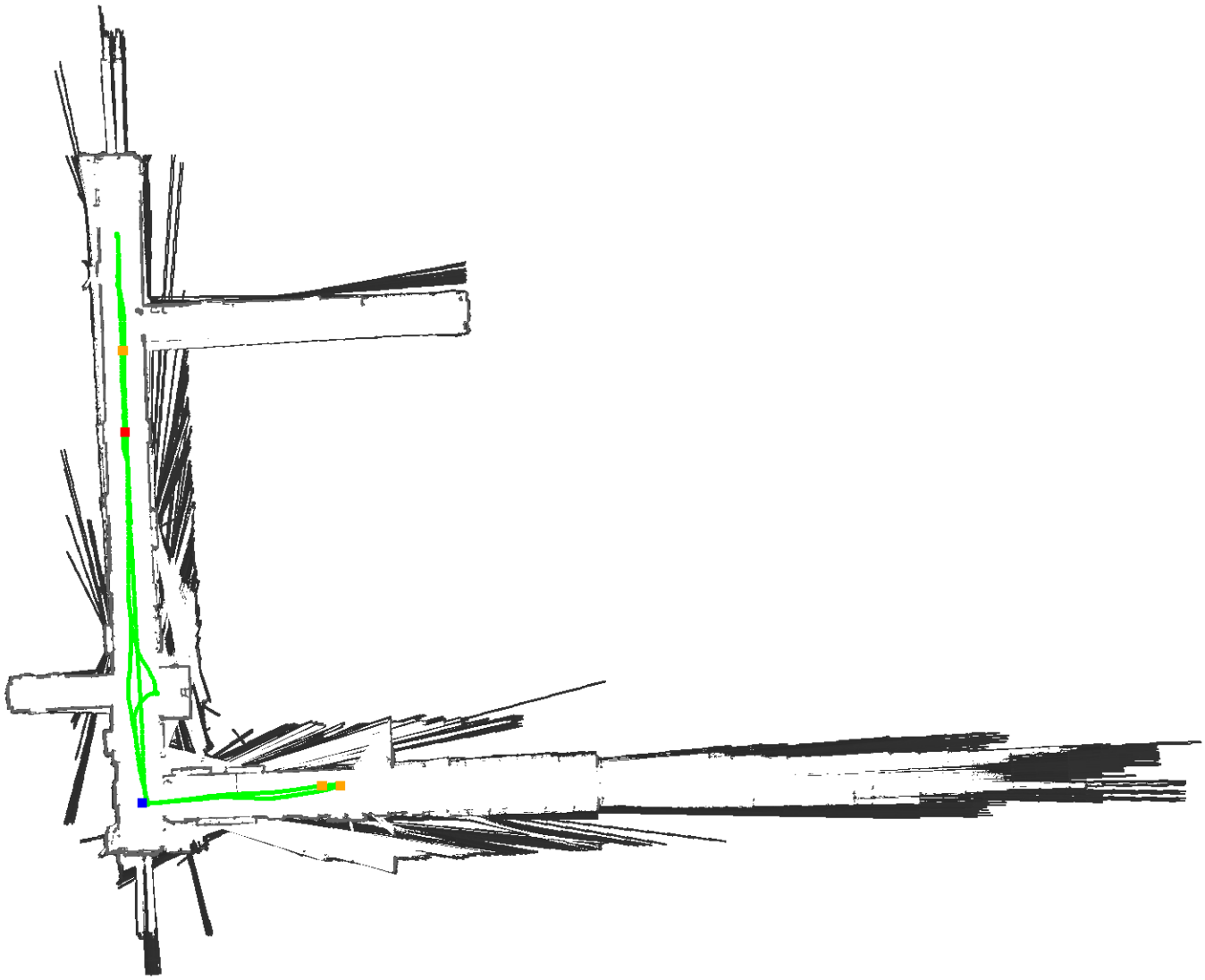

Fig. 5. Trial 5 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 6

Summary

Building: HAMP
Floor: 3
Volunteer: D
Goal: 3212
Floor plan: Figure 67
SLAM map: Figure 6
Result: Failure
Reason: The robot followed directions to the hallway where the goal was. The hallway was narrow and the robot eventually got stuck, unable to move because of wall avoidance.

Sequence of Behaviors

1) WANDER (2 s)
2) APPROACH_PERSON (1 s)
3) WANDER (27 s)
4) APPROACH_PERSON (4 s)
5) WANDER (2 s)
6) APPROACH_PERSON (0 s)
7) WANDER (2 s)
8) APPROACH_PERSON (11 s)
9) WANDER (1 s)
10) APPROACH_PERSON (4 s)
11) WANDER (6 s)
12) APPROACH_PERSON (4 s)
13) WANDER (1 s)
14) APPROACH_PERSON (1 s)
15) WANDER (1 s)
16) APPROACH_PERSON (20 s)
17) HOLD_CONVERSATION (85 s)
18) FOLLOW_DIRECTIONS (97 s)
19) NAVIGATE_DOOR (328 s)
20) WANDER (37 s)
21) APPROACH_PERSON (1 s)
22) HOLD_CONVERSATION (84 s)
23) FOLLOW_DIRECTIONS (7 s)
24) WANDER (42 s)
25) APPROACH_PERSON (1 s)
26) WANDER (19 s)
27) APPROACH_PERSON (2 s)
28) WANDER (1 s)
29) APPROACH_PERSON (8 s)
30) HOLD_CONVERSATION (53 s)
31) FOLLOW_DIRECTIONS (10 s)
32) WANDER (2 s)
33) APPROACH_PERSON (1 s)
34) HOLD_CONVERSATION (78 s)
35) FOLLOW_DIRECTIONS (23 s)
36) WANDER (14 s)
37) APPROACH_PERSON (2 s)
38) WANDER (13 s)
39) APPROACH_PERSON (0 s)
40) WANDER (2 s)
41) APPROACH_PERSON (11 s)
42) HOLD_CONVERSATION (81 s)
43) FOLLOW_DIRECTIONS (32 s)
44) WANDER (11 s)
45) APPROACH_PERSON (7 s)
46) HOLD_CONVERSATION (162 s)
47) FOLLOW_DIRECTIONS (48 s)
48) WANDER (12 s)
49) APPROACH_PERSON (–)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 3212?
Person:	yes, turn around.
Robot:	What do I do after turning around and going forward?
Person:	go to the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	go past the elevator.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	go to the hallway on the left.
Robot:	What do I do after I turn left?
Person:	find a second door on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `right`, `int-L`, `left`, `goal-R`]

Conversation 2

Robot:	Could you tell me how to navigate to 3212?
Person:	yes, turn around.
Robot:	What do I do after turning around and going forward?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	will be the second door on your left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	go straight.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	find second door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `int-L`, `left`, `goal-L`]

Conversation 3

Robot:	Could you tell me how to navigate to 3212?
Person:	yes.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 3212?
Person:	yes.
Robot:	I did not understand that.
Robot:	Could you tell me how to navigate to 3212?
Person:	yes.
Robot:	I did not understand that.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 4

Robot:	Could you tell me how to navigate to 3212?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	go straight.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	at the end of the hall
Robot:	What do I do after getting to the first end of the hall?
Person:	turn left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	find the second door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `end`, `left`, `goal-L`]

Conversation 5

Robot:	Could you tell me how to navigate to 3212?
Person:	turn left at the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	find second door.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	go straight find the second door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `end`, `left`, `goal-L`]

Conversation 6

Robot:	Could you tell me how to navigate to 3212?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	app
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after turning around and going forward?
Person:	app
Robot:	I did not understand that.
Robot:	What do I do after turning around and going forward?
Person:	turn left at the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	app
Robot:	I did not understand that.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3212?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	at the end of the hall turn left.
Robot:	What do I do after I turn left?
Person:	go straight the second door on the left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3212?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	at the end of the hall turn left.
Robot:	What do I do after I turn left?
Person:	find the second door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-L`]

Navigate Door

Number of doors approached: 11
Number of doors labeled: 10

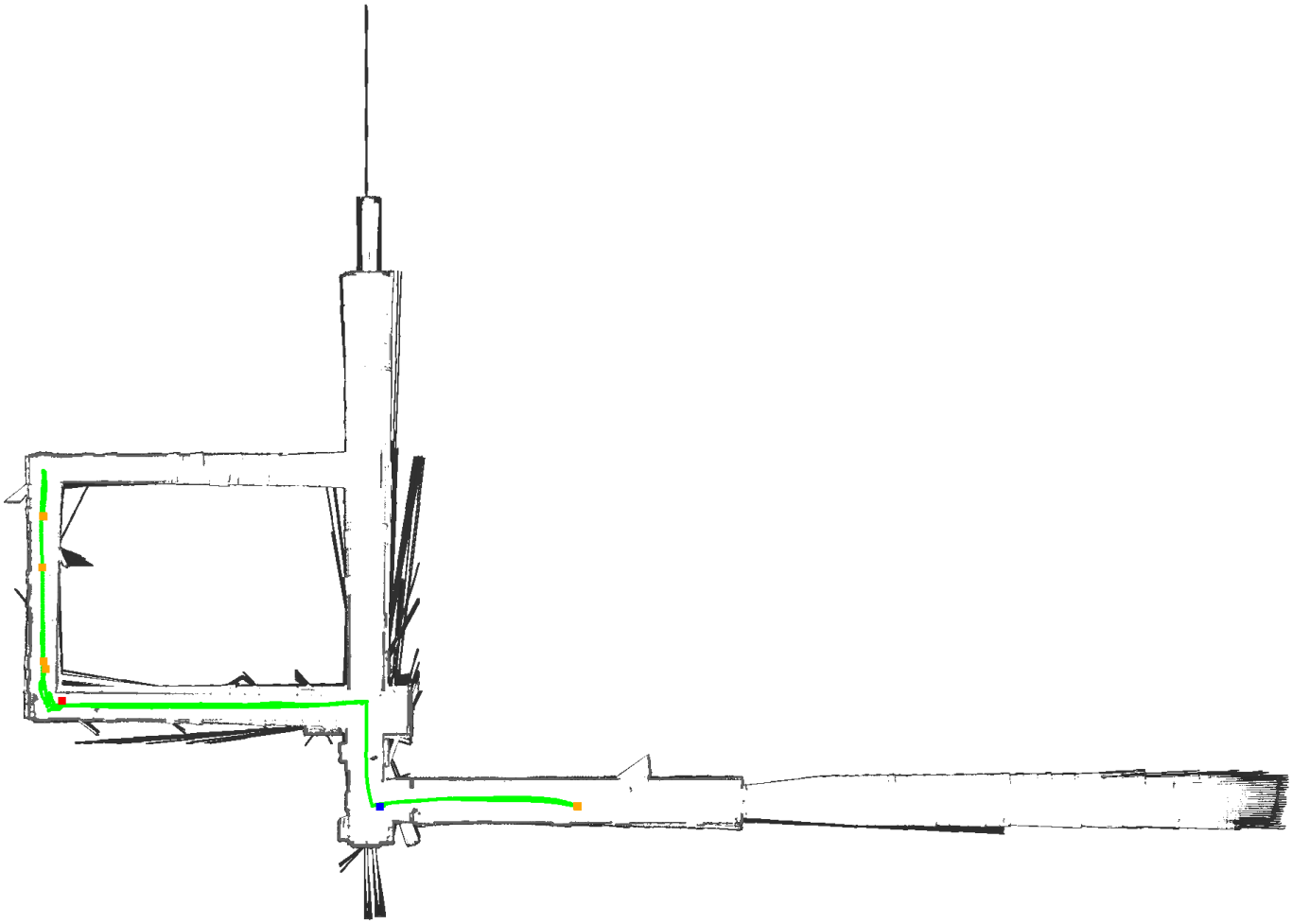

Fig. 6. Trial 6 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 7

Summary

Building: HAMP
Floor: 2
Volunteer: D
Goal: 2146
Floor plan: Figure 66
SLAM map: Figure 7
Result: Failure
Reason: When the robot returned to the NAVIGATE_DOOR behavior, it should have reset the data structures holding previous door detections, which it was not doing. This could have prevented new doors from being correctly detected, localized, and investigated.

Sequence of Behaviors

1) WANDER (7 s)
2) APPROACH_PERSON (0 s)
3) WANDER (128 s)
4) APPROACH_PERSON (7 s)
5) HOLD_CONVERSATION (117 s)
6) FOLLOW_DIRECTIONS (25 s)
7) NAVIGATE_DOOR (335 s)
8) WANDER (71 s)
9) APPROACH_PERSON (11 s)
10) HOLD_CONVERSATION (24 s)
11) FOLLOW_DIRECTIONS (17 s)
12) NAVIGATE_DOOR (216 s)
13) WANDER (74 s)
14) APPROACH_PERSON (1 s)
15) HOLD_CONVERSATION (36 s)
16) FOLLOW_DIRECTIONS (90 s)
17) NAVIGATE_DOOR (–)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 2146?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 2146?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	go down the hall.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 2146?
Person:	at turn around
Robot:	What do I do after turning around and going forward?
Person:	turn right at the hallway.
Robot:	What do I do after I turn right?
Person:	go pass the drinking fountain
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	find the fifth door on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-R`]

Conversation 2	
Robot:	Could you tell me how to navigate to 2146?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	find the third door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Conversation 3	
Robot:	Could you tell me how to navigate to 2146?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	at the hallway turn, right?
Robot:	What do I do after I turn right?
Person:	find the six door on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-R`]

Navigate Door

Number of doors approached: 11
Number of doors labeled: 8

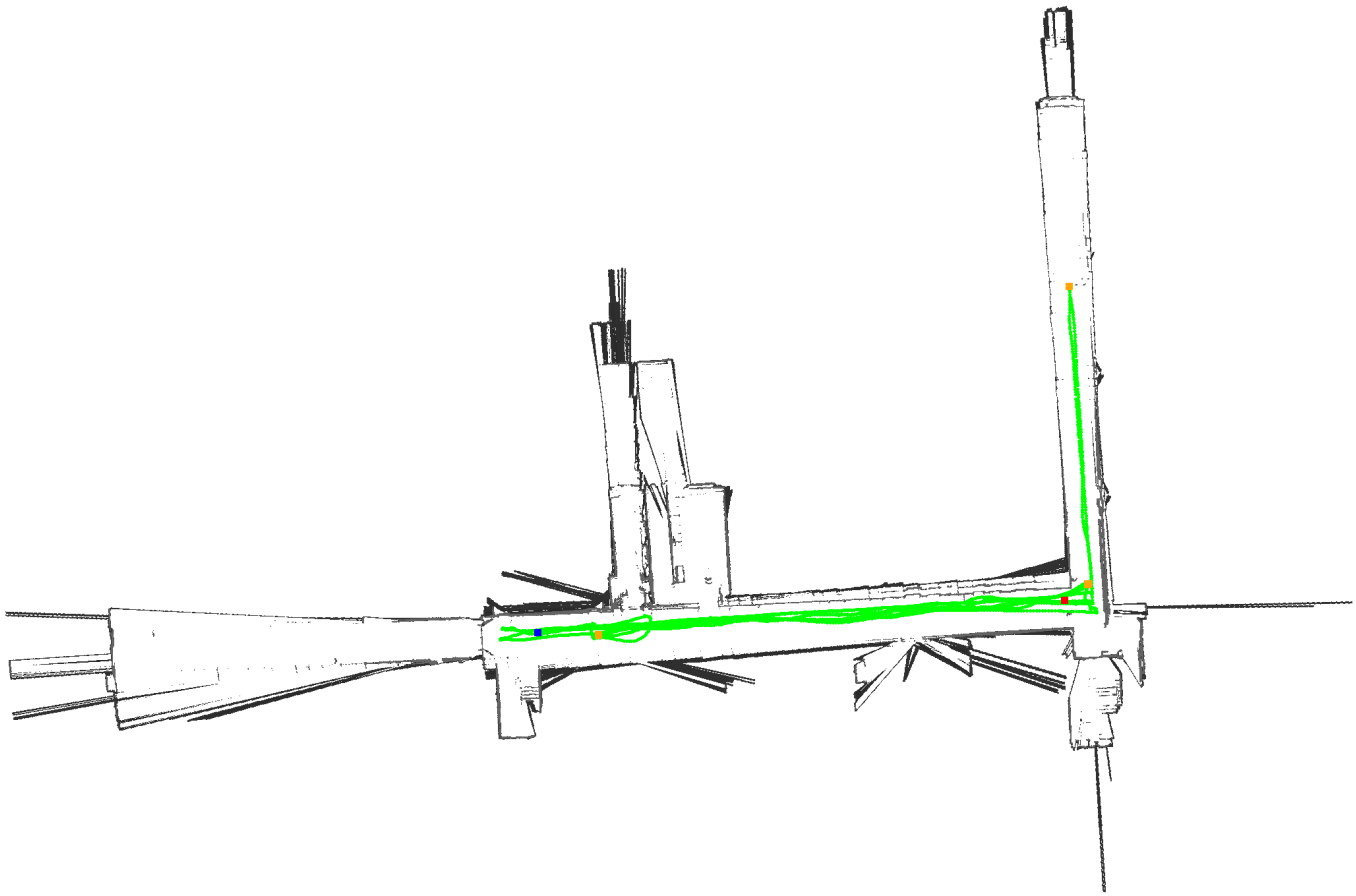

Fig. 7. Trial 7 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 8

Summary

Building: HAMP
Floor: 1
Volunteer: D
Goal: 1147
Floor plan: Figure 65
SLAM map: Figure 8
Result: Success

Sequence of Behaviors

1) WANDER (24 s)
2) APPROACH_PERSON (2 s)
3) WANDER (1 s)
4) APPROACH_PERSON (22 s)
5) HOLD_CONVERSATION (25 s)
6) FOLLOW_DIRECTIONS (17 s)
7) NAVIGATE_DOOR (378 s)
8) WANDER (25 s)
9) APPROACH_PERSON (7 s)
10) HOLD_CONVERSATION (22 s)
11) FOLLOW_DIRECTIONS (0 s)
12) NAVIGATE_DOOR (70 s)
13) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 1147?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	find the third door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]
Conversation 2	
Robot:	Could you tell me how to navigate to 1147?
Person:	find the second door on the right.
Robot:	Which direction do I start out going?
Person:	straight
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

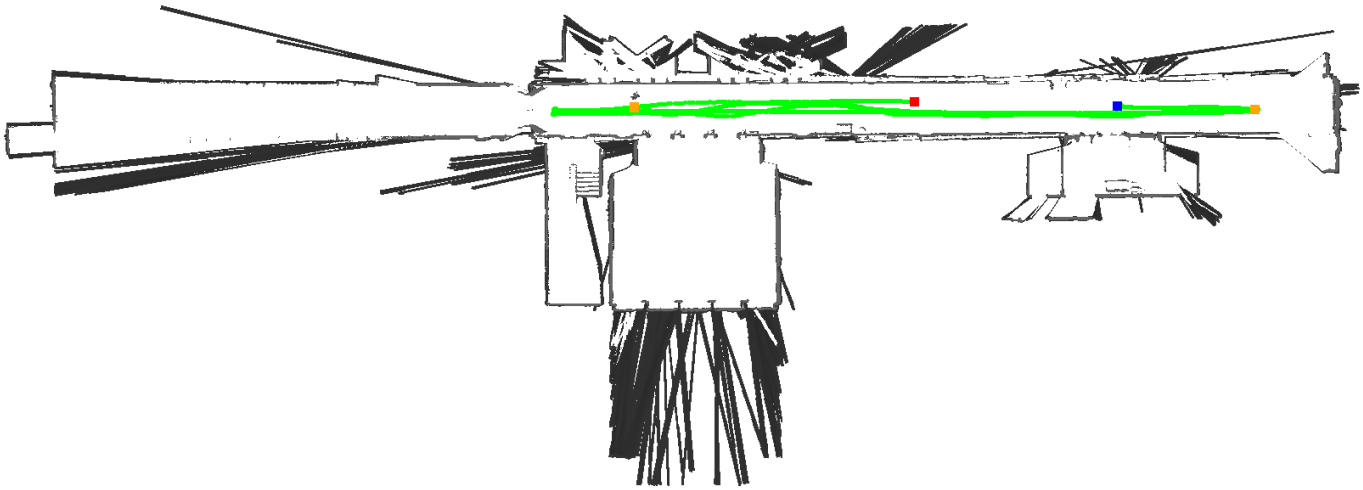

Fig. 8. Trial 8 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 9

Summary

Building: HAMP
Floor: 4
Volunteer: D
Goal: 4105
Floor plan: Figure 68
SLAM map: Figure 9
Result: Success

Sequence of Behaviors

1) WANDER (45 s)
2) APPROACH_PERSON (9 s)
3) HOLD_CONVERSATION (29 s)
4) FOLLOW_DIRECTIONS (7 s)
5) WANDER (38 s)
6) APPROACH_PERSON (2 s)
7) WANDER (0 s)
8) APPROACH_PERSON (4 s)
9) HOLD_CONVERSATION (41 s)
10) FOLLOW_DIRECTIONS (8 s)
11) WANDER (124 s)
12) APPROACH_PERSON (0 s)
13) WANDER (30 s)
14) APPROACH_PERSON (0 s)
15) WANDER (2 s)
16) APPROACH_PERSON (1 s)
17) WANDER (13 s)
18) APPROACH_PERSON (0 s)
19) WANDER (2 s)
20) APPROACH_PERSON (2 s)
21) WANDER (2 s)
22) APPROACH_PERSON (2 s)
23) WANDER (1 s)
24) APPROACH_PERSON (2 s)
25) WANDER (1 s)
26) APPROACH_PERSON (0 s)
27) WANDER (6 s)
28) APPROACH_PERSON (0 s)
29) WANDER (1 s)
30) APPROACH_PERSON (3 s)
31) WANDER (1 s)
32) APPROACH_PERSON (2 s)
33) WANDER (3 s)
34) APPROACH_PERSON (1 s)
35) WANDER (2 s)
36) APPROACH_PERSON (4 s)
37) WANDER (1 s)
38) APPROACH_PERSON (1 s)
39) WANDER (1 s)
40) APPROACH_PERSON (8 s)
41) HOLD_CONVERSATION (25 s)
42) FOLLOW_DIRECTIONS (17 s)
43) NAVIGATE_DOOR (501 s)
44) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 4105?
Person:	at the end of the hallway turn left.
Robot:	What do I do after I turn left?
Person:	go to the end of the hall and i'll be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `end`, `goal-R`]
Conversation 2	
Robot:	Could you tell me how to navigate to 4105?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	at the end of the hall turn left.
Robot:	What do I do after I turn left?
Person:	go to the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	it will be the door on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `end`, `goal-R`]
Conversation 3	
Robot:	Could you tell me how to navigate to 4105?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	find the seventh door on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 16
Number of doors labeled: 11

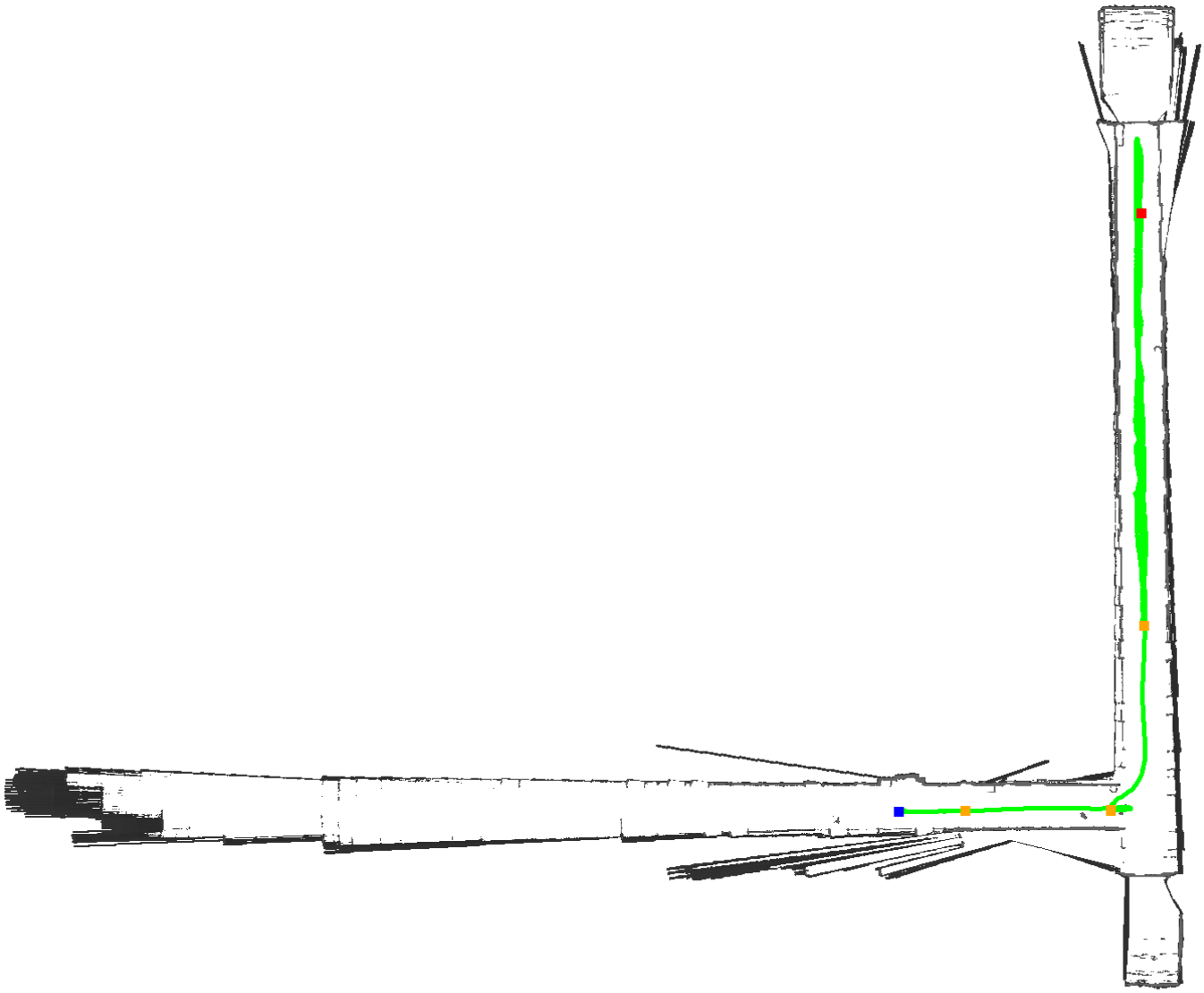

Fig. 9. Trial 9 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 10

Summary

Building: ME
Floor: 0
Volunteer: E
Goal: g010
Floor plan: Figure 73
SLAM map: Figure 10
Result: Success

Sequence of Behaviors

1) WANDER (69 s)
2) APPROACH_PERSON (2 s)
3) WANDER (1 s)
4) APPROACH_PERSON (17 s)
5) HOLD_CONVERSATION (60 s)
6) FOLLOW_DIRECTIONS (22 s)
7) NAVIGATE_DOOR (76 s)
8) WANDER (31 s)
9) APPROACH_PERSON (1 s)
10) WANDER (39 s)
11) APPROACH_PERSON (1 s)
12) WANDER (1 s)
13) APPROACH_PERSON (23 s)
14) HOLD_CONVERSATION (18 s)
15) FOLLOW_DIRECTIONS (16 s)
16) NAVIGATE_DOOR (535 s)
17) WANDER (–)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to g010?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to g010?
Person:	drive straight until the end of the hallway and then turn left and keep going left until we reach the door that says jeezy are 10. how much is on my laptop. hallway?
Robot:	Sorry, I am a little confused. Could we start over? Could you tell me how to navigate to g010?
Person:	drive straight until the end of the hallway then turn left and keep going until you reach the door in g0 10, which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `left`, `goal-L`]

Conversation 2	
Robot:	Could you tell me how to navigate to g010?
Person:	turn around 180 degrees and then keep going straight until g0 10 is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 12
Number of doors labeled: 3

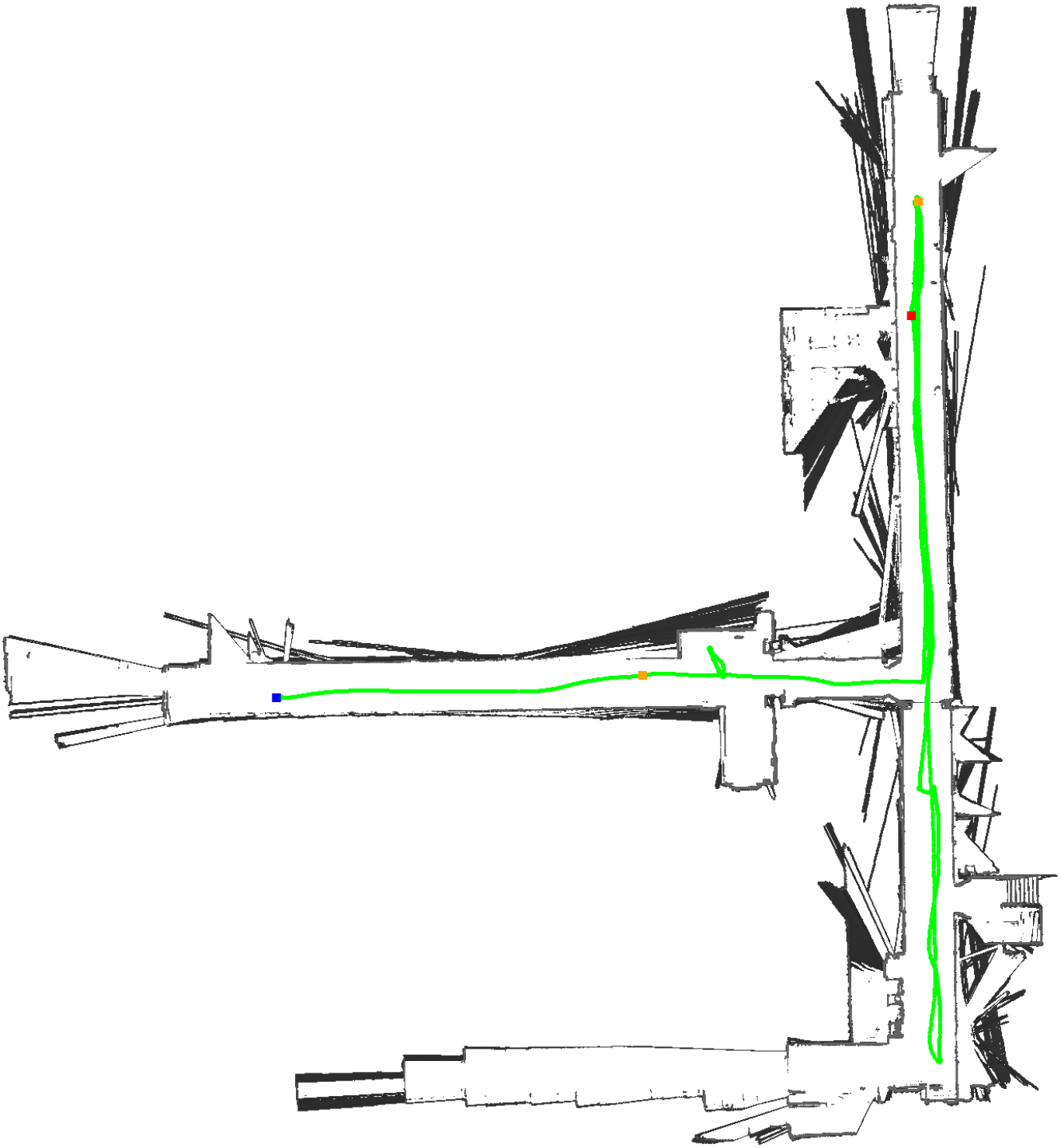

Fig. 10. Trial 10 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 11

Summary

Building: ME
Floor: 1
Volunteer: E
Goal: 1067
Floor plan: Figure 74
SLAM map: Figure 11
Result: Success

Sequence of Behaviors

1) WANDER (123 s)
2) APPROACH_PERSON (10 s)
3) HOLD_CONVERSATION (33 s)
4) FOLLOW_DIRECTIONS (87 s)
5) WANDER (40 s)
6) APPROACH_PERSON (2 s)
7) HOLD_CONVERSATION (108 s)
8) FOLLOW_DIRECTIONS (119 s)
9) WANDER (15 s)
10) APPROACH_PERSON (9 s)
11) HOLD_CONVERSATION (22 s)
12) FOLLOW_DIRECTIONS (13 s)
13) WANDER (14 s)
14) APPROACH_PERSON (8 s)
15) HOLD_CONVERSATION (39 s)
16) FOLLOW_DIRECTIONS (45 s)
17) WANDER (58 s)
18) APPROACH_PERSON (7 s)
19) HOLD_CONVERSATION (22 s)
20) FOLLOW_DIRECTIONS (16 s)
21) NAVIGATE_DOOR (47 s)
22) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 1067?
Person:	keep going straight until the end of the hallway and then turn right and then go straight until the end of the hallway then turn left and go straight to the end of the hallway and then turn right and keep going until you see the door, which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `right`, `end`, `left`, `end`, `right`, `goal-L`]

Conversation 2

Robot:	Could you tell me how to navigate to 1067?
Person:	turn left and go straight until the end of the hallway, then turn right and go straight to the end of the hallway and then
Robot:	What do I do after getting to the second end of the hall?
Person:	and then
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after getting to the second end of the hall?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 1067?
Person:	turn left then go to the end of the hallway then turn left again and go to the end of the hallway and then turn right and keep going straight until you see the door, which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `end`, `left`, `end`, `right`, `goal-L`]

Conversation 3

Robot:	Could you tell me how to navigate to 1067?
Person:	turn around and keep going and then turn right at the end of the hallway and keep going straight until you see the door, which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `right`, `goal-L`]

Conversation 4	
Robot:	Could you tell me how to navigate to 1067?
Person:	turn around 180 degrees then go straight until the end of the hallway and then
Robot:	What do I do after getting to the first end of the hall?
Person:	then turn right.
Robot:	What do I do after I turn right?
Person:	keep going straight until you see the door, which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `right`, `goal-L`]

Conversation 5	
Robot:	Could you tell me how to navigate to 1067?
Person:	turn around 180 degrees and then keep going straight until you see the door that says 1067 which is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

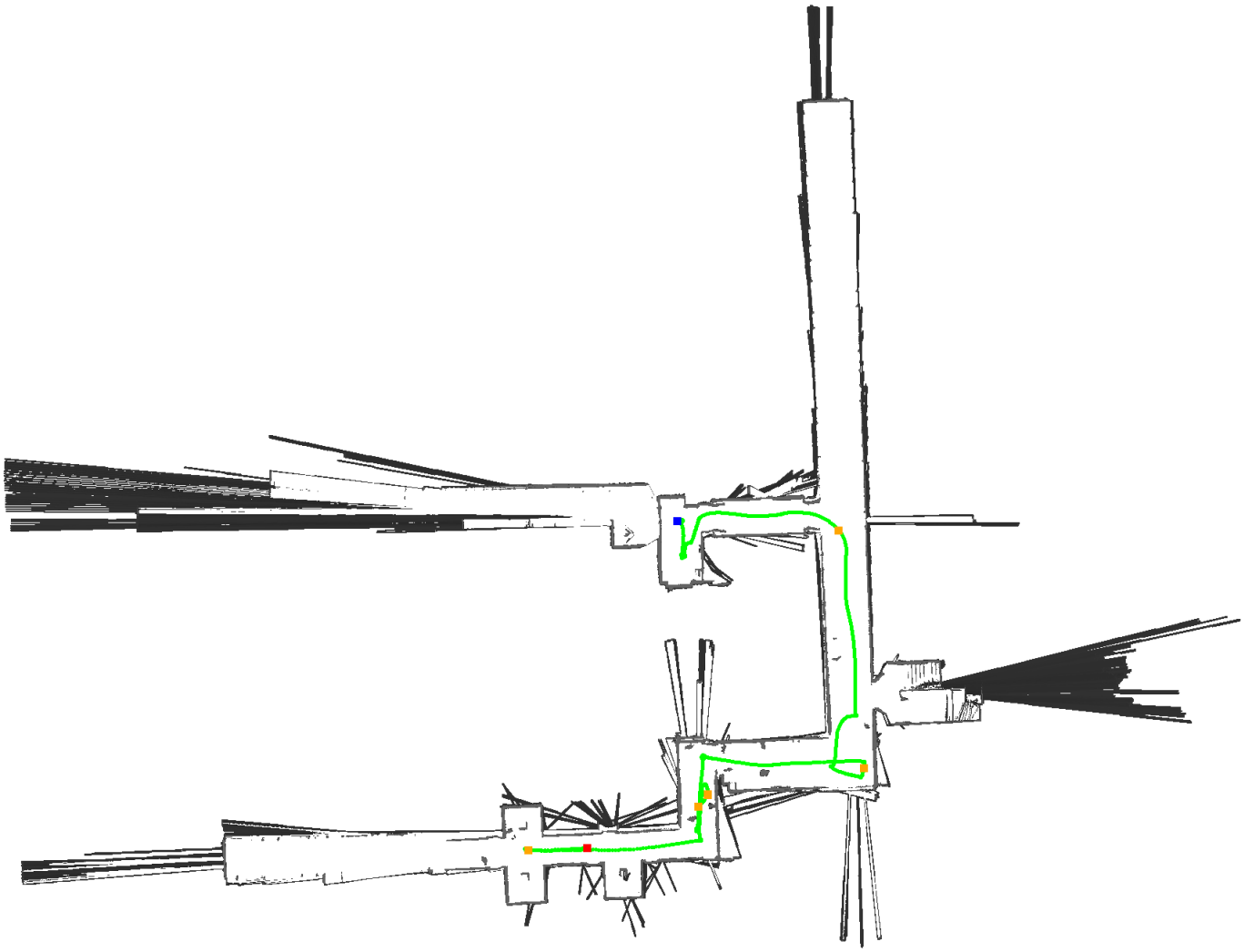

Fig. 11. Trial 11 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 12

Summary

Building: ME
Floor: 2
Volunteer: E
Goal: 2051
Floor plan: Figure 75
SLAM map: Figure 12
Result: Success

Sequence of Behaviors

1) WANDER (73 s)
2) APPROACH_PERSON (5 s)
3) HOLD_CONVERSATION (21 s)
4) FOLLOW_DIRECTIONS (58 s)
5) NAVIGATE_DOOR (207 s)
6) WANDER (15 s)
7) APPROACH_PERSON (3 s)
8) HOLD_CONVERSATION (0 s)
9) FOLLOW_DIRECTIONS (1 s)
10) NAVIGATE_DOOR (31 s)
11) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 2051?
Person:	keep going straight until the end of the hallway and then turn right and then keep going until you see the door, which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `right`, `goal-L`]
Conversation 2	
Robot:	Could you tell me how to navigate to 2051?
Person:	keep going straight until you see the door 2051 which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-F`]

Navigate Door

Number of doors approached: 3
Number of doors labeled: 2

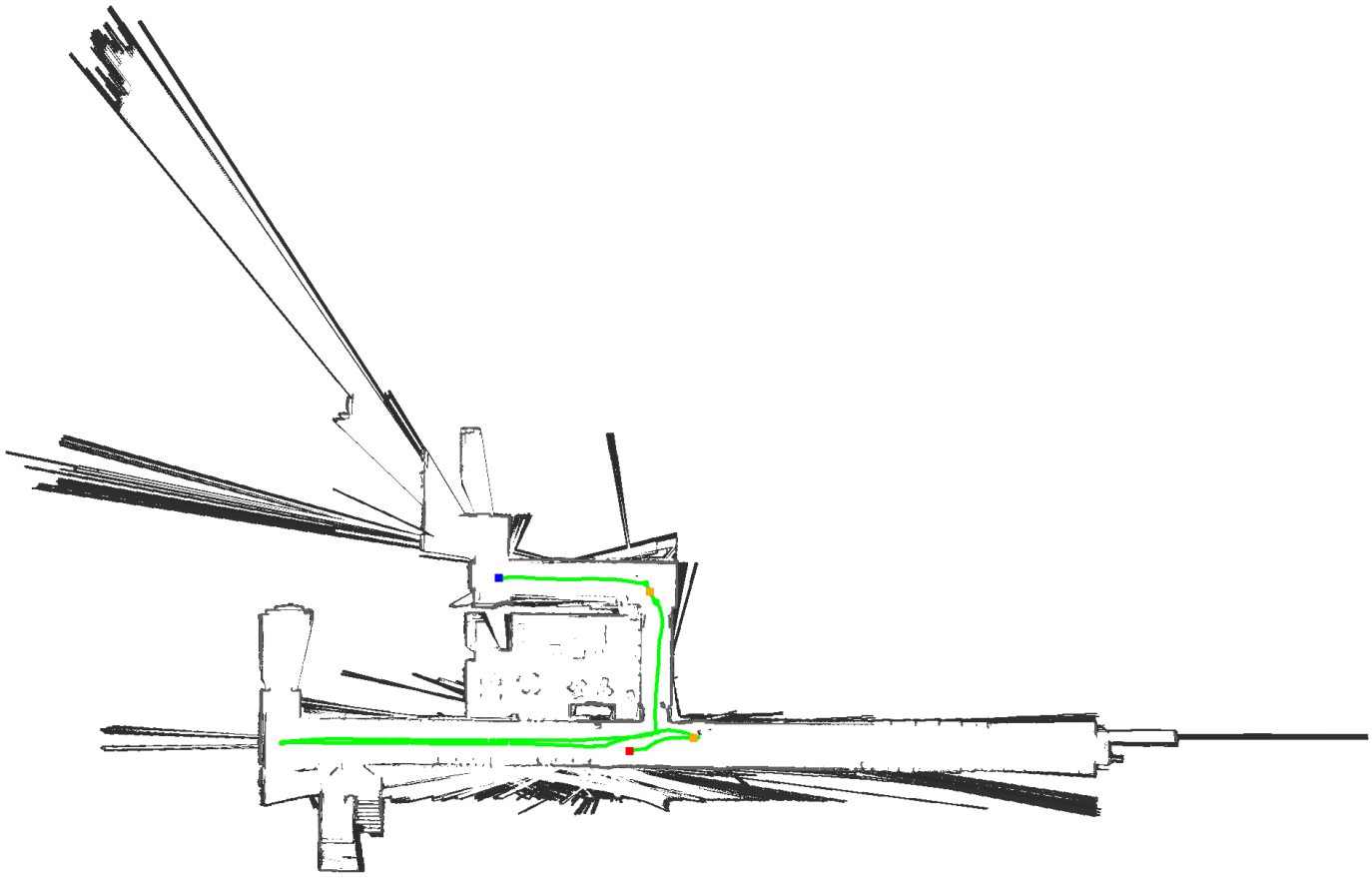

Fig. 12. Trial 12 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 13

Summary

Building: ME
Floor: 3
Volunteer: E
Goal: 3006
Floor plan: Figure 76
SLAM map: Figure 13
Result: Success

Sequence of Behaviors

1) WANDER (27 s)
2) APPROACH_PERSON (15 s)
3) HOLD_CONVERSATION (16 s)
4) FOLLOW_DIRECTIONS (1 s)
5) NAVIGATE_DOOR (126 s)
6) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 3006?
Person:	keep going straight until you see room 3006 which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-F`]

Navigate Door

Number of doors approached: 5
Number of doors labeled: 3

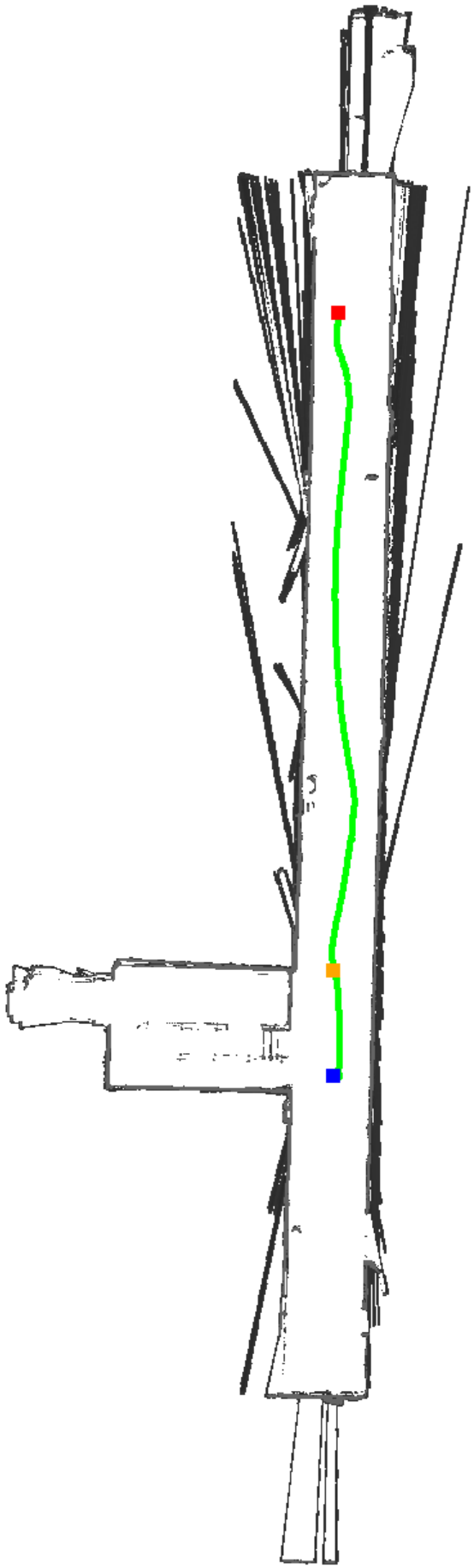

Fig. 13. Trial 13 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 14

Summary

Building: ME
Floor: 3
Volunteer: E
Goal: 3007
Floor plan: Figure 76
SLAM map: Figure 14
Result: Success

Sequence of Behaviors

1) WANDER (45 s)
2) APPROACH_PERSON (1 s)
3) WANDER (23 s)
4) APPROACH_PERSON (16 s)
5) HOLD_CONVERSATION (27 s)
6) FOLLOW_DIRECTIONS (17 s)
7) NAVIGATE_DOOR (54 s)
8) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 3007?
Person:	turn around 180 degrees then keep going straight until you see the.
Robot:	What do I do after turning around and going forward?
Person:	keep going until you see the door, which is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

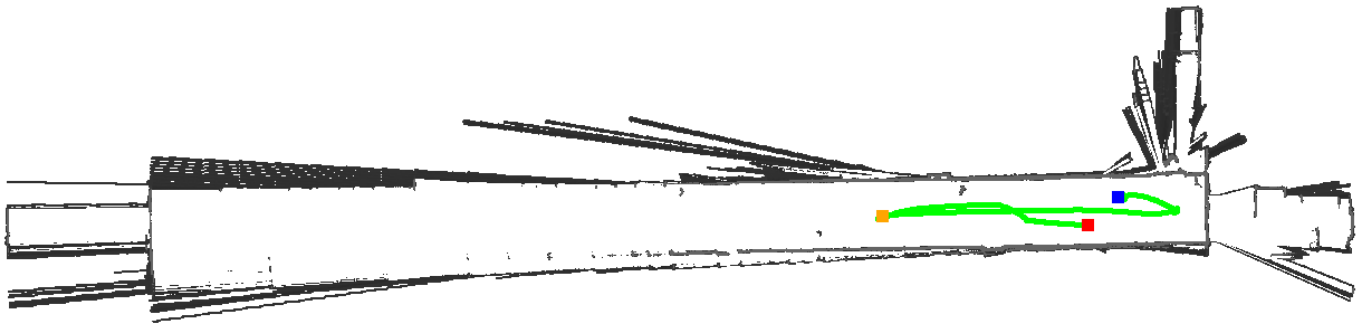

Fig. 14. Trial 14 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 15

Summary

Building: ME
Floor: 2
Volunteer: E
Goal: 2038
Floor plan: Figure 75
SLAM map: Figure 15
Result: Success

Sequence of Behaviors

1) WANDER (23 s)
2) APPROACH_PERSON (21 s)
3) HOLD_CONVERSATION (39 s)
4) FOLLOW_DIRECTIONS (100 s)
5) WANDER (46 s)
6) APPROACH_PERSON (16 s)
7) HOLD_CONVERSATION (19 s)
8) FOLLOW_DIRECTIONS (7 s)
9) WANDER (2 s)
10) APPROACH_PERSON (5 s)
11) HOLD_CONVERSATION (19 s)
12) FOLLOW_DIRECTIONS (9 s)
13) WANDER (9 s)
14) APPROACH_PERSON (0 s)
15) WANDER (0 s)
16) APPROACH_PERSON (11 s)
17) HOLD_CONVERSATION (21 s)
18) FOLLOW_DIRECTIONS (8 s)
19) NAVIGATE_DOOR (253 s)
20) WANDER (205 s)
21) APPROACH_PERSON (1 s)
22) WANDER (16 s)
23) APPROACH_PERSON (23 s)
24) HOLD_CONVERSATION (53 s)
25) FOLLOW_DIRECTIONS (170 s)
26) WANDER (9 s)
27) APPROACH_PERSON (149 s)
28) HOLD_CONVERSATION (93 s)
29) FOLLOW_DIRECTIONS (9 s)
30) WANDER (13 s)
31) APPROACH_PERSON (15 s)
32) HOLD_CONVERSATION (21 s)
33) FOLLOW_DIRECTIONS (17 s)
34) NAVIGATE_DOOR (45 s)
35) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 2038?
Person:	turn around 180 degrees then go straight until the end of the hallway and then turn right and keep going into the wall then turn left and keep going into the wall and then turn right again and keep going straight until you see room 2038 which is on the right side of the hallway.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `right`, `int-L`, `left`, `int-R`, `right`, `goal-F`]

Conversation 2

Robot:	Could you tell me how to navigate to 2038?
Person:	turn around 180 degrees and keep going straight until you see room 2038 which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]

Conversation 3

Robot:	Could you tell me how to navigate to 2038?
Person:	turn around 180 degrees and keep going straight until you see room 2038 which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]

Conversation 4

Robot:	Could you tell me how to navigate to 2038?
Person:	slightly turn to the right and then keep going straight until you see room 2038, which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-F`]

Conversation 5

Robot:	Could you tell me how to navigate to 2038?
Person:	keep going straight until the end of the hallway and turn left and then keep going great until the end of the hallway and then slightly turn right and then go straight until you reach the wall and then do a full right turn.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	keep going straight and dc room 2038 on the right side of the hallway.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `end`, `right`, `int-R`, `right`, `int-R`, `right`, `goal-F`]

Conversation 6	
Robot:	Could you tell me how to navigate to 2038?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 2038?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 2038?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]
Conversation 7	
Robot:	Could you tell me how to navigate to 2038?
Person:	turn around 180 degrees and then keep going straight until you see room 2038 which is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]

Navigate Door

Number of doors approached: 5
Number of doors labeled: 3

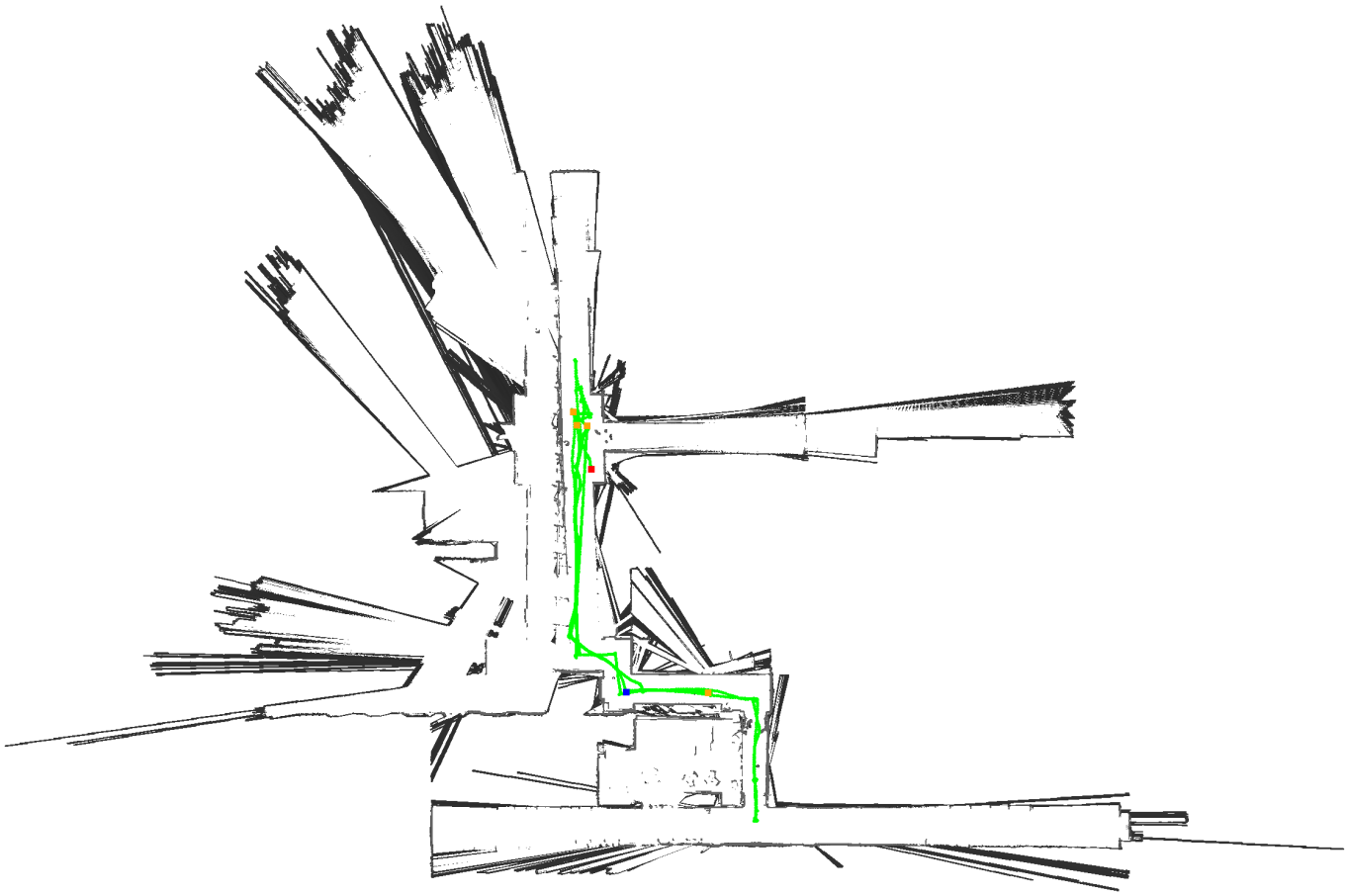

Fig. 15. Trial 15 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 16

Summary

Building: ME
Floor: 1
Volunteer: F
Goal: 1088
Floor plan: Figure 74
SLAM map: Figure 16
Result: Success

Sequence of Behaviors

1) WANDER (71 s)
2) APPROACH_PERSON (19 s)
3) HOLD_CONVERSATION (61 s)
4) FOLLOW_DIRECTIONS (160 s)
5) WANDER (15 s)
6) APPROACH_PERSON (17 s)
7) HOLD_CONVERSATION (30 s)
8) FOLLOW_DIRECTIONS (39 s)
9) WANDER (276 s)
10) APPROACH_PERSON (0 s)
11) WANDER (8 s)
12) APPROACH_PERSON (26 s)
13) HOLD_CONVERSATION (18 s)
14) FOLLOW_DIRECTIONS (17 s)
15) NAVIGATE_DOOR (150 s)
16) WANDER (31 s)
17) APPROACH_PERSON (26 s)
18) HOLD_CONVERSATION (20 s)
19) FOLLOW_DIRECTIONS (16 s)
20) NAVIGATE_DOOR (58 s)
21) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 1088?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	go to the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	turn right.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	classrooms on the right at the end of the hall
Robot:	What do I do after I turn right (this being the third right I take)?
Person:	cothron's on the right
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `right`, `int-L`, `left`, `int-R`, `right`, `end`, `right`, `person`]

Conversation 2	
Robot:	Could you tell me how to navigate to 1088?
Person:	turn around and go forward.
Robot:	What do I do after turning around and going forward?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	classroom is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `int-R`, `right`, `goal-R`]

Conversation 3	
Robot:	Could you tell me how to navigate to 1088?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	class is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 4	
Robot:	Could you tell me how to navigate to 1088?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	class is the last door on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 4

Number of doors labeled: 3

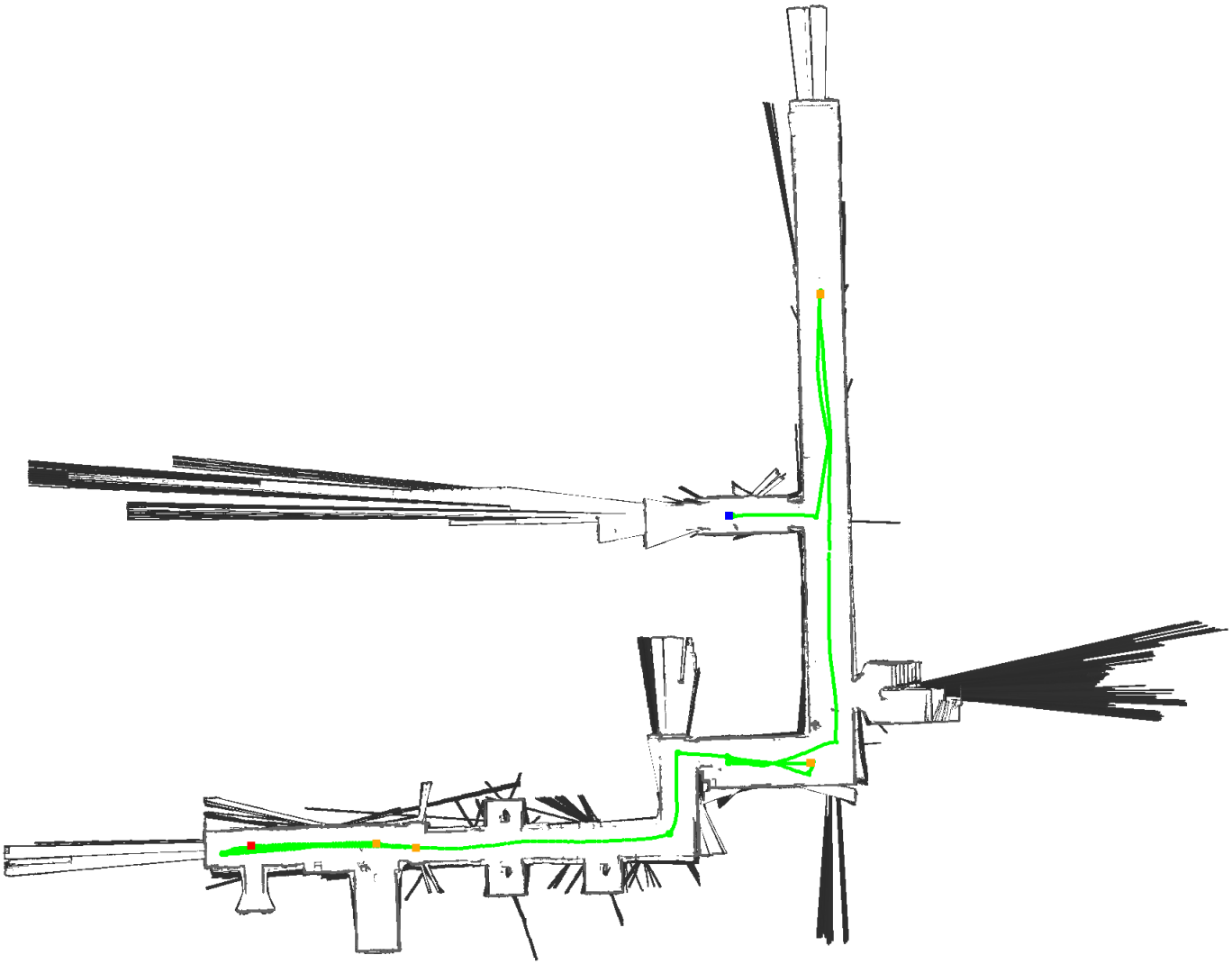

Fig. 16. Trial 16 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 17

Summary

Building: ME
Floor: 1
Volunteer: F
Goal: 1052
Floor plan: Figure 74
SLAM map: Figure 17
Result: Success

Sequence of Behaviors

1) WANDER (83 s)
2) APPROACH_PERSON (8 s)
3) HOLD_CONVERSATION (21 s)
4) FOLLOW_DIRECTIONS (16 s)
5) NAVIGATE_DOOR (323 s)
6) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 1052?
Person:	turn around and go straight.
Robot:	What do I do after turning around and going forward?
Person:	class is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 5
Number of doors labeled: 5

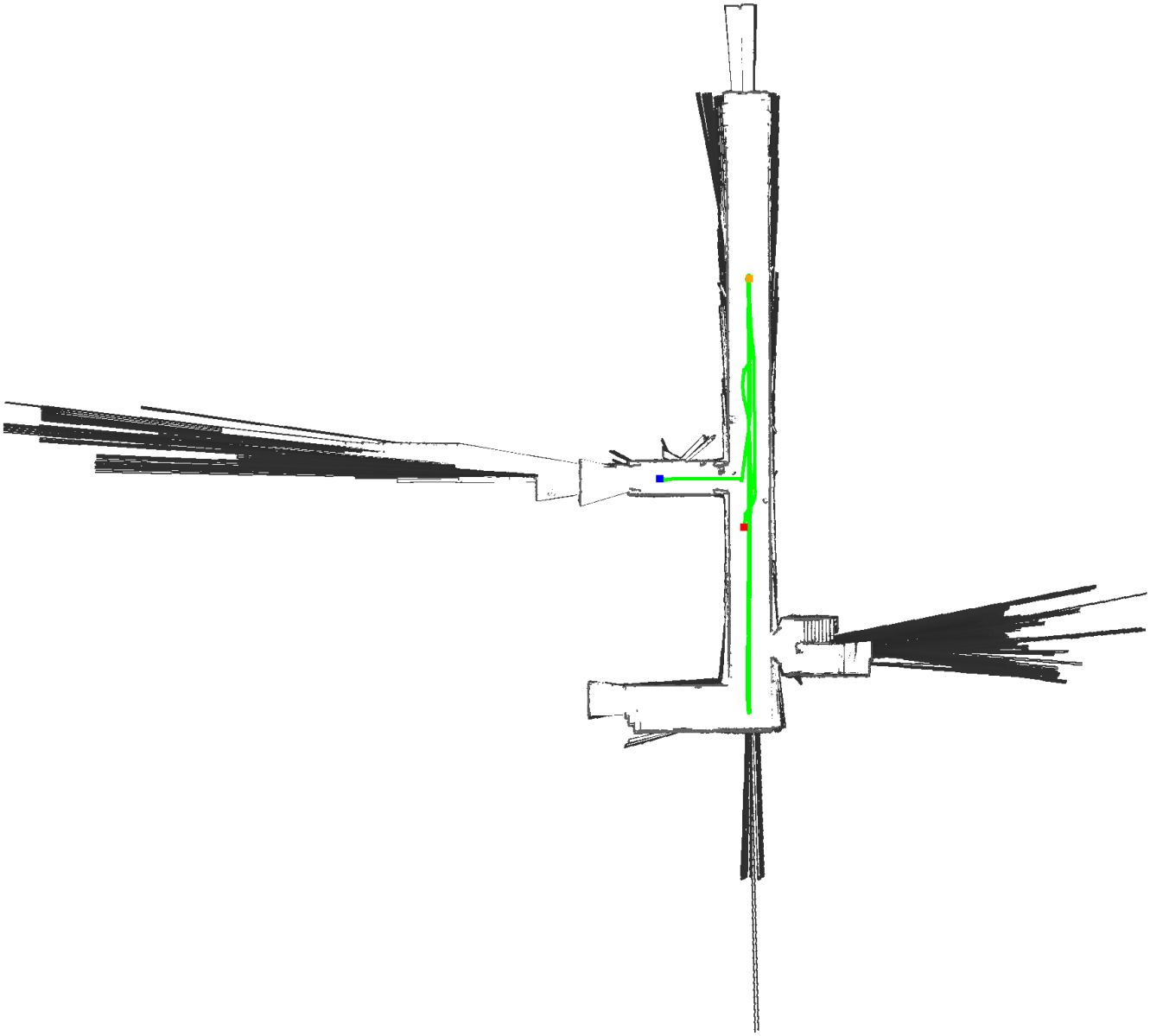

Fig. 17. Trial 17 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 18

Summary

Building: ME
Floor: 2
Volunteer: F
Goal: 2024
Floor plan: Figure 75
SLAM map: Figure 18
Result: Failure
Reason: When the robot returned to the NAVIGATE_DOOR behavior, it should have reset the data structures holding previous door detections, which it was not doing. This could have prevented new doors from being correctly detected, localized, and investigated.

Sequence of Behaviors

1) WANDER (170 s)
2) APPROACH_PERSON (0 s)
3) WANDER (6 s)
4) APPROACH_PERSON (12 s)
5) HOLD_CONVERSATION (137 s)
6) FOLLOW_DIRECTIONS (54 s)
7) WANDER (2 s)
8) APPROACH_PERSON (1 s)
9) HOLD_CONVERSATION (115 s)
10) FOLLOW_DIRECTIONS (0 s)
11) WANDER (42 s)
12) APPROACH_PERSON (3 s)
13) WANDER (1 s)
14) APPROACH_PERSON (2 s)
15) HOLD_CONVERSATION (65 s)
16) FOLLOW_DIRECTIONS (15 s)
17) WANDER (2 s)
18) APPROACH_PERSON (5 s)
19) HOLD_CONVERSATION (21 s)
20) FOLLOW_DIRECTIONS (8 s)
21) NAVIGATE_DOOR (137 s)
22) WANDER (32 s)
23) APPROACH_PERSON (11 s)
24) HOLD_CONVERSATION (15 s)
25) FOLLOW_DIRECTIONS (17 s)
26) NAVIGATE_DOOR (345 s)
27) WANDER (28 s)
28) APPROACH_PERSON (10 s)
29) HOLD_CONVERSATION (15 s)
30) FOLLOW_DIRECTIONS (16 s)
31) NAVIGATE_DOOR (122 s)
32) WANDER (–)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 2024?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	tournament
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	turn left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	room is at the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 2024?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	09
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right?
Person:	
Robot:	I did not hear you.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `int-R`, `right`, □]

Conversation 2

Robot:	Could you tell me how to navigate to 2024?
Person:	murrieta baby, just the other day when i went through a lot today morning.
Robot:	What do I do after starting to go forward?
Person:	can two other guys
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after starting to go forward?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	What do I do after starting to go forward?
Person:	
Robot:	I did not hear you.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, □]

Conversation 3

Robot:	Could you tell me how to navigate to 2024?
Person:	continue forward
Robot:	What do I do after starting to go forward?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	room is at the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 2024?
Person:	right and then left?
Robot:	What do I do after I turn left?
Person:	room is straight ahead.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `int-L`, `left`, `goal-F`]

Conversation 4

Robot:	Could you tell me how to navigate to 2024?
Person:	turn left and straight ahead.
Robot:	What do I do after I turn left?
Person:	room is straight ahead.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `goal-F`]

Conversation 5

Robot:	Could you tell me how to navigate to 2024?
Person:	turn around class is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 6

Robot:	Could you tell me how to navigate to 2024?
Person:	turn around classroom is on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 3
Number of doors labeled: 3

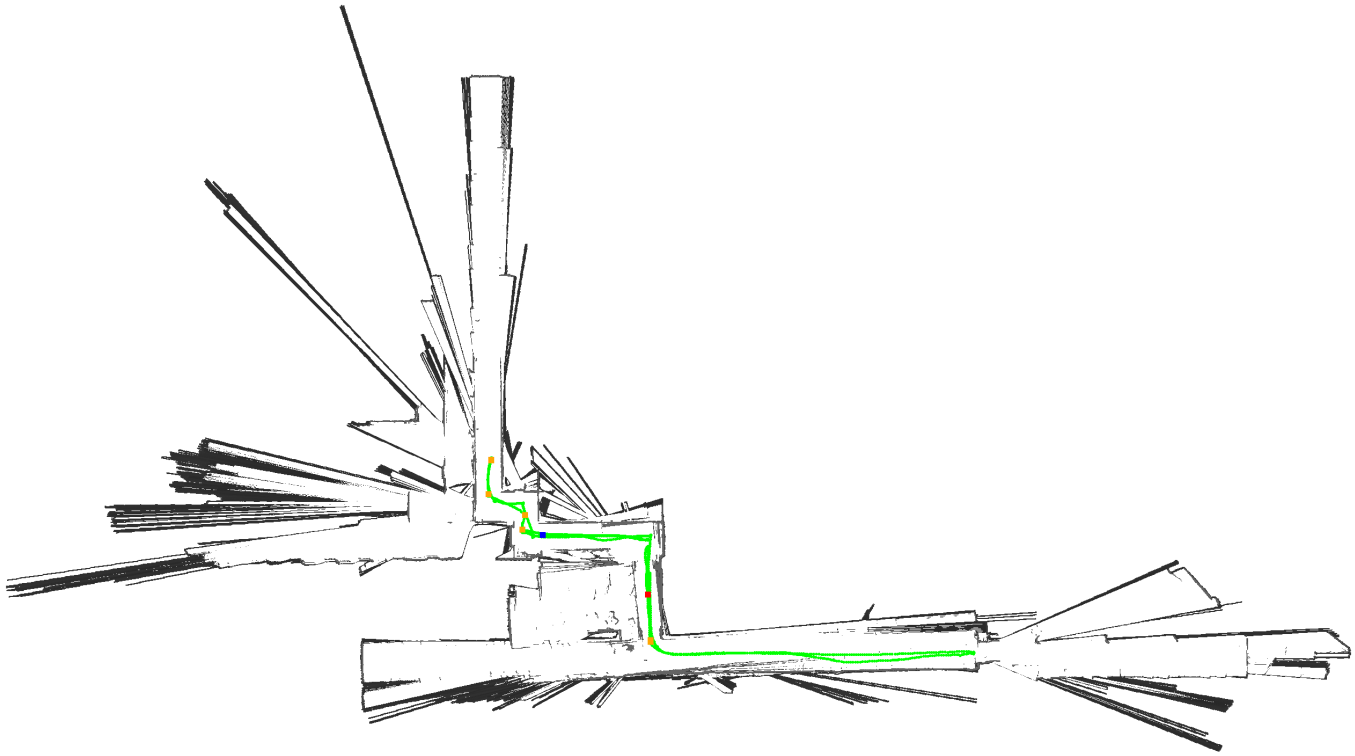

Fig. 18. Trial 18 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 19

Summary

Building: ME
Floor: 3
Volunteer: F
Goal: 3005
Floor plan: Figure 76
SLAM map: Figure 19
Result: Success

Sequence of Behaviors

1) WANDER (130 s)
2) APPROACH_PERSON (0 s)
3) WANDER (32 s)
4) APPROACH_PERSON (4 s)
5) WANDER (1 s)
6) APPROACH_PERSON (29 s)
7) HOLD_CONVERSATION (21 s)
8) FOLLOW_DIRECTIONS (16 s)
9) NAVIGATE_DOOR (88 s)
10) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 3005?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	class is the last door on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

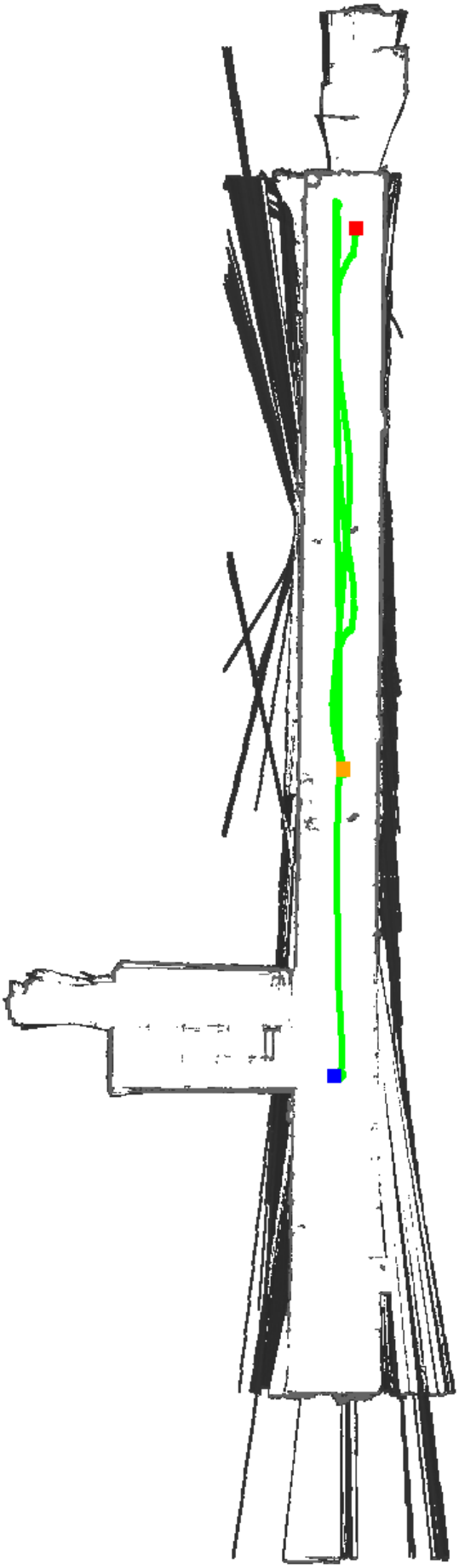

Fig. 19. Trial 19 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 20

Summary

Building: ME
Floor: 3
Volunteer: G
Goal: 3013
Floor plan: Figure 76
SLAM map: Figure 20
Result: Success

Sequence of Behaviors

1) WANDER (7 s)
2) APPROACH_PERSON (1 s)
3) WANDER (5 s)
4) APPROACH_PERSON (4 s)
5) HOLD_CONVERSATION (69 s)
6) FOLLOW_DIRECTIONS (0 s)
7) NAVIGATE_DOOR (466 s)
8) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 3013?
Person:	just go down straight straight down the hall. it'll be under red.
Robot:	What do I do after starting to go forward?
Person:	the door will be on your right about halfway down the hall.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after starting to go forward?
Person:	just keep going down the hall the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Navigate Door

Number of doors approached: 10
Number of doors labeled: 8

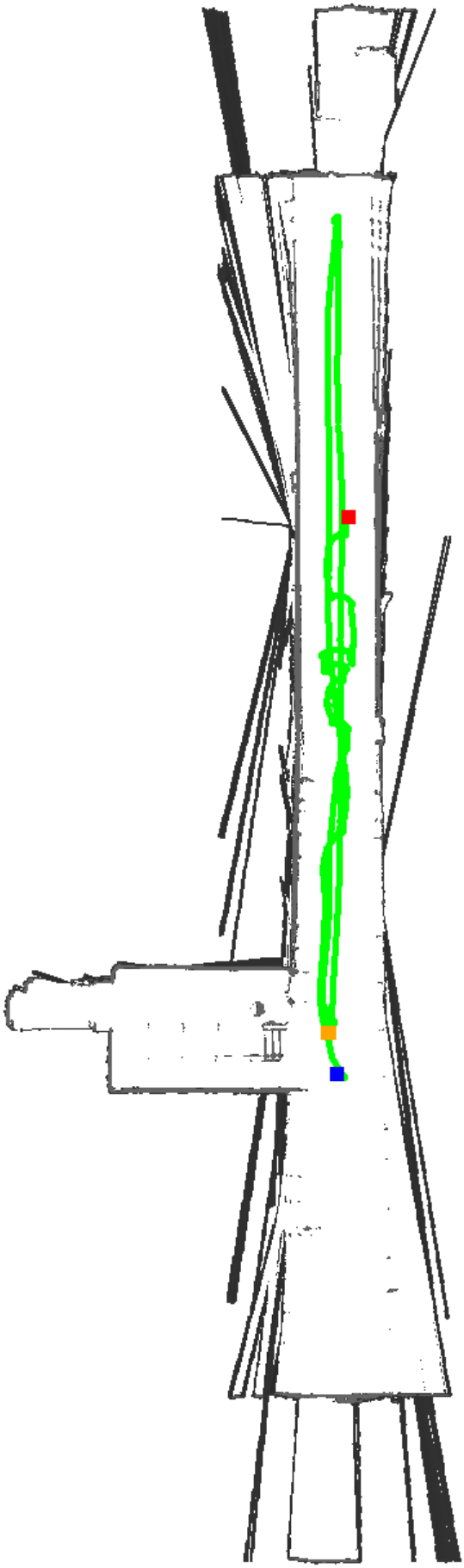

Fig. 20. Trial 20 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 21

Summary

Building: ME
Floor: 2
Volunteer: G
Goal: 2008
Floor plan: Figure 75
SLAM map: Figure 21
Result: Success

Sequence of Behaviors

1) WANDER (56 s)
2) APPROACH_PERSON (1 s)
3) WANDER (70 s)
4) APPROACH_PERSON (0 s)
5) WANDER (29 s)
6) APPROACH_PERSON (17 s)
7) HOLD_CONVERSATION (18 s)
8) FOLLOW_DIRECTIONS (16 s)
9) NAVIGATE_DOOR (86 s)
10) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 2008?
Person:	turn around with alcohol. it will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 1

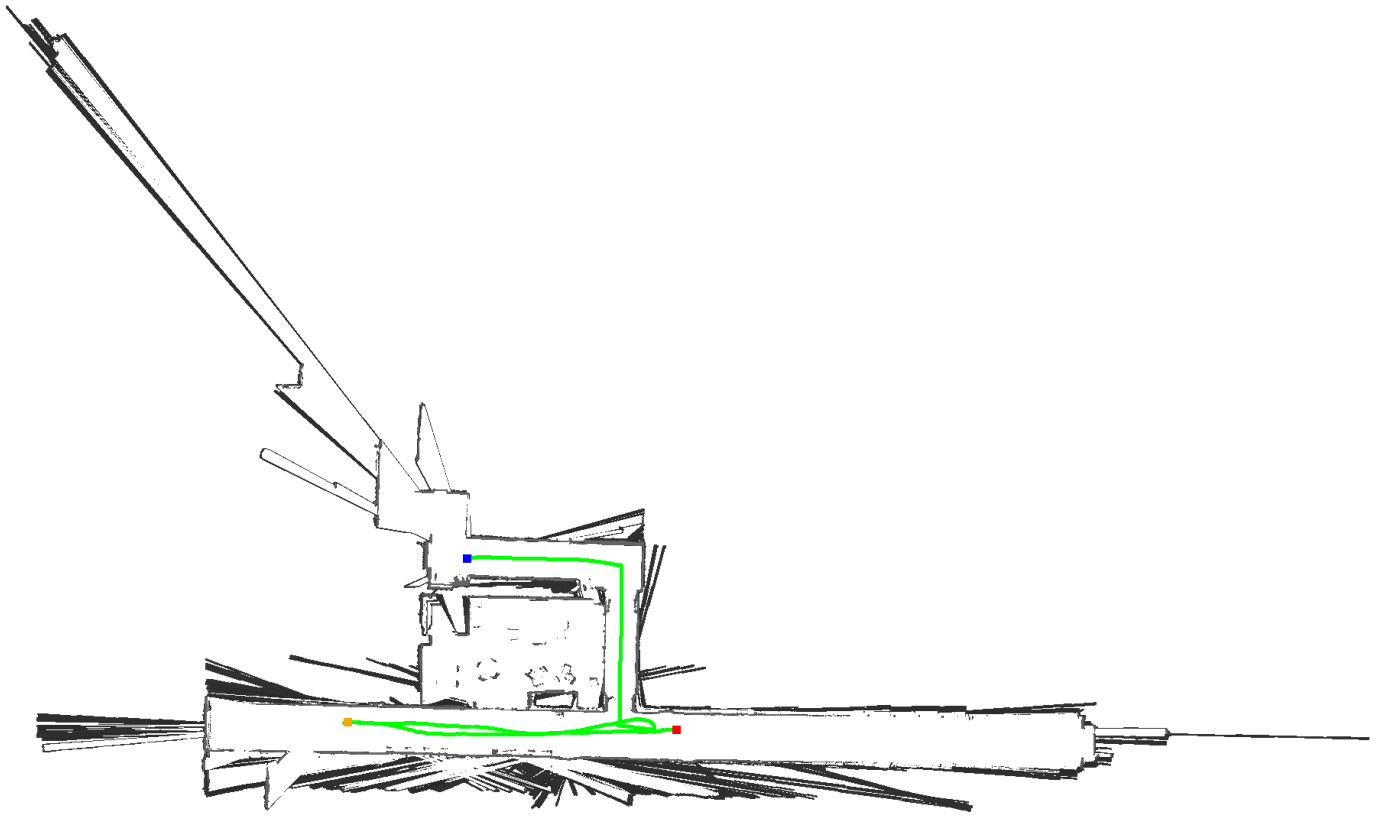

Fig. 21. Trial 21 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 22

Summary

Building: KNOY
Floor: 1
Volunteer: H
Goal: 159
Floor plan: Figure 69
SLAM map: Figure 22
Result: Success

Sequence of Behaviors

1) WANDER (135 s)
2) APPROACH_PERSON (10 s)
3) HOLD_CONVERSATION (23 s)
4) FOLLOW_DIRECTIONS (18 s)
5) NAVIGATE_DOOR (38 s)
6) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 159?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	arrived at destination
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]

Navigate Door

Number of doors approached: 1
Number of doors labeled: 1

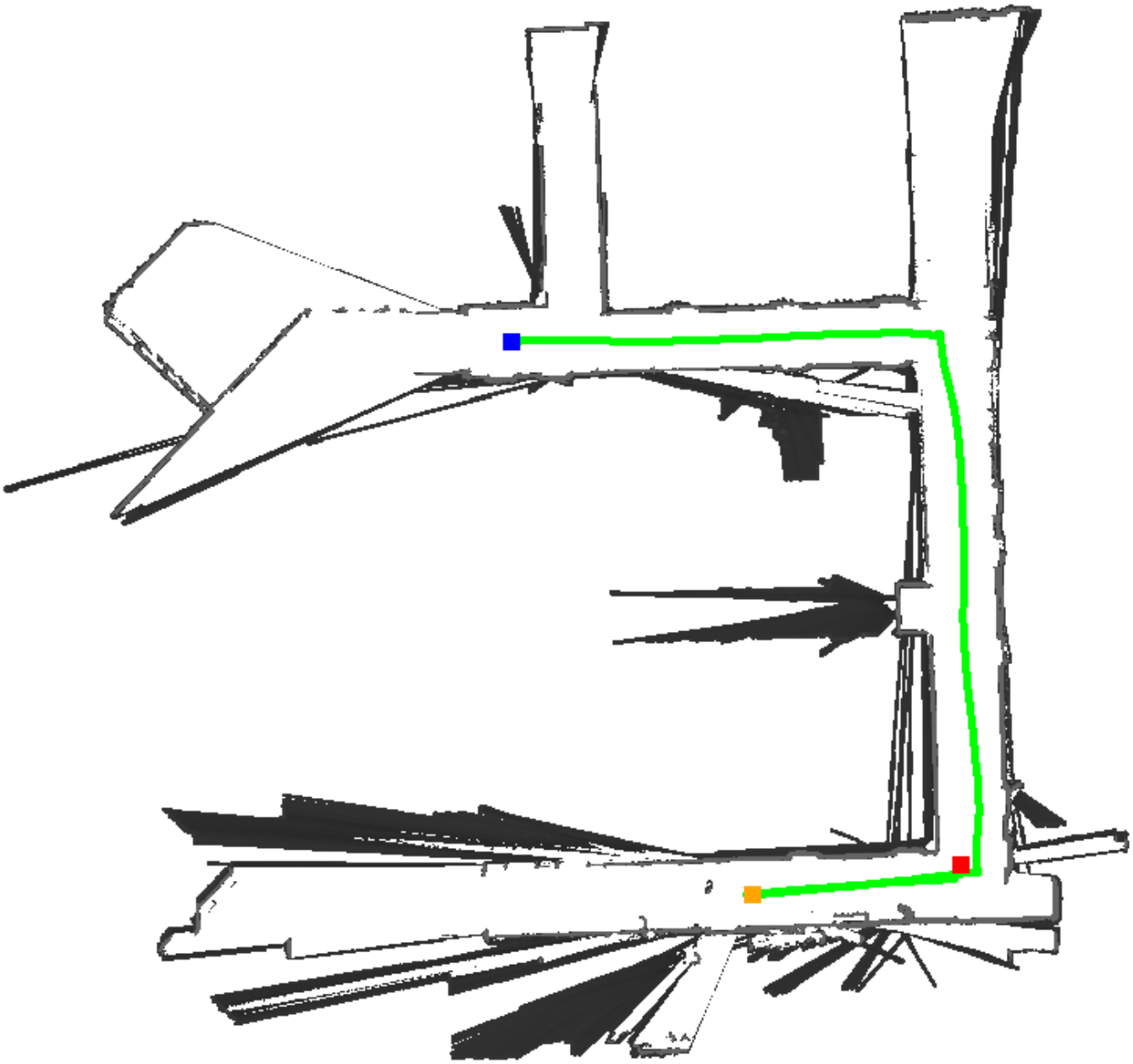

Fig. 22. Trial 22 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 23

Summary

Building: HAMP
Floor: 3
Volunteer: I
Goal: 3125
Floor plan: Figure 67
SLAM map: Figure 23
Result: Failure
Reason: When the robot returned to the NAVIGATE_DOOR behavior, it should have reset the data structures holding previous door detections, which it was not doing. This could have prevented new doors from being correctly detected, localized, and investigated.

Sequence of Behaviors

1) WANDER (118 s)
2) APPROACH_PERSON (8 s)
3) HOLD_CONVERSATION (19 s)
4) FOLLOW_DIRECTIONS (17 s)
5) NAVIGATE_DOOR (300 s)
6) WANDER (31 s)
7) APPROACH_PERSON (19 s)
8) HOLD_CONVERSATION (24 s)
9) FOLLOW_DIRECTIONS (41 s)
10) NAVIGATE_DOOR (343 s)
11) WANDER (26 s)
12) APPROACH_PERSON (40 s)
13) HOLD_CONVERSATION (23 s)
14) FOLLOW_DIRECTIONS (1 s)
15) NAVIGATE_DOOR (331 s)
16) WANDER (242 s)
17) APPROACH_PERSON (17 s)
18) HOLD_CONVERSATION (14 s)
19) FOLLOW_DIRECTIONS (17 s)
20) NAVIGATE_DOOR (–)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 3125?
Person:	turn around and go 30 ft. and the door will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]
Conversation 2	
Robot:	Could you tell me how to navigate to 3125?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	turn left at the intersection and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]
Conversation 3	
Robot:	Could you tell me how to navigate to 3125?
Person:	yes, go straight and it will be the third door on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-L`]
Conversation 4	
Robot:	Could you tell me how to navigate to 3125?
Person:	turn around and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 9
Number of doors labeled: 7

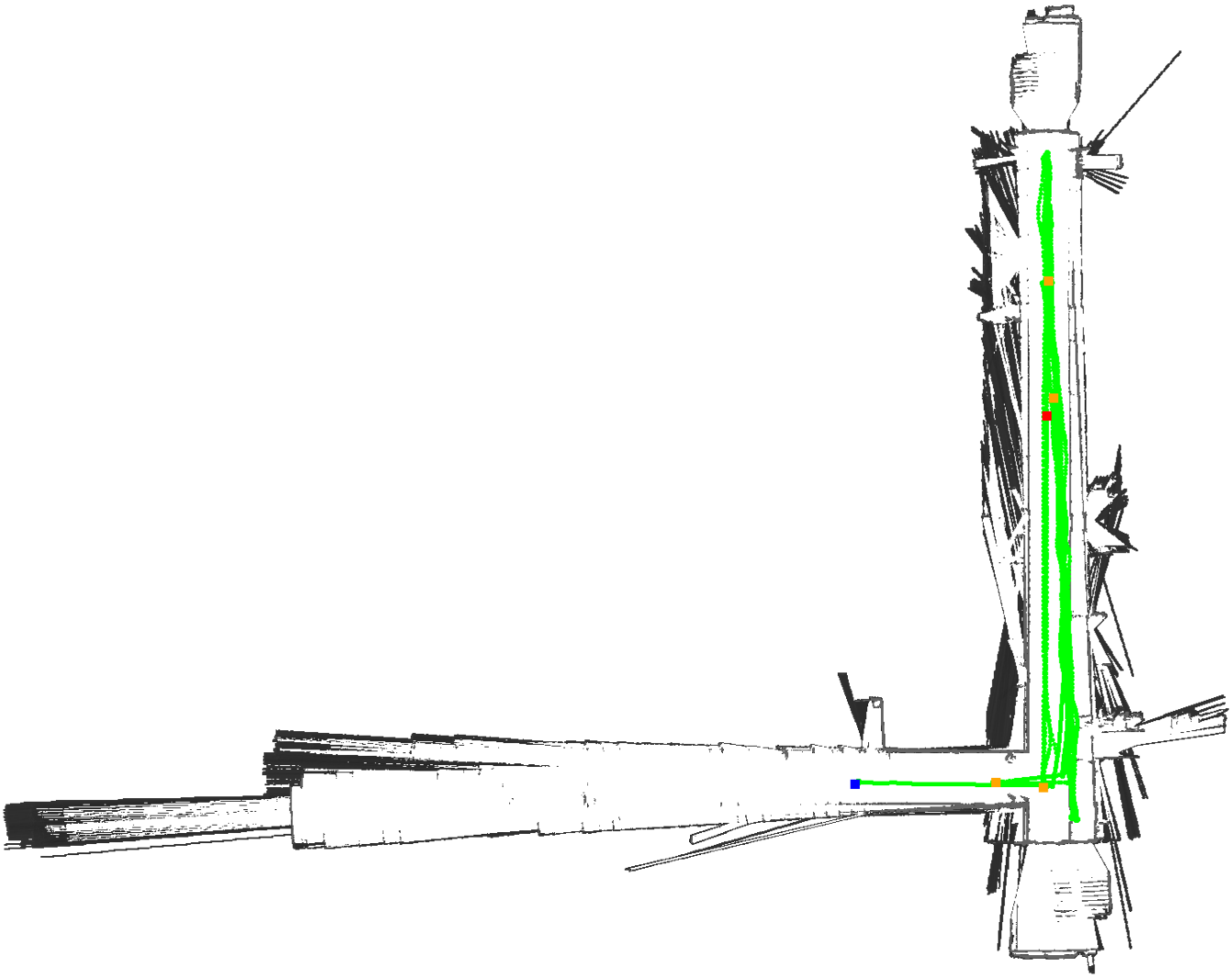

Fig. 23. Trial 23 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 24

Summary

Building: HAMP
Floor: 3
Volunteer: I
Goal: 3187
Floor plan: Figure 67
SLAM map: Figure 24
Result: Failure
Reason: When the robot returned to the NAVIGATE_DOOR behavior, it should have reset the data structures holding previous door detections, which it was not doing. This could have prevented new doors from being correctly detected, localized, and investigated.

Sequence of Behaviors

1) WANDER (67 s)
2) APPROACH_PERSON (6 s)
3) HOLD_CONVERSATION (74 s)
4) FOLLOW_DIRECTIONS (59 s)
5) NAVIGATE_DOOR (373 s)
6) WANDER (1 s)
7) APPROACH_PERSON (1 s)
8) HOLD_CONVERSATION (94 s)
9) FOLLOW_DIRECTIONS (16 s)
10) NAVIGATE_DOOR (225 s)
11) WANDER (26 s)
12) APPROACH_PERSON (3 s)
13) HOLD_CONVERSATION (28 s)
14) FOLLOW_DIRECTIONS (17 s)
15) NAVIGATE_DOOR (62 s)
16) WANDER (43 s)
17) APPROACH_PERSON (0 s)
18) WANDER (6 s)
19) APPROACH_PERSON (1 s)
20) WANDER (1 s)
21) APPROACH_PERSON (19 s)
22) HOLD_CONVERSATION (23 s)
23) FOLLOW_DIRECTIONS (17 s)
24) NAVIGATE_DOOR (285 s)
25) WANDER (–)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 3287?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	make your first left.
Robot:	What do I do after I turn left?
Person:	in the room.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	go straight and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Conversation 2

Robot:	Could you tell me how to navigate to 3287?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	go straight and turn to the left.
Robot:	What do I do after I turn left?
Person:	should be about there somewhere.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3287?
Person:	please turn around.
Robot:	What do I do after turning around and going forward?
Person:	the door should be the first one on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Conversation 3	
Robot:	Could you tell me how to navigate to 3287?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	it will be your first door on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Conversation 4	
Robot:	Could you tell me how to navigate to 3287?
Person:	turn around go straight.
Robot:	What do I do after turning around and going forward?
Person:	the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 14
Number of doors labeled: 14

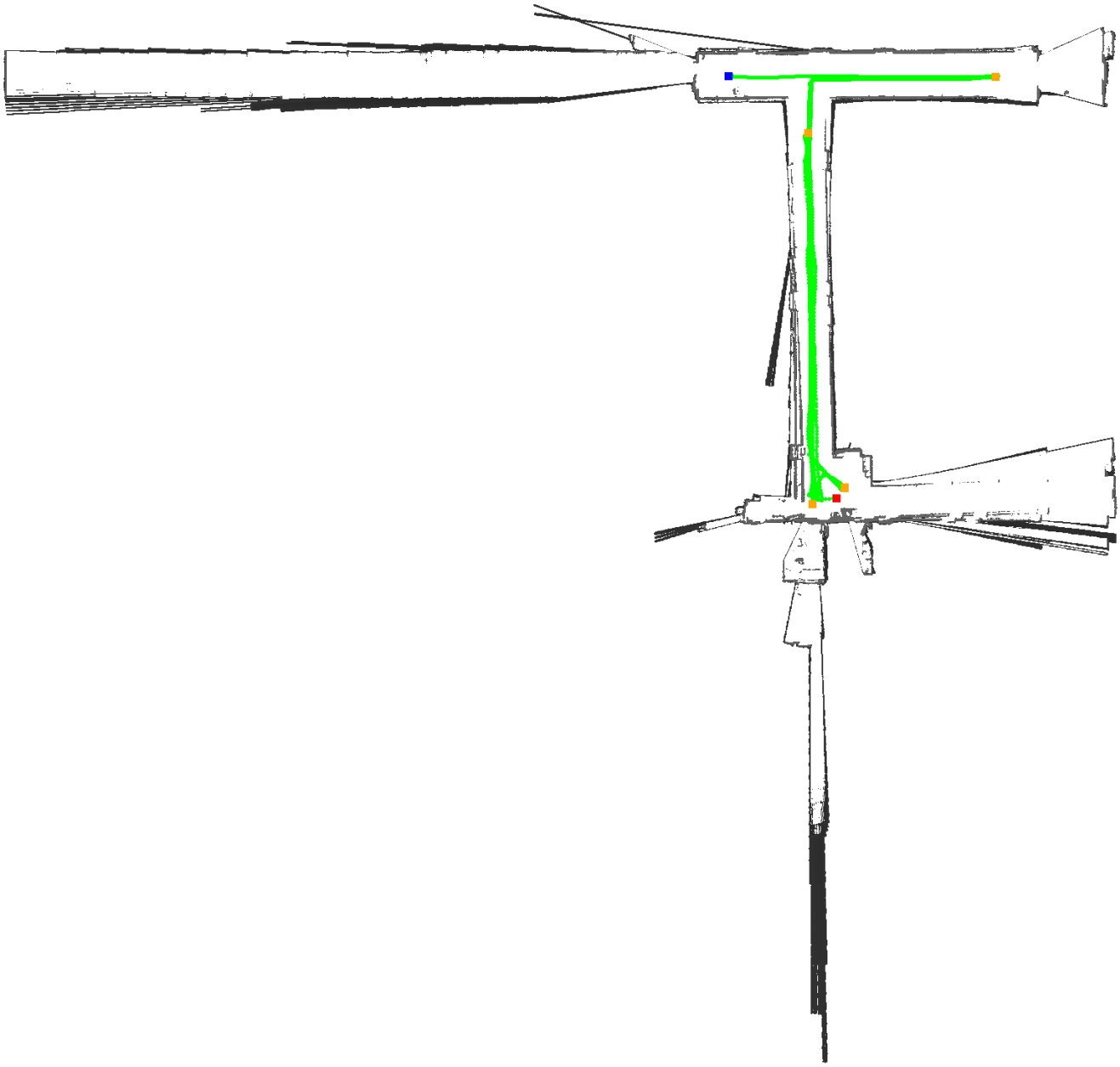

Fig. 24. Trial 24 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 25

Summary

Building: HAMP
Floor: 1
Volunteer: J
Goal: 1273
Floor plan: Figure 65
SLAM map: Figure 25
Result: Success

Sequence of Behaviors

1) WANDER (18 s)
2) APPROACH_PERSON (4 s)
3) HOLD_CONVERSATION (121 s)
4) FOLLOW_DIRECTIONS (8 s)
5) WANDER (9 s)
6) APPROACH_PERSON (1 s)
7) HOLD_CONVERSATION (47 s)
8) FOLLOW_DIRECTIONS (130 s)
9) WANDER (69 s)
10) APPROACH_PERSON (5 s)
11) HOLD_CONVERSATION (16 s)
12) FOLLOW_DIRECTIONS (32 s)
13) NAVIGATE_DOOR (81 s)
14) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 1273?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 1273?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	Could you tell me how to navigate to 1273?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]
Conversation 2	
Robot:	Could you tell me how to navigate to 1273?
Person:	yes, turn right.
Robot:	What do I do after I turn right?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right?
Person:	and then turn right.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	find room 1273.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `int-R`, `right`, `goal-F`]
Conversation 3	
Robot:	Could you tell me how to navigate to 1273?
Person:	turn around turn right if it went through 73 is on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-L`]

Navigate Door

Number of doors approached: 3
Number of doors labeled: 3

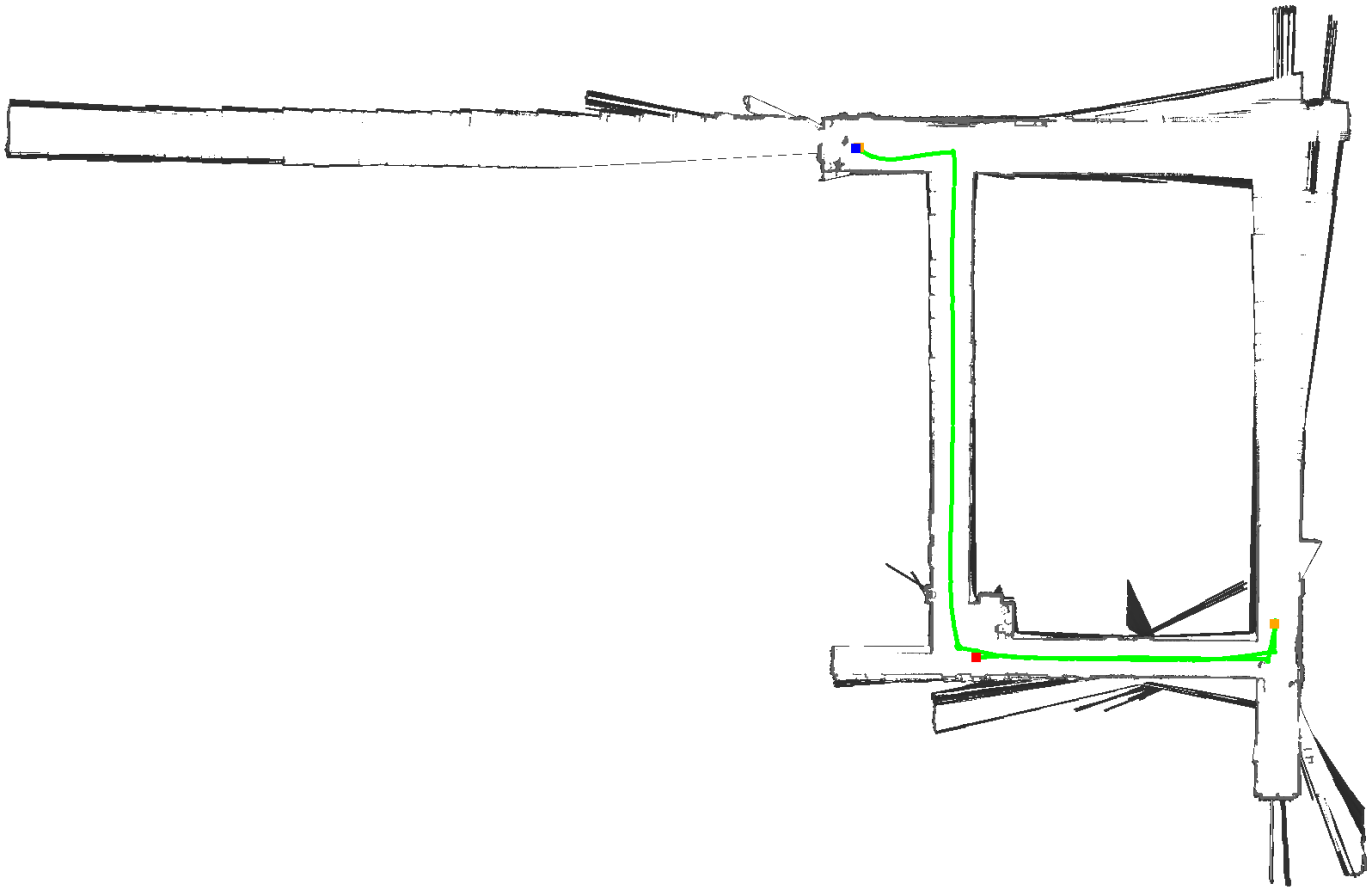

Fig. 25. Trial 25 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 26

Summary

Building: HAMP
Floor: 4
Volunteer: J
Goal: 4167
Floor plan: Figure 68
SLAM map: Figure 26
Result: Success

Sequence of Behaviors

1) WANDER (122 s)
2) APPROACH_PERSON (4 s)
3) WANDER (1 s)
4) APPROACH_PERSON (3 s)
5) WANDER (1 s)
6) APPROACH_PERSON (14 s)
7) HOLD_CONVERSATION (18 s)
8) FOLLOW_DIRECTIONS (17 s)
9) NAVIGATE_DOOR (87 s)
10) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 4167?
Person:	yes, turn around and it will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

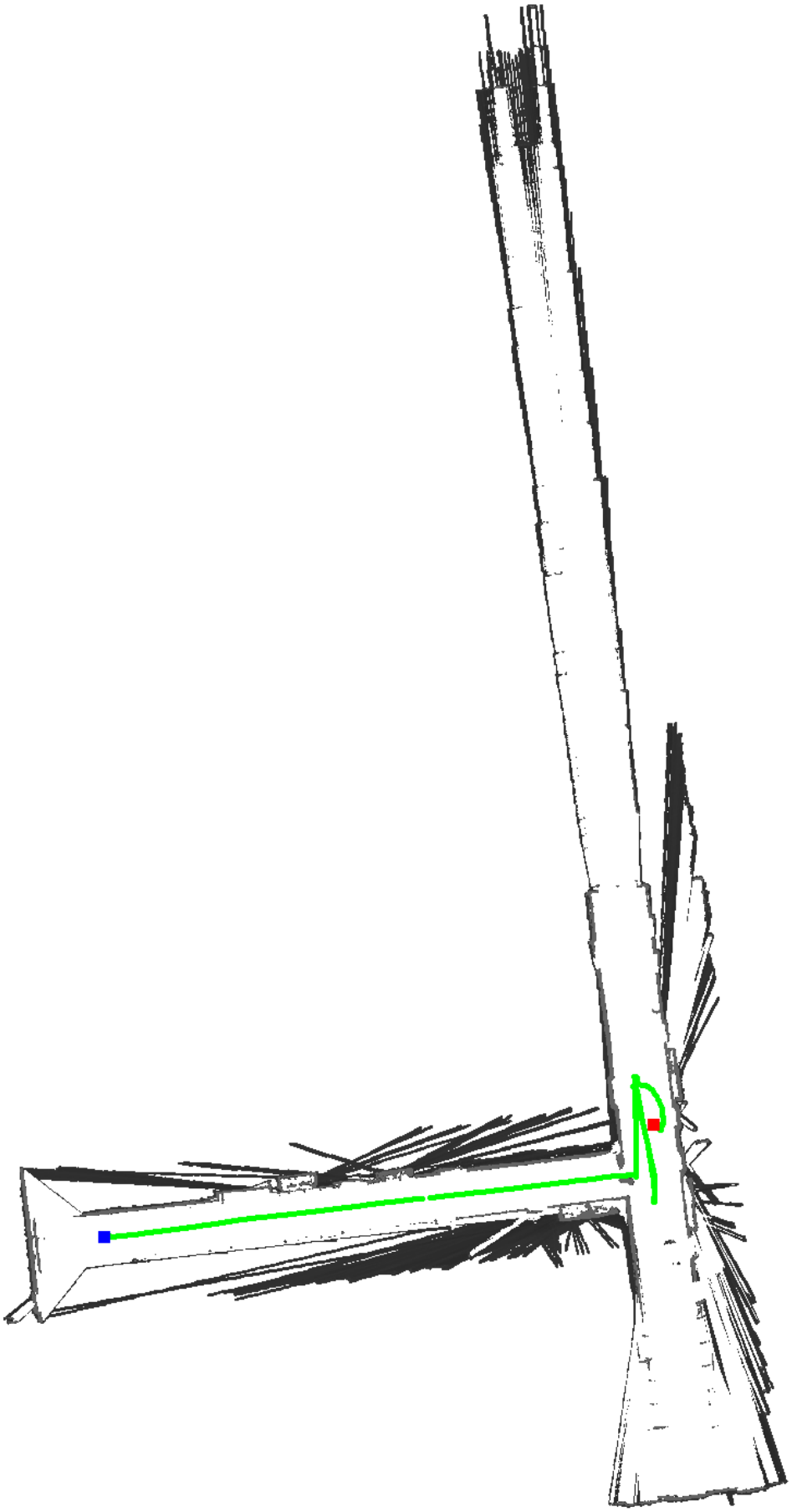

Fig. 26. Trial 26 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 27

Summary

Building: HAMP
Floor: 4
Volunteer: J
Goal: 4120
Floor plan: Figure 68
SLAM map: Figure 27
Result: Success

Sequence of Behaviors

1) WANDER (199 s)
2) APPROACH_PERSON (5 s)
3) HOLD_CONVERSATION (125 s)
4) FOLLOW_DIRECTIONS (9 s)
5) WANDER (44 s)
6) APPROACH_PERSON (2 s)
7) WANDER (2 s)
8) APPROACH_PERSON (3 s)
9) WANDER (1 s)
10) APPROACH_PERSON (4 s)
11) WANDER (1 s)
12) APPROACH_PERSON (1 s)
13) WANDER (2 s)
14) APPROACH_PERSON (17 s)
15) HOLD_CONVERSATION (16 s)
16) FOLLOW_DIRECTIONS (17 s)
17) NAVIGATE_DOOR (230 s)
18) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 4120?
Person:	turn around and look for it on your right.
Robot:	What do I do after I turn right?
Person:	turn around.
Robot:	Sorry, I am a little confused. Could we start over? Could you tell me how to navigate to 4120?
Person:	turn around and look for or 120 on your right.
Robot:	What do I do after I turn right?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 4120?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 4120?
Person:	amber court
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 4120?
Person:	what app
Robot:	I did not understand that.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 2	
Robot:	Could you tell me how to navigate to 4120?
Person:	turn around and go straight on till you find 4120.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]

Navigate Door

Number of doors approached: 7
Number of doors labeled: 5

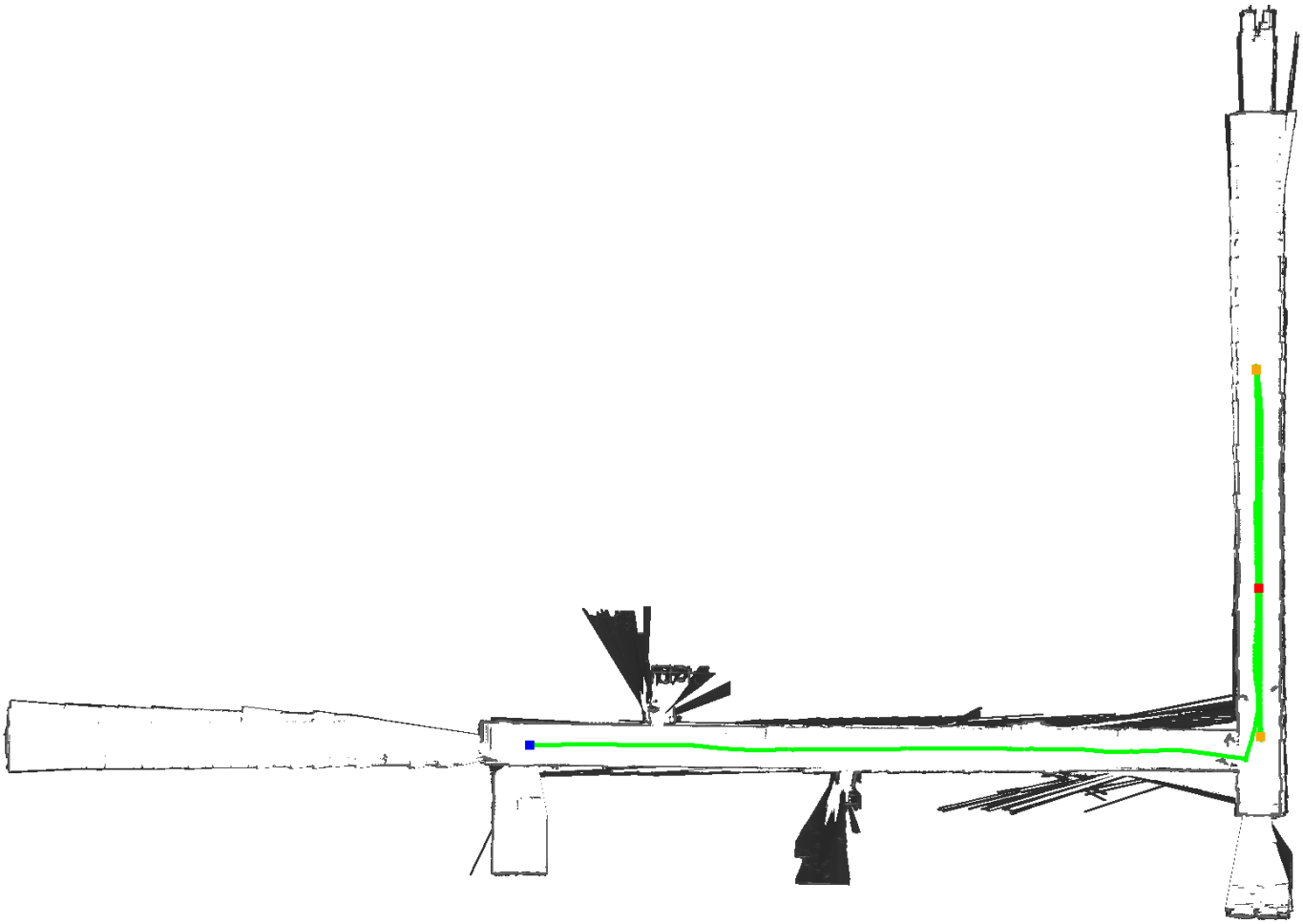

Fig. 27. Trial 27 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 28

Summary

Building: HAMP
Floor: 3
Volunteer: J
Goal: 3119
Floor plan: Figure 67
SLAM map: Figure 28
Result: Success

Sequence of Behaviors

1) WANDER (5 s)
2) APPROACH_PERSON (0 s)
3) WANDER (1 s)
4) APPROACH_PERSON (2 s)
5) HOLD_CONVERSATION (124 s)
6) FOLLOW_DIRECTIONS (10 s)
7) WANDER (89 s)
8) APPROACH_PERSON (0 s)
9) WANDER (44 s)
10) APPROACH_PERSON (3 s)
11) WANDER (3 s)
12) APPROACH_PERSON (11 s)
13) WANDER (0 s)
14) APPROACH_PERSON (15 s)
15) HOLD_CONVERSATION (73 s)
16) FOLLOW_DIRECTIONS (200 s)
17) WANDER (78 s)
18) APPROACH_PERSON (27 s)
19) HOLD_CONVERSATION (115 s)
20) FOLLOW_DIRECTIONS (17 s)
21) NAVIGATE_DOOR (64 s)
22) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 3119?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 3119?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	Could you tell me how to navigate to 3119?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 2

Robot:	Could you tell me how to navigate to 3119?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	look for the door on your right.
Robot:	What do I do after I turn right?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right?
Person:	first turn left and look for 4119 on your right.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	
Robot:	I did not hear you.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `int-R`, `right`, `int-L`, `left`, `int-R`, `right`, □]

Conversation 3	
Robot:	Could you tell me how to navigate to 3119?
Person:	turn around and go straight.
Robot:	What do I do after turning around and going forward?
Person:	what word on your right?
Robot:	What do I do after I turn right?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right?
Person:	look for the door on your right.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	it has been confused.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 3119?
Person:	turn around and go straight until your destination.
Robot:	What do I do after turning around and going forward?
Person:	find your destination.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

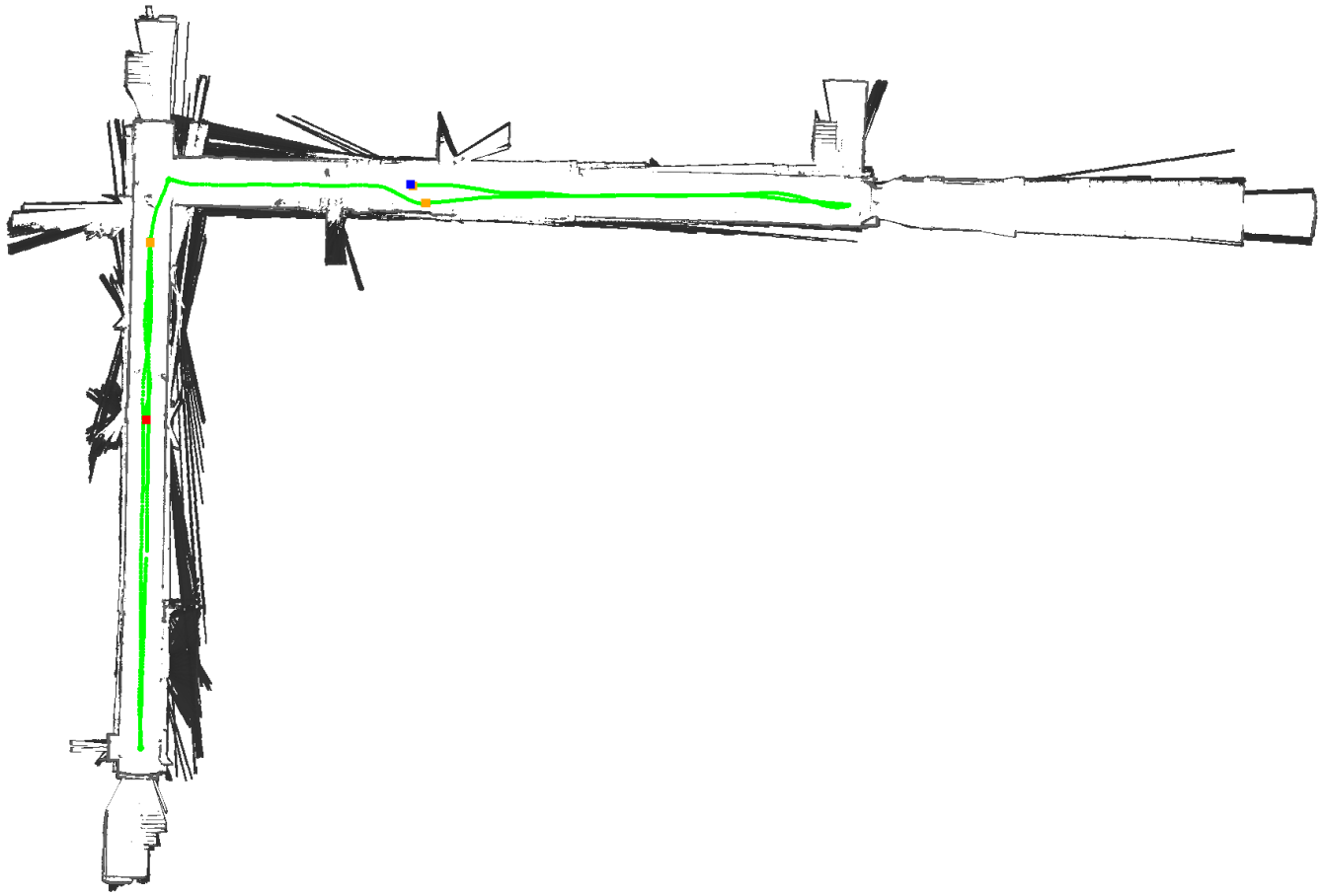

Fig. 28. Trial 28 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 29

Summary

Building: HAMP
Floor: 2
Volunteer: J
Goal: 2152
Floor plan: Figure 66
SLAM map: Figure 29
Result: Success

Sequence of Behaviors

1) WANDER (143 s)
2) APPROACH_PERSON (0 s)
3) WANDER (1 s)
4) APPROACH_PERSON (0 s)
5) WANDER (5 s)
6) APPROACH_PERSON (1 s)
7) WANDER (8 s)
8) APPROACH_PERSON (12 s)
9) WANDER (3 s)
10) APPROACH_PERSON (2 s)
11) WANDER (0 s)
12) APPROACH_PERSON (0 s)
13) WANDER (11 s)
14) APPROACH_PERSON (4 s)
15) WANDER (2 s)
16) APPROACH_PERSON (0 s)
17) WANDER (12 s)
18) APPROACH_PERSON (0 s)
19) WANDER (29 s)
20) APPROACH_PERSON (0 s)
21) WANDER (19 s)
22) APPROACH_PERSON (26 s)
23) HOLD_CONVERSATION (23 s)
24) FOLLOW_DIRECTIONS (19 s)
25) NAVIGATE_DOOR (791 s)
26) WANDER (20 s)
27) APPROACH_PERSON (18 s)
28) HOLD_CONVERSATION (15 s)
29) FOLLOW_DIRECTIONS (0 s)
30) NAVIGATE_DOOR (67 s)
31) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 2152?
Person:	turn around and go straight.
Robot:	What do I do after turning around and going forward?
Person:	final destination
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]
Conversation 2	
Robot:	Could you tell me how to navigate to 2152?
Person:	go straight in by destination.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-F`]

Navigate Door

Number of doors approached: 24
Number of doors labeled: 15

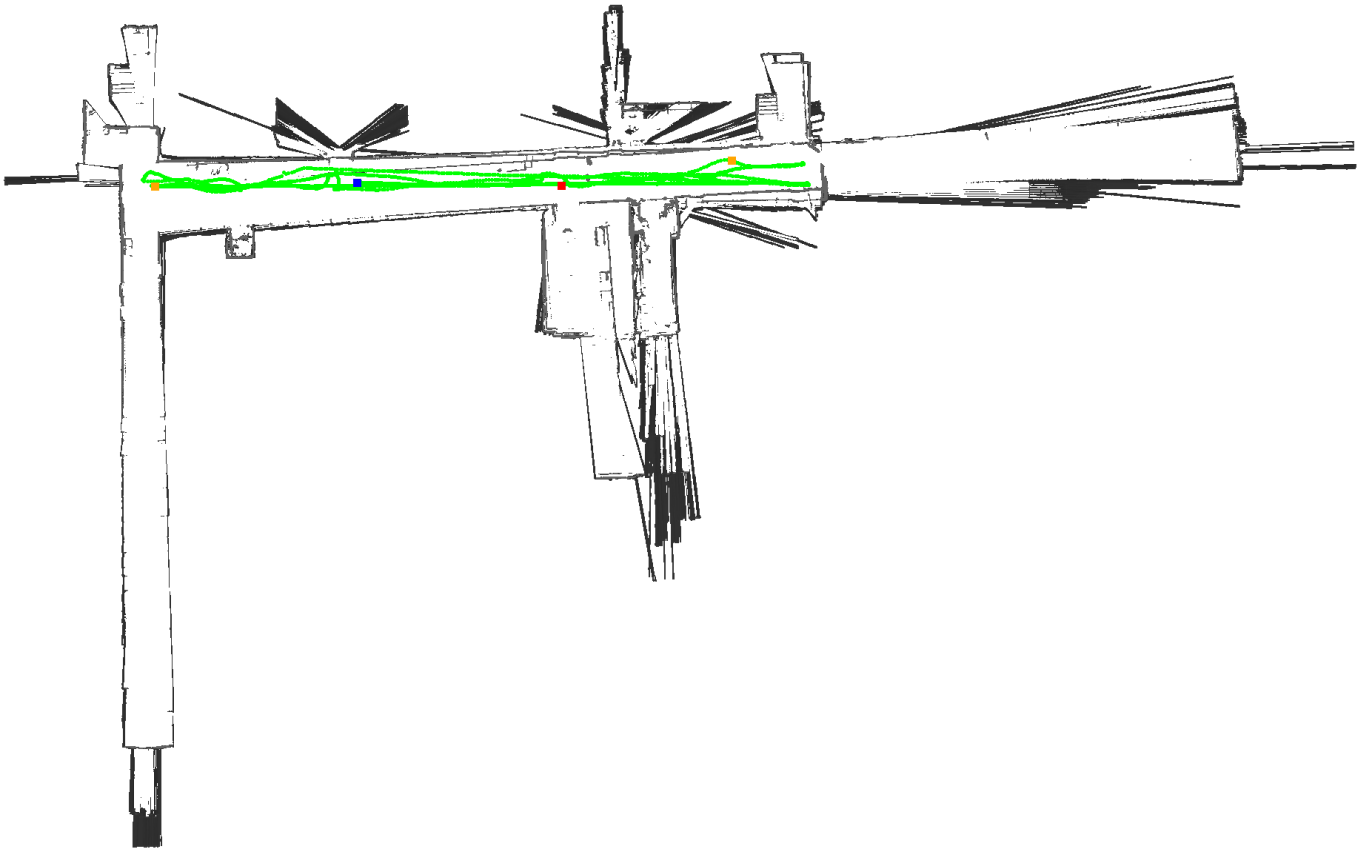

Fig. 29. Trial 29 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 30

Summary

Building: HAMP
Floor: 1
Volunteer: J
Goal: 1268
Floor plan: Figure 65
SLAM map: Figure 30
Result: Success

Sequence of Behaviors

1) WANDER (15 s)
2) APPROACH_PERSON (1 s)
3) HOLD_CONVERSATION (99 s)
4) FOLLOW_DIRECTIONS (9 s)
5) WANDER (157 s)
6) APPROACH_PERSON (0 s)
7) WANDER (275 s)
8) APPROACH_PERSON (10 s)
9) HOLD_CONVERSATION (124 s)
10) FOLLOW_DIRECTIONS (9 s)
11) WANDER (82 s)
12) APPROACH_PERSON (0 s)
13) WANDER (28 s)
14) APPROACH_PERSON (0 s)
15) WANDER (3 s)
16) APPROACH_PERSON (0 s)
17) WANDER (1 s)
18) APPROACH_PERSON (4 s)
19) WANDER (0 s)
20) APPROACH_PERSON (0 s)
21) WANDER (1 s)
22) APPROACH_PERSON (28 s)
23) HOLD_CONVERSATION (76 s)
24) FOLLOW_DIRECTIONS (61 s)
25) NAVIGATE_DOOR (60 s)
26) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 1268?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 1268?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 1268?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 2

Robot:	Could you tell me how to navigate to 1268?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 1268?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	Could you tell me how to navigate to 1268?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 3	
Robot:	Could you tell me how to navigate to 1268?
Person:	go forward and then turn right.
Robot:	What do I do after I turn right?
Person:	binder definition
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	reach your destination.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-F`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 1

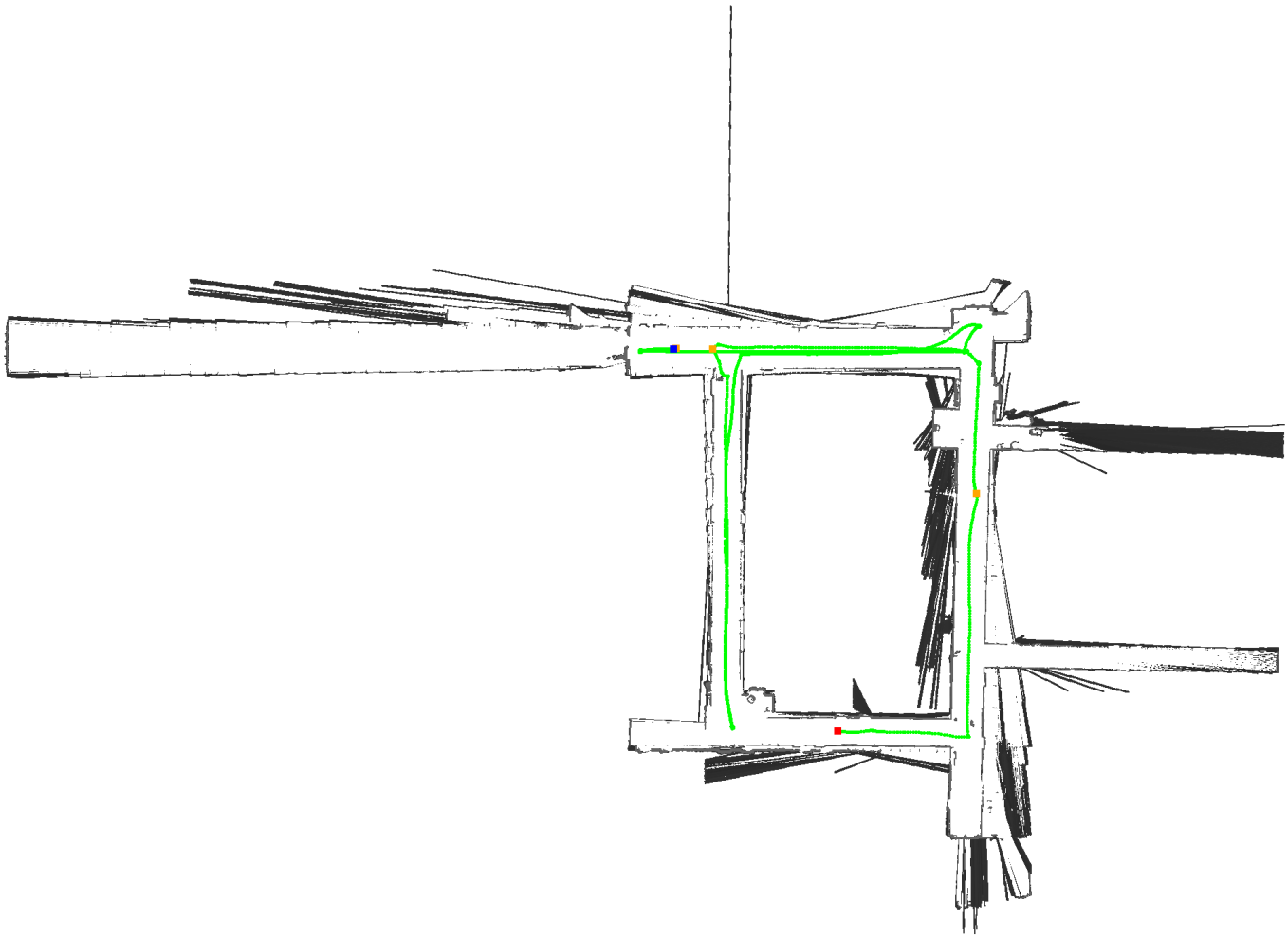

Fig. 30. Trial 30 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 31

Summary

Building: ME
Floor: 0
Volunteer: B
Goal: g055
Floor plan: Figure 73
SLAM map: Figure 31
Result: Success

Sequence of Behaviors

1) WANDER (51 s)
2) APPROACH_PERSON (7 s)
3) HOLD_CONVERSATION (128 s)
4) FOLLOW_DIRECTIONS (56 s)
5) WANDER (3 s)
6) APPROACH_PERSON (1 s)
7) WANDER (2 s)
8) APPROACH_PERSON (1 s)
9) WANDER (1 s)
10) APPROACH_PERSON (6 s)
11) HOLD_CONVERSATION (76 s)
12) FOLLOW_DIRECTIONS (59 s)
13) WANDER (9 s)
14) APPROACH_PERSON (2 s)
15) HOLD_CONVERSATION (104 s)
16) FOLLOW_DIRECTIONS (43 s)
17) WANDER (18 s)
18) APPROACH_PERSON (5 s)
19) HOLD_CONVERSATION (18 s)
20) FOLLOW_DIRECTIONS (9 s)
21) NAVIGATE_DOOR (277 s)
22) WANDER (63 s)
23) APPROACH_PERSON (1 s)
24) WANDER (3 s)
25) APPROACH_PERSON (2 s)
26) WANDER (1 s)
27) APPROACH_PERSON (9 s)
28) HOLD_CONVERSATION (93 s)
29) FOLLOW_DIRECTIONS (9 s)
30) WANDER (26 s)
31) APPROACH_PERSON (6 s)
32) HOLD_CONVERSATION (123 s)
33) FOLLOW_DIRECTIONS (42 s)
34) NAVIGATE_DOOR (133 s)
35) WANDER (33 s)
36) APPROACH_PERSON (3 s)
37) WANDER (1 s)
38) APPROACH_PERSON (0 s)
39) WANDER (1 s)
40) APPROACH_PERSON (4 s)
41) WANDER (1 s)
42) APPROACH_PERSON (4 s)
43) WANDER (1 s)
44) APPROACH_PERSON (19 s)
45) HOLD_CONVERSATION (26 s)
46) FOLLOW_DIRECTIONS (159 s)
47) NAVIGATE_DOOR (763 s)
48) WANDER (10 s)
49) APPROACH_PERSON (11 s)
50) HOLD_CONVERSATION (15 s)
51) FOLLOW_DIRECTIONS (0 s)
52) NAVIGATE_DOOR (101 s)
53) WANDER (1 s)
54) APPROACH_PERSON (12 s)
55) HOLD_CONVERSATION (37 s)
56) FOLLOW_DIRECTIONS (–)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to g055?
Person:	yeah, go straight to the end of the hall take the second, right and then door is there.
Robot:	What do I do after I turn right?
Person:	go straight and the door is there.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	okay start over.
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to g055?
Person:	turn around and go straight take the second right at the end of the hallway and the door is there.
Robot:	When I am at end, which direction will I go to get to end?
Person:	what?
Robot:	I did not understand that.
Robot:	When I am at end, which direction will I go to get to end?
Person:	right
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	the door is there.
Robot:	I did not understand that.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	go straight and the door is there.
Robot:	I did not understand that.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	go straight.
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `right`, `end`, `right`, □]

Conversation 2

Robot:	Could you tell me how to navigate to g055?
Person:	yeah, turn around.
Robot:	What do I do after turning around and going forward?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	go straight and the door is there.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	go straight and the door is there.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go straight.
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, □]

Conversation 3

Robot:	Could you tell me how to navigate to g055?
Person:	turn right and right go straight.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	go straight and take another right and then the door is there.
Robot:	What do I do after I turn right (this being the third right I take)?
Person:	the door is there.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right (this being the third right I take)?
Person:	go to your destination.
Robot:	I did not understand that.
Robot:	What do I do after I turn right (this being the third right I take)?
Person:	go forward.
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `int-R`, `right`, `int-R`, `right`, □]

Conversation 4

Robot:	Could you tell me how to navigate to g055?
Person:	yeah, go straight and take the second right and the bull will be there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `forward`, `int-R`, `right`, `goal-F`]

Conversation 5

Robot:	Could you tell me how to navigate to g055?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to g055?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to g055?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 6

Robot:	Could you tell me how to navigate to g055?
Person:	yes, turn around go straight take the second. right and the bull is there.
Robot:	What do I do after I turn right?
Person:	the boil is there.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to g055?
Person:	turn around and go straight take the second, right?
Robot:	What do I do after I turn right?
Person:	go straight.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	ghost
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go to the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	turn right.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to g055?
Person:	around go to the end of the hall turn, right and the goal is there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `right`, `goal-F`]

Conversation 7

Robot:	Could you tell me how to navigate to g055?
Person:	go straight and turn left then go to the end of the hall and make a right and the goal is there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `end`, `right`, `goal-F`]

Conversation 8

Robot:	Could you tell me how to navigate to g055?
Person:	yes, go straight and the bowl is on the right hand side.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Conversation 9

Robot:	Could you tell me how to navigate to g055?
Person:	yeah, turn around and the doors on the right hand side.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to g055?
Person:	turn around in the bowl is on the right hand side.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 33
Number of doors labeled: 21

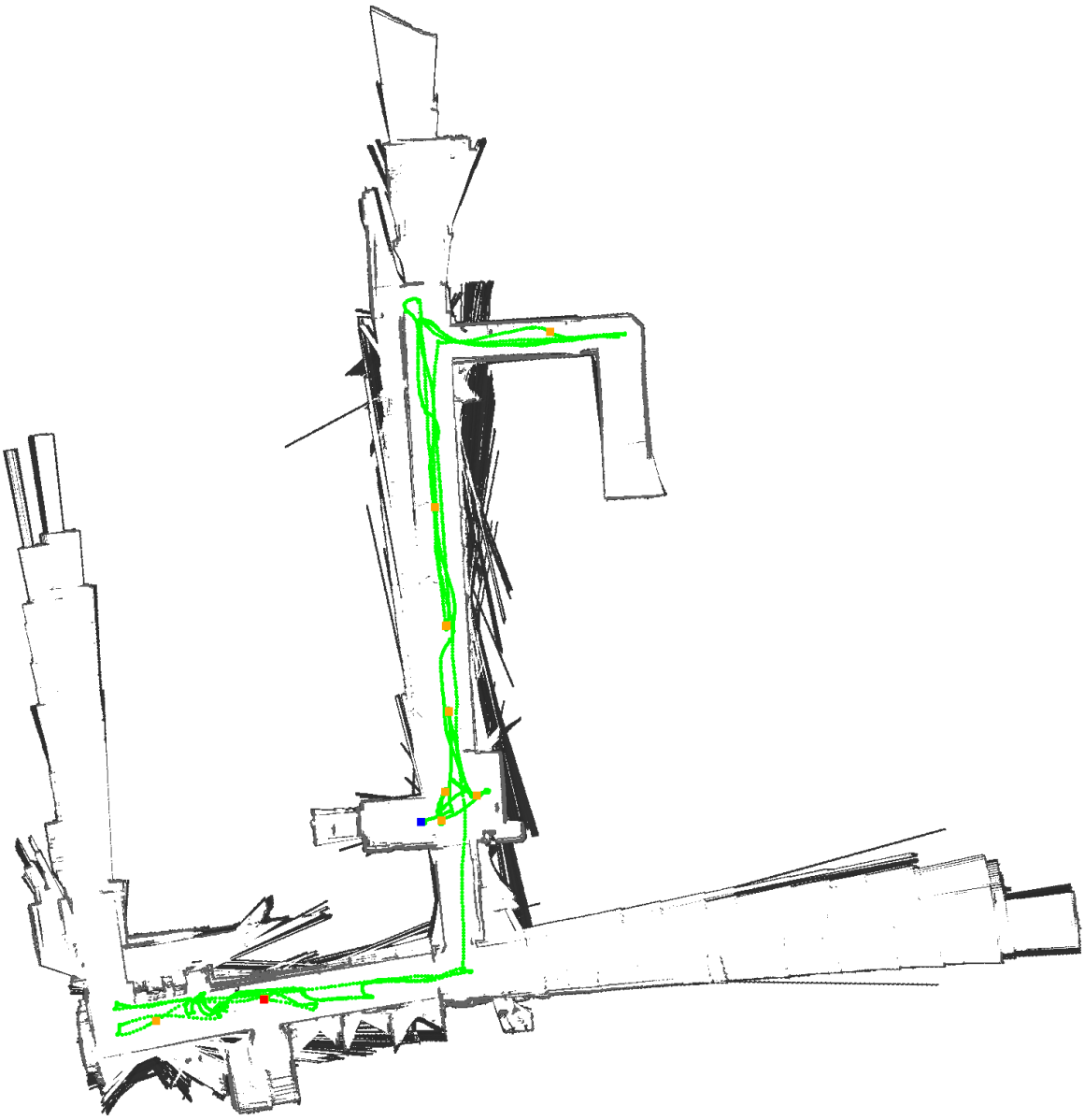

Fig. 31. Trial 31 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 32

Summary

Building: KNOY
Floor: 4
Volunteer: K
Goal: 422
Floor plan: Figure 72
SLAM map: Figure 32
Result: Failure
Reason: The robot drove up to a non-goal door and read an advertisement on that door for an event in the goal room. Because it was beside a door and the text it was looking for (i.e., the goal room number) was present in what it read, it erroneously thought it was at the goal door.

Sequence of Behaviors

1) WANDER (267 s)
2) APPROACH_PERSON (4 s)
3) HOLD_CONVERSATION (29 s)
4) FOLLOW_DIRECTIONS (7 s)
5) WANDER (5 s)
6) APPROACH_PERSON (1 s)
7) HOLD_CONVERSATION (23 s)
8) FOLLOW_DIRECTIONS (30 s)
9) NAVIGATE_DOOR (150 s)
10) WANDER (103 s)
11) APPROACH_PERSON (0 s)
12) WANDER (6 s)
13) APPROACH_PERSON (24 s)
14) HOLD_CONVERSATION (24 s)
15) FOLLOW_DIRECTIONS (17 s)
16) NAVIGATE_DOOR (289 s)
17) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 422?
Person:	schurr high hosch if you go keep going forward and turn right it's going to be
Robot:	What do I do after I turn right?
Person:	it's the door for 22 will be on your right the first door on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-R`]
Conversation 2	
Robot:	Could you tell me how to navigate to 422?
Person:	sure, continue going straight down this hallway and turn right 422 will be the first door on your right i believe.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-F`]
Conversation 3	
Robot:	Could you tell me how to navigate to 422?
Person:	sure room 422 is behind you turn around go to the end of the hallway. it is the last door on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Navigate Door

Number of doors approached: 7
Number of doors labeled: 6

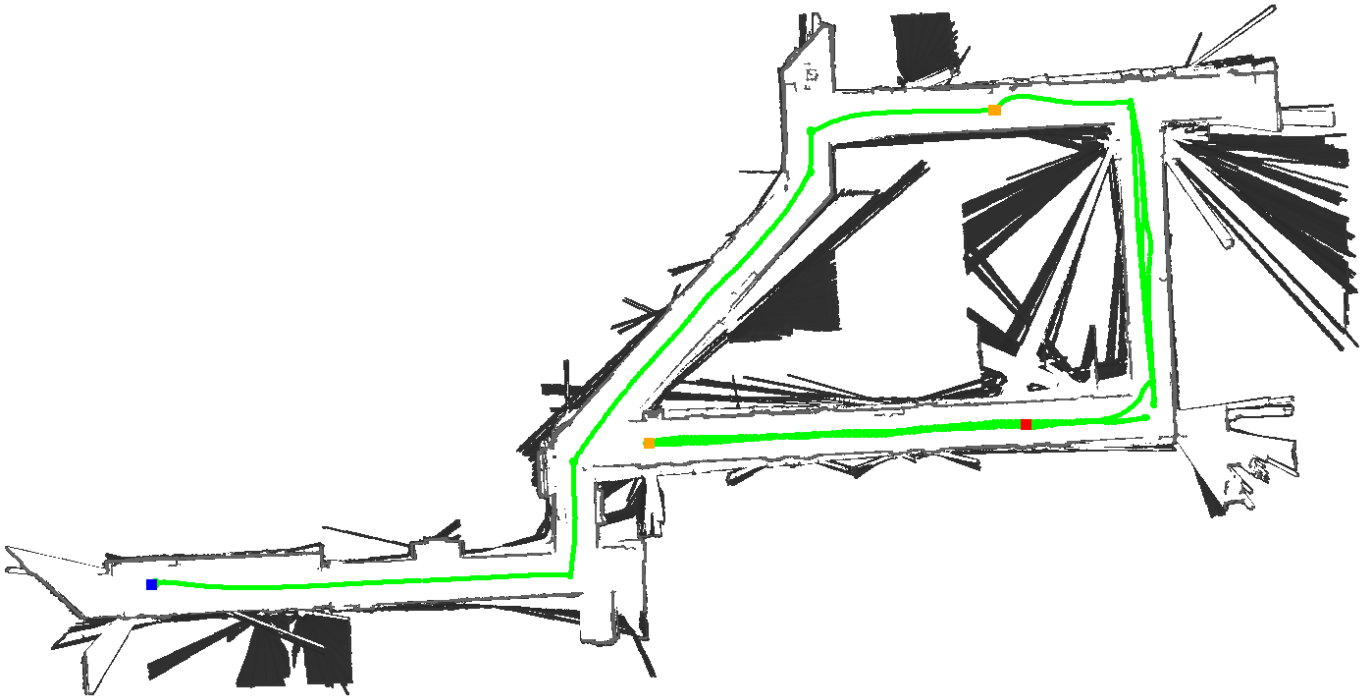

Fig. 32. Trial 32 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 33

Summary

Building: KNOY
Floor: 4
Volunteer: K
Goal: 417
Floor plan: Figure 72
SLAM map: Figure 33
Result: Success

Sequence of Behaviors

1) WANDER (7 s)
2) APPROACH_PERSON (0 s)
3) WANDER (20 s)
4) APPROACH_PERSON (3 s)
5) HOLD_CONVERSATION (130 s)
6) FOLLOW_DIRECTIONS (8 s)
7) WANDER (144 s)
8) APPROACH_PERSON (1 s)
9) WANDER (5 s)
10) APPROACH_PERSON (16 s)
11) HOLD_CONVERSATION (24 s)
12) FOLLOW_DIRECTIONS (38 s)
13) NAVIGATE_DOOR (79 s)
14) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 417?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 417?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 417?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]
Conversation 2	
Robot:	Could you tell me how to navigate to 417?
Person:	sure, turn around take your first left and go down the hallway room 417 will be on the right hand side.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-F`]

Navigate Door

Number of doors approached: 3
Number of doors labeled: 3

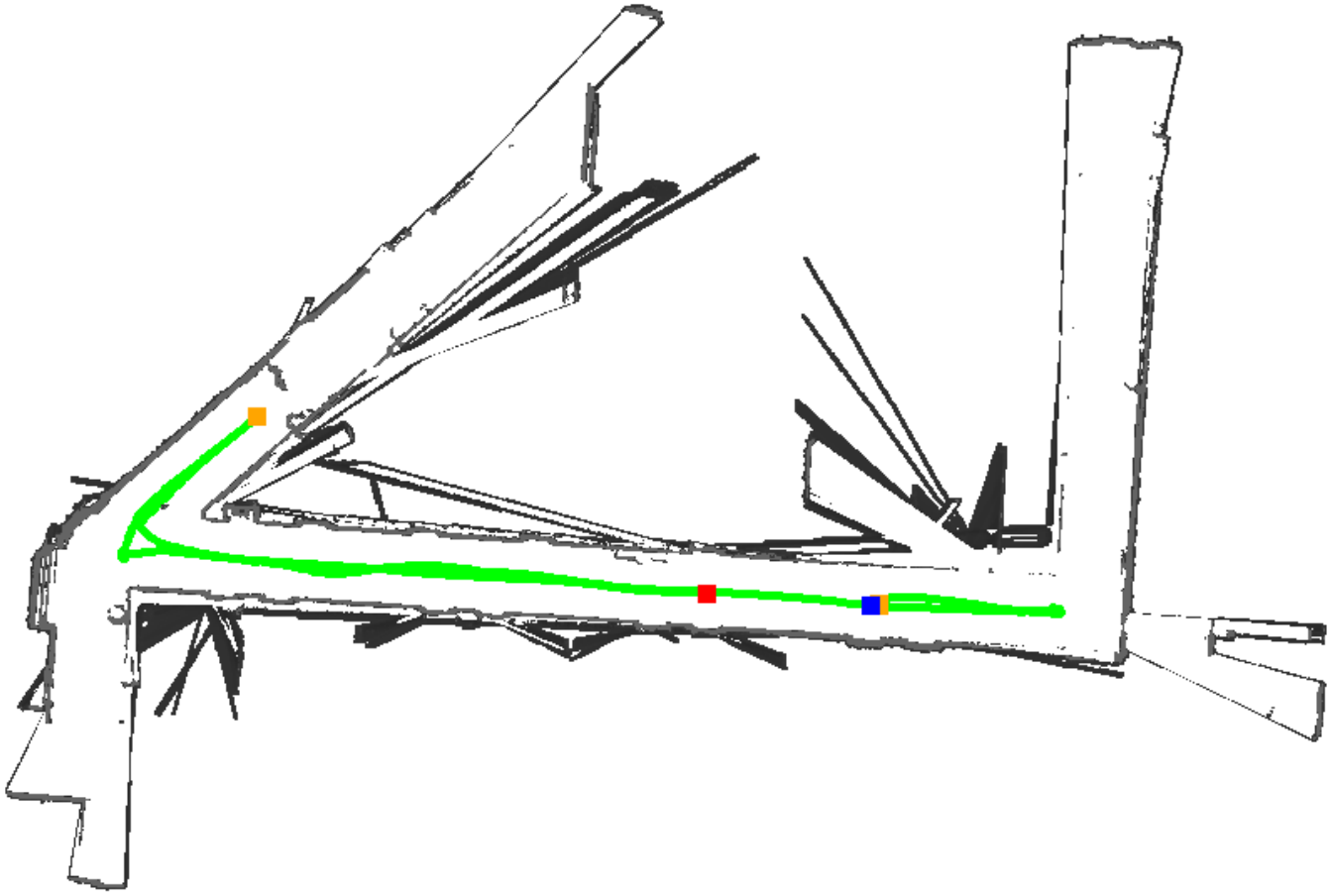

Fig. 33. Trial 33 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 34

Summary

Building: KNOY
Floor: 3
Volunteer: K
Goal: 313
Floor plan: Figure 71
SLAM map: Figure 34
Result: Success

Sequence of Behaviors

1) WANDER (209 s)
2) APPROACH_PERSON (3 s)
3) WANDER (1 s)
4) APPROACH_PERSON (9 s)
5) HOLD_CONVERSATION (30 s)
6) FOLLOW_DIRECTIONS (94 s)
7) NAVIGATE_DOOR (70 s)
8) WANDER (91 s)
9) APPROACH_PERSON (1 s)
10) HOLD_CONVERSATION (46 s)
11) FOLLOW_DIRECTIONS (7 s)
12) WANDER (40 s)
13) APPROACH_PERSON (0 s)
14) WANDER (2 s)
15) APPROACH_PERSON (4 s)
16) HOLD_CONVERSATION (37 s)
17) FOLLOW_DIRECTIONS (8 s)
18) WANDER (129 s)
19) APPROACH_PERSON (0 s)
20) WANDER (106 s)
21) APPROACH_PERSON (11 s)
22) HOLD_CONVERSATION (59 s)
23) FOLLOW_DIRECTIONS (52 s)
24) NAVIGATE_DOOR (244 s)
25) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 313?
Person:	sure room 313 you just continue for down this hallway. it's going to be your fourth door on the left. the fourth door on your left is room 313.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `goal-F`]
Conversation 2	
Robot:	Could you tell me how to navigate to 313?
Person:	sure room 313 will be to your right down the hallway on the right hand side.
Robot:	Which direction do I start out going?
Person:	you're going to go back up and go right so.
Robot:	What do I do after I turn right?
Person:	you're going to go straight down the hallway for probably about 100 ft and it's going to be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-R`]
Conversation 3	
Robot:	Could you tell me how to navigate to 313?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 313?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 313?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]
Conversation 4	
Robot:	Could you tell me how to navigate to 313?
Person:	app
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 313?
Person:	turn around take your first right go down the hallway about 30 to 50 ft and it will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-L`]

Navigate Door

Number of doors approached: 5
Number of doors labeled: 5

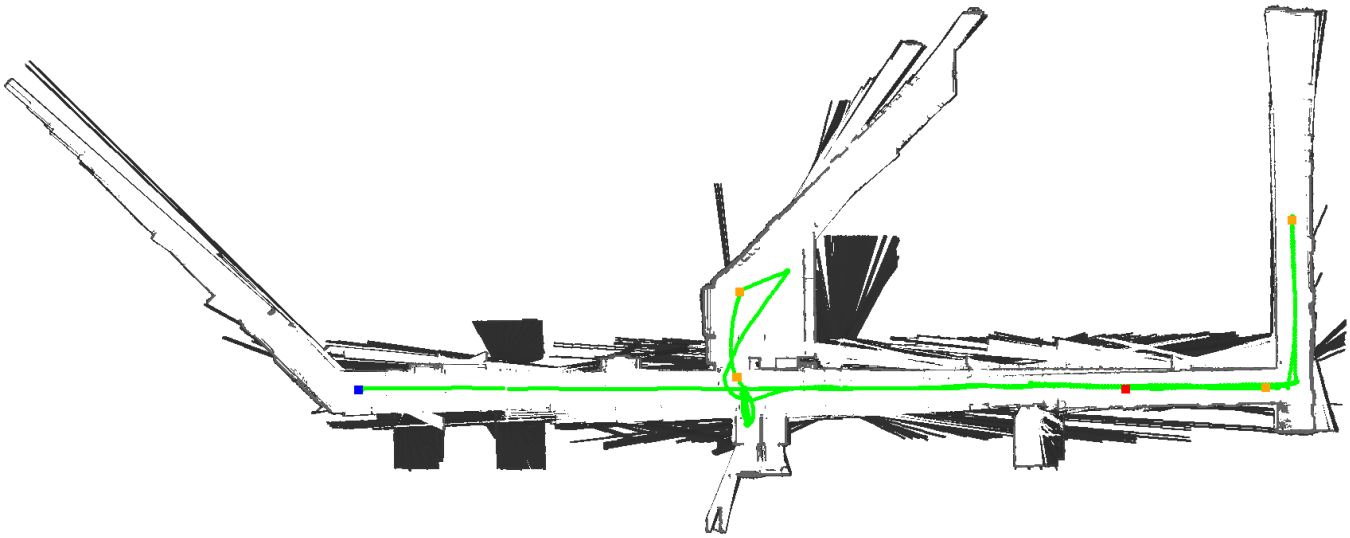

Fig. 34. Trial 34 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 35

Summary

Building: KNOY
Floor: 1
Volunteer: L
Goal: 186
Floor plan: Figure 69
SLAM map: Figure 35
Result: Success

Sequence of Behaviors

1) WANDER (129 s)
2) APPROACH_PERSON (12 s)
3) HOLD_CONVERSATION (111 s)
4) FOLLOW_DIRECTIONS (25 s)
5) WANDER (41 s)
6) APPROACH_PERSON (0 s)
7) WANDER (2 s)
8) APPROACH_PERSON (1 s)
9) HOLD_CONVERSATION (116 s)
10) FOLLOW_DIRECTIONS (19 s)
11) WANDER (124 s)
12) APPROACH_PERSON (2 s)
13) WANDER (1 s)
14) APPROACH_PERSON (7 s)
15) HOLD_CONVERSATION (15 s)
16) FOLLOW_DIRECTIONS (17 s)
17) NAVIGATE_DOOR (44 s)
18) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 169?
Person:	yes.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 169?
Person:	go.
Robot:	I did not understand that.
Robot:	Could you tell me how to navigate to 169?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	go straight for about 20 feet and
Robot:	I did not understand that.
Robot:	What do I do after turning around and going forward?
Person:	turn left.
Robot:	What do I do after I turn left?
Person:	go straight.
Robot:	I did not understand that.
Robot:	What do I do after I turn left?
Person:	drive straight
Robot:	I did not understand that.
Robot:	What do I do after I turn left?
Person:	move forward
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, □]

Conversation 2	
Robot:	Could you tell me how to navigate to 169?
Person:	yes.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 169?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 169?
Person:	turn around.
Robot:	What do I do after turning around and going forward?
Person:	turn around go straight until you reach the intersection turn.
Robot:	Sorry, I am a little confused. Could we start over? Could you tell me how to navigate to 169?
Person:	turn around and go forward.
Robot:	What do I do after turning around and going forward?
Person:	turn left at the intersection.
Robot:	What do I do after I turn left?
Person:	go forward.
Robot:	I did not understand that.
Robot:	What do I do after I turn left?
Person:	move forward
Robot:	I did not understand that.
Robot:	What do I do after I turn left?
Person:	what app
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, □]

Conversation 3	
Robot:	Could you tell me how to navigate to 169?
Person:	turn around and go straight there door is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

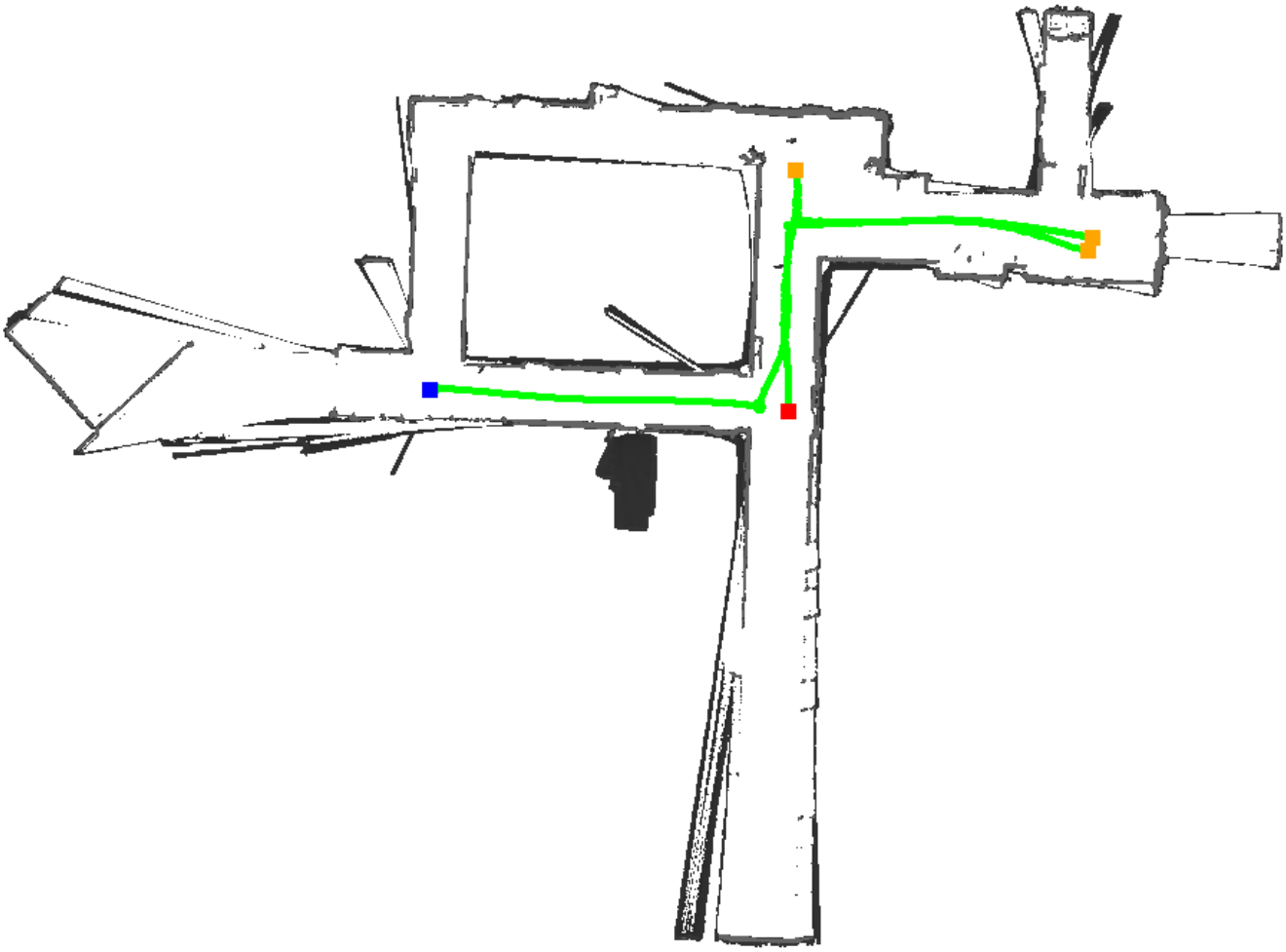

Fig. 35. Trial 35 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 36

Summary

Building: KNOY
Floor: 2
Volunteer: L
Goal: 261
Floor plan: Figure 70
SLAM map: Figure 36
Result: Success

Sequence of Behaviors

1) WANDER (14 s)
2) APPROACH_PERSON (1 s)
3) WANDER (10 s)
4) APPROACH_PERSON (1 s)
5) HOLD_CONVERSATION (88 s)
6) FOLLOW_DIRECTIONS (9 s)
7) WANDER (2 s)
8) APPROACH_PERSON (0 s)
9) WANDER (77 s)
10) APPROACH_PERSON (13 s)
11) HOLD_CONVERSATION (107 s)
12) FOLLOW_DIRECTIONS (60 s)
13) WANDER (38 s)
14) APPROACH_PERSON (10 s)
15) HOLD_CONVERSATION (59 s)
16) FOLLOW_DIRECTIONS (41 s)
17) WANDER (4 s)
18) APPROACH_PERSON (3 s)
19) HOLD_CONVERSATION (125 s)
20) FOLLOW_DIRECTIONS (9 s)
21) WANDER (35 s)
22) APPROACH_PERSON (18 s)
23) HOLD_CONVERSATION (19 s)
24) FOLLOW_DIRECTIONS (16 s)
25) NAVIGATE_DOOR (61 s)
26) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 261?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 261?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 261?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 2

Robot:	Could you tell me how to navigate to 261?
Person:	turn around go straight. turn right go straight. turn right go straight the doors on the left.
Robot:	What do I do after I turn left?
Person:	what app
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 261?
Person:	turn around go straight turn right at the elbow.
Robot:	What do I do after I turn right?
Person:	go straight.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go forward.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go.
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `elbow`, `either`, `elbow`, `right`, □]

Conversation 3

Robot:	Could you tell me how to navigate to 261?
Person:	keep going turn right and it's the first door on the left.
Robot:	What do I do after I turn left?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 261?
Person:	go straight turn right. it's the first door on the left.
Robot:	What do I do after I turn left?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 261?
Person:	go straight turn, right.
Robot:	What do I do after I turn right?
Person:	the door is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-L`]

Conversation 4

Robot:	Could you tell me how to navigate to 261?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 261?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	Could you tell me how to navigate to 261?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]

Conversation 5

Robot:	Could you tell me how to navigate to 261?
Person:	turn around go straight. your destination is at the end of the hall on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

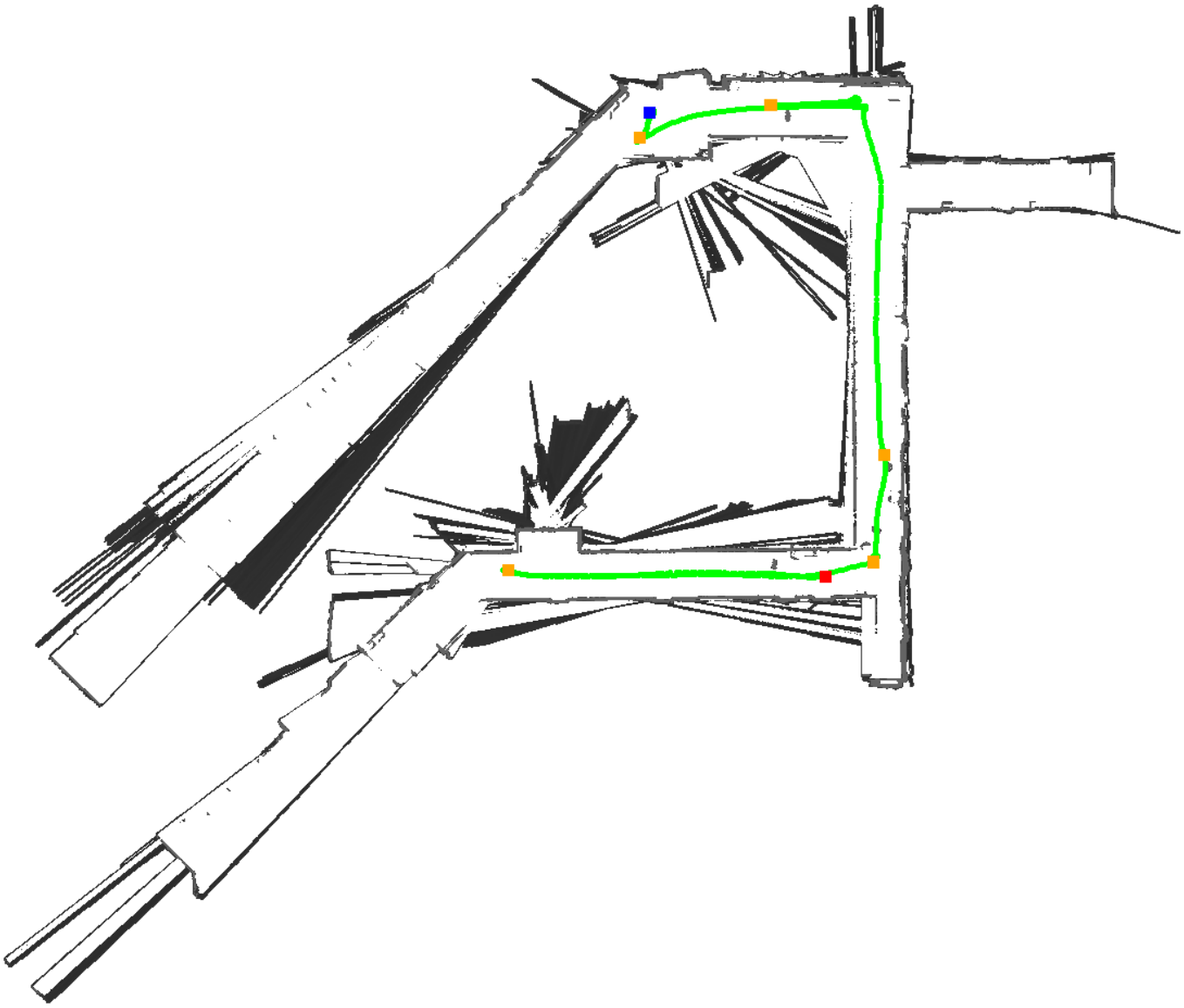

Fig. 36. Trial 36 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 37

Summary

Building: KNOY
Floor: 2
Volunteer: L
Goal: 287
Floor plan: Figure 70
SLAM map: Figure 37
Result: Success

Sequence of Behaviors

1) WANDER (214 s)
2) APPROACH_PERSON (6 s)
3) WANDER (6 s)
4) APPROACH_PERSON (1 s)
5) HOLD_CONVERSATION (27 s)
6) FOLLOW_DIRECTIONS (12 s)
7) WANDER (88 s)
8) APPROACH_PERSON (11 s)
9) HOLD_CONVERSATION (16 s)
10) FOLLOW_DIRECTIONS (16 s)
11) NAVIGATE_DOOR (29 s)
12) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 287?
Person:	turn right then turn left go straight turn left. and your destination is on the rake.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `int-L`, `left`, `int-L`, `left`, `goal-F`]
Conversation 2	
Robot:	Could you tell me how to navigate to 287?
Person:	turn around go straight. your destination is the second door on the right?
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 1
Number of doors labeled: 1

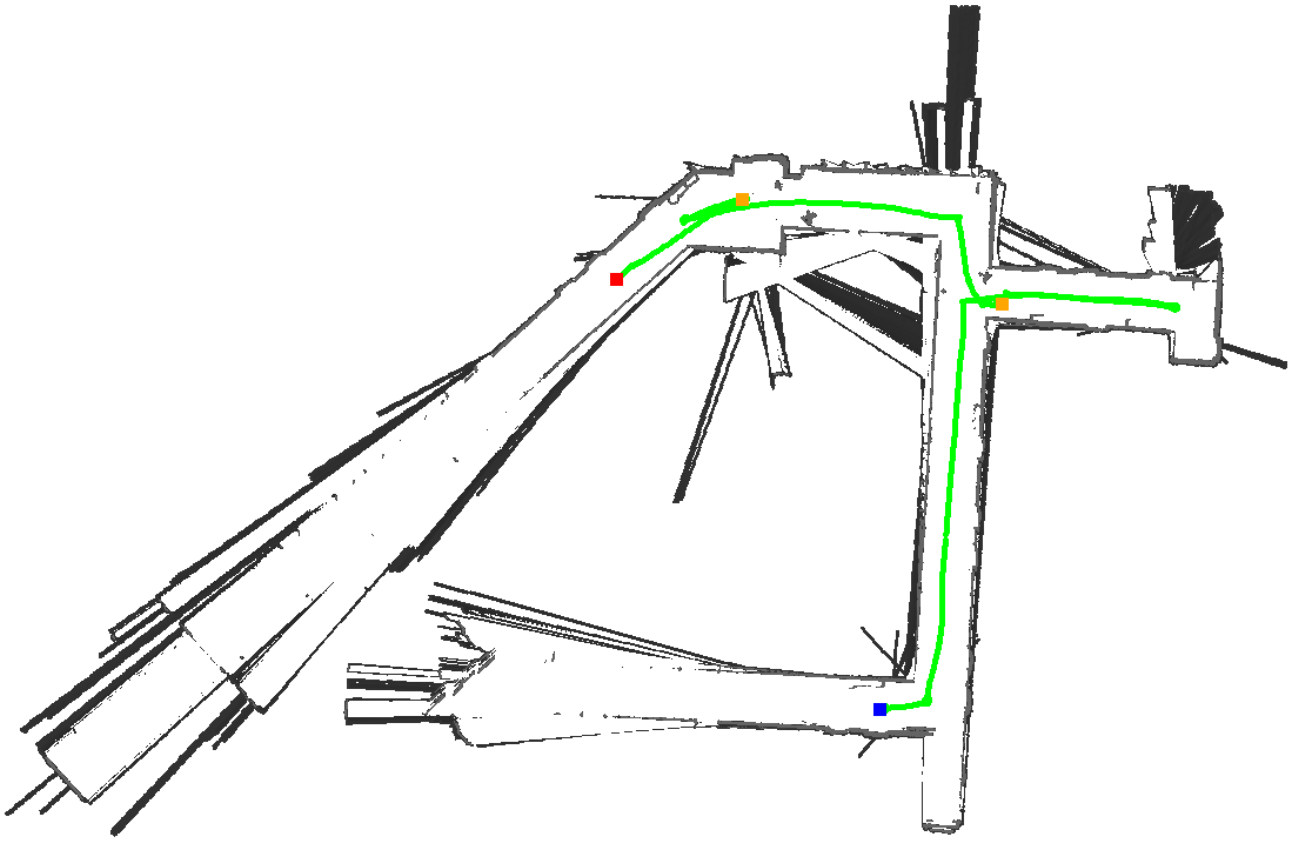

Fig. 37. Trial 37 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 38

Summary

Building: KNOY
Floor: 3
Volunteer: L
Goal: 314
Floor plan: Figure 71
SLAM map: Figure 38
Result: Failure
Reason: The robot didn't see the goal door, but did see the one immediately following it. It stopped at this second door's near doorpost, panned the camera and read the door tag of the goal door, then drove to the far door post (of the second door), read the door tag of the second door, and declared success.

Sequence of Behaviors

1) WANDER (300 s)
2) APPROACH_PERSON (3 s)
3) WANDER (8 s)
4) APPROACH_PERSON (6 s)
5) HOLD_CONVERSATION (19 s)
6) FOLLOW_DIRECTIONS (7 s)
7) WANDER (2 s)
8) APPROACH_PERSON (2 s)
9) HOLD_CONVERSATION (19 s)
10) FOLLOW_DIRECTIONS (19 s)
11) NAVIGATE_DOOR (64 s)
12) WANDER (16 s)
13) APPROACH_PERSON (13 s)
14) WANDER (2 s)
15) APPROACH_PERSON (4 s)
16) HOLD_CONVERSATION (131 s)
17) FOLLOW_DIRECTIONS (159 s)
18) WANDER (18 s)
19) APPROACH_PERSON (70 s)
20) WANDER (2 s)
21) APPROACH_PERSON (16 s)
22) HOLD_CONVERSATION (15 s)
23) FOLLOW_DIRECTIONS (1 s)
24) NAVIGATE_DOOR (38 s)
25) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 314?
Person:	turn around go straight. your destination is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]
Conversation 2	
Robot:	Could you tell me how to navigate to 314?
Person:	turn around go straight down the hall at your destination is on the left at the end of the hall.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]
Conversation 3	
Robot:	Could you tell me how to navigate to 314?
Person:	what's up, the directions to the store down there in the world?
Robot:	What do I do after starting to go forward?
Person:	go to the door on the left.
Robot:	What do I do after I turn left?
Person:	stop
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	go down the hall to the door on the left.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	stay still.
Robot:	I did not understand that.
Robot:	What do I do after I turn left (this being the second left I take)?
Person:	turn right.
Robot:	What do I do after I turn right?
Person:	keep going.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	app
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	app
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `int-L`, `left`, `int-R`, `right`, □]

Conversation 4	
Robot:	Could you tell me how to navigate to 314?
Person:	go straight the door is your destination is the first on the right?
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Navigate Door

Number of doors approached: 1
Number of doors labeled: 1

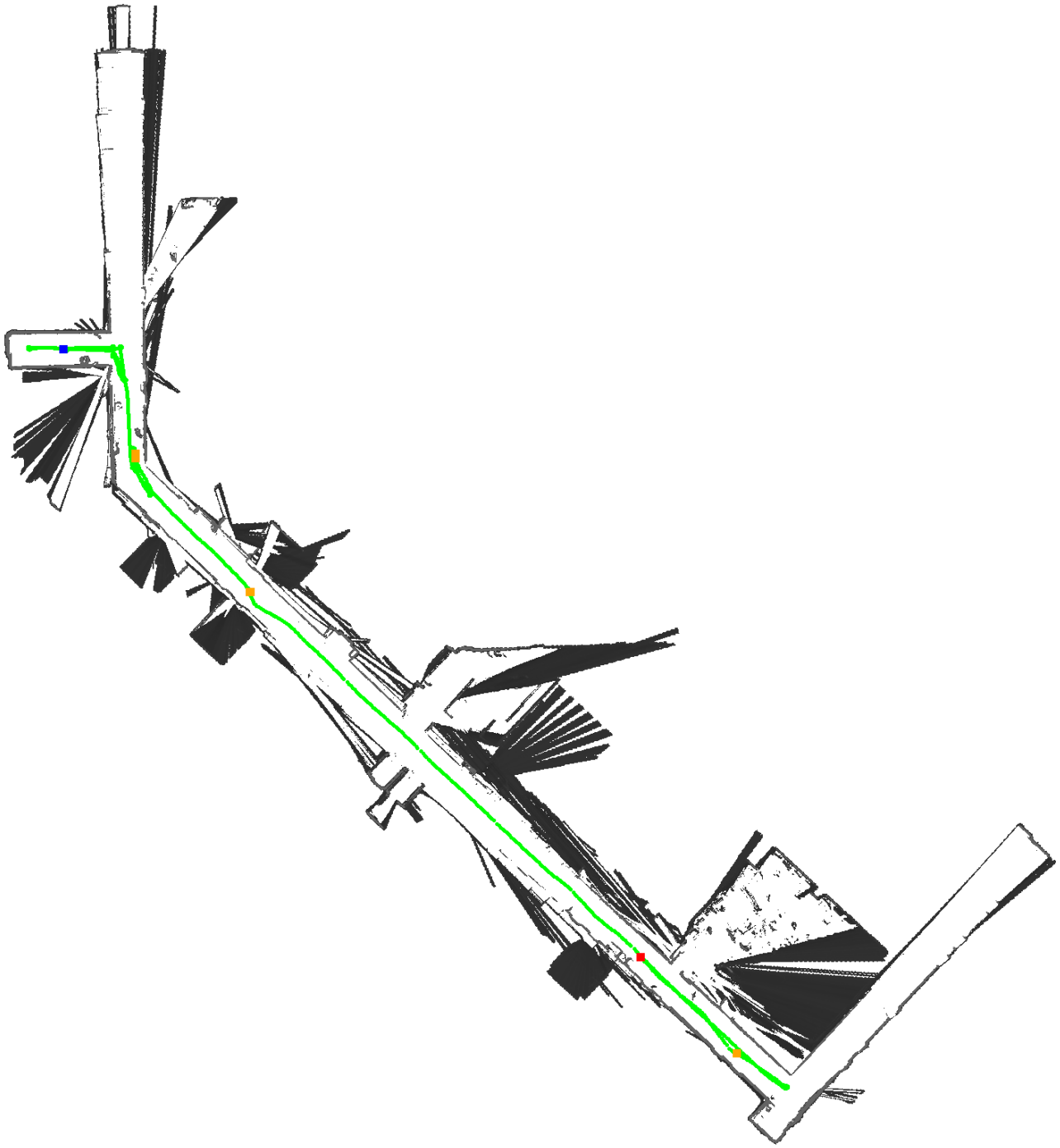

Fig. 38. Trial 38 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 39

Summary

Building: KNOY
Floor: 4
Volunteer: L
Goal: 445
Floor plan: Figure 72
SLAM map: Figure 39
Result: Success

Sequence of Behaviors

1) WANDER (164 s)
2) APPROACH_PERSON (12 s)
3) WANDER (4 s)
4) APPROACH_PERSON (4 s)
5) WANDER (1 s)
6) APPROACH_PERSON (1 s)
7) WANDER (0 s)
8) APPROACH_PERSON (12 s)
9) WANDER (1 s)
10) APPROACH_PERSON (1 s)
11) WANDER (2 s)
12) APPROACH_PERSON (0 s)
13) WANDER (81 s)
14) APPROACH_PERSON (5 s)
15) HOLD_CONVERSATION (22 s)
16) FOLLOW_DIRECTIONS (17 s)
17) NAVIGATE_DOOR (132 s)
18) WANDER (1 s)
19) APPROACH_PERSON (1 s)
20) HOLD_CONVERSATION (18 s)
21) FOLLOW_DIRECTIONS (1 s)
22) NAVIGATE_DOOR (244 s)
23) WANDER (34 s)
24) APPROACH_PERSON (1 s)
25) WANDER (1 s)
26) APPROACH_PERSON (9 s)
27) HOLD_CONVERSATION (16 s)
28) FOLLOW_DIRECTIONS (0 s)
29) NAVIGATE_DOOR (73 s)
30) WANDER (4 s)
31) APPROACH_PERSON (8 s)
32) HOLD_CONVERSATION (72 s)
33) FOLLOW_DIRECTIONS (16 s)
34) WANDER (69 s)
35) APPROACH_PERSON (2 s)
36) WANDER (13 s)
37) APPROACH_PERSON (27 s)
38) HOLD_CONVERSATION (17 s)
39) FOLLOW_DIRECTIONS (17 s)
40) NAVIGATE_DOOR (47 s)
41) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 445?
Person:	turn around go straight. your destination is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]
Conversation 2	
Robot:	Could you tell me how to navigate to 445?
Person:	continue straight your destination is the first door on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]
Conversation 3	
Robot:	Could you tell me how to navigate to 445?
Person:	continue straight your destination is the last door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-L`]
Conversation 4	
Robot:	Could you tell me how to navigate to 445?
Person:	turn left continue straight and the door your destination is the last door on the left.
Robot:	Which direction do I start out going?
Person:	google apps
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Which direction do I start out going?
Person:	left
Robot:	Thanks for your help. Have a great day!
Plan:	[`left`, `end`, `left`, `end`, `forward`, `goal-L`]
Conversation 5	
Robot:	Could you tell me how to navigate to 445?
Person:	turn around go straight. your destination is the third door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Navigate Door

Number of doors approached: 6
Number of doors labeled: 5

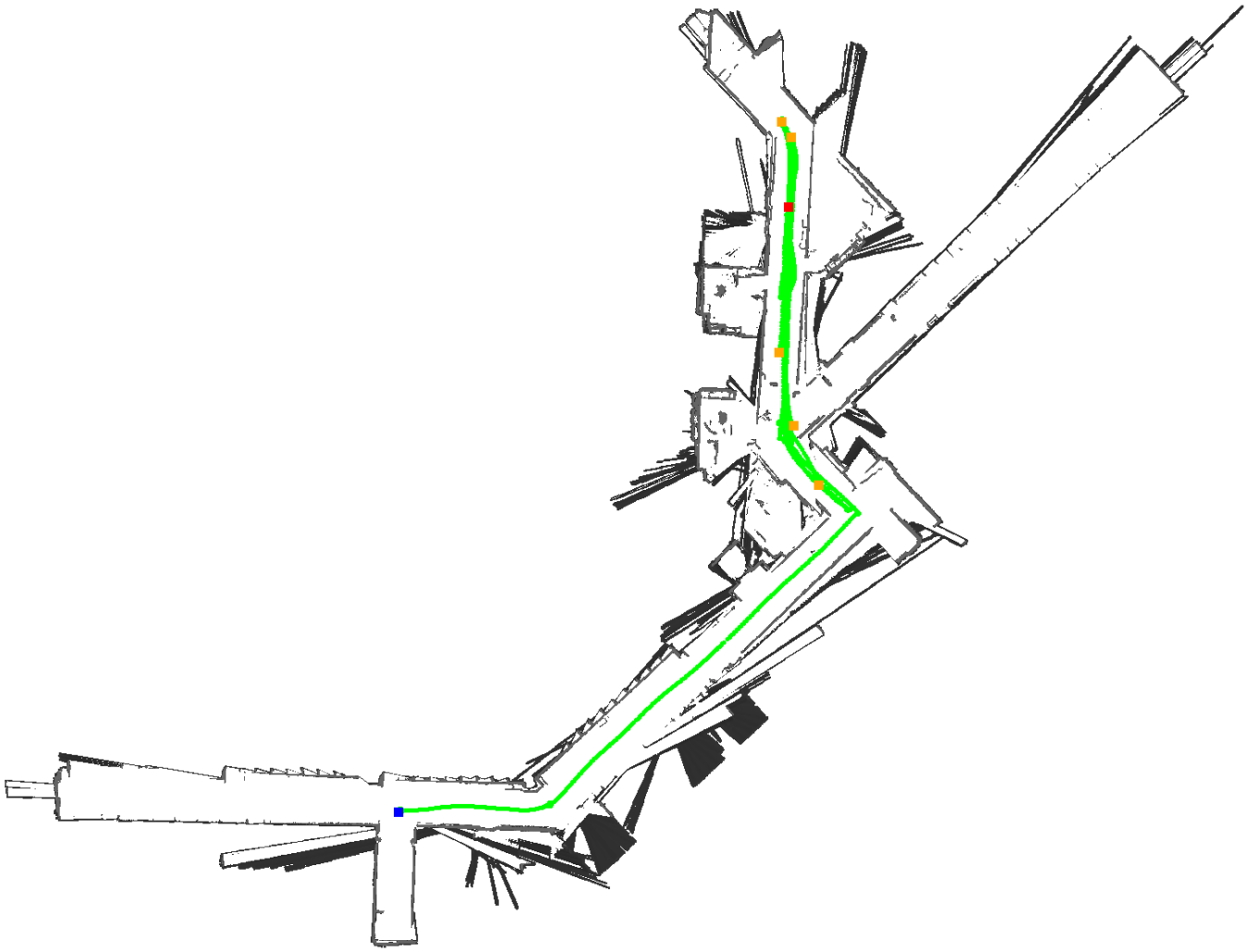

Fig. 39. Trial 39 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 40

Summary

Building: ME
Floor: 1
Volunteer: B
Goal: 1061
Floor plan: Figure 74
SLAM map: Figure 40
Result: Success

Sequence of Behaviors

1) WANDER (41 s)
2) APPROACH_PERSON (6 s)
3) HOLD_CONVERSATION (17 s)
4) FOLLOW_DIRECTIONS (8 s)
5) WANDER (8 s)
6) APPROACH_PERSON (4 s)
7) WANDER (4 s)
8) APPROACH_PERSON (7 s)
9) HOLD_CONVERSATION (80 s)
10) FOLLOW_DIRECTIONS (9 s)
11) WANDER (80 s)
12) APPROACH_PERSON (0 s)
13) WANDER (25 s)
14) APPROACH_PERSON (10 s)
15) HOLD_CONVERSATION (54 s)
16) FOLLOW_DIRECTIONS (16 s)
17) NAVIGATE_DOOR (68 s)
18) WANDER (29 s)
19) APPROACH_PERSON (9 s)
20) HOLD_CONVERSATION (32 s)
21) FOLLOW_DIRECTIONS (8 s)
22) WANDER (7 s)
23) APPROACH_PERSON (8 s)
24) HOLD_CONVERSATION (24 s)
25) FOLLOW_DIRECTIONS (25 s)
26) NAVIGATE_DOOR (100 s)
27) WANDER (17 s)
28) APPROACH_PERSON (6 s)
29) HOLD_CONVERSATION (33 s)
30) FOLLOW_DIRECTIONS (9 s)
31) WANDER (134 s)
32) APPROACH_PERSON (0 s)
33) WANDER (7 s)
34) APPROACH_PERSON (14 s)
35) HOLD_CONVERSATION (20 s)
36) FOLLOW_DIRECTIONS (57 s)
37) NAVIGATE_DOOR (204 s)
38) WANDER (21 s)
39) APPROACH_PERSON (11 s)
40) HOLD_CONVERSATION (77 s)
41) FOLLOW_DIRECTIONS (17 s)
42) NAVIGATE_DOOR (100 s)
43) WANDER (32 s)
44) APPROACH_PERSON (5 s)
45) HOLD_CONVERSATION (18 s)
46) FOLLOW_DIRECTIONS (47 s)
47) NAVIGATE_DOOR (32 s)
48) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 1061?
Person:	yeah, turn around and go straight to the end of the hall and your goal is there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `goal-F`]

Conversation 2

Robot:	Could you tell me how to navigate to 1061?
Person:	yes, turn around and go straight to the ender hall and your goal is there?
Robot:	What do I do after turning around and going forward?
Person:	go to the end of the hall and the goal is there.
Robot:	What do I do after getting to the first end of the hall?
Person:	the door is there.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after getting to the first end of the hall?
Person:	the goal is there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `goal-F`]

Conversation 3

Robot:	Could you tell me how to navigate to 1061?
Person:	the bulls in this hallway
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 1061?
Person:	turn around and the bowl is on the right hand side.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 4

Robot:	Could you tell me how to navigate to 1061?
Person:	turn around go straight and the bowl is at the end of the hall.
Robot:	What do I do after turning around and going forward?
Person:	the ball is at the end of the hall.
Robot:	What do I do after getting to the first end of the hall?
Person:	the goal is there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `end`, `goal-F`]

Conversation 5

Robot:	Could you tell me how to navigate to 1061?
Person:	go straight.
Robot:	What do I do after starting to go forward?
Person:	turn right at the end of the hall and the bowl is on the left hand side.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `right`, `goal-L`]

Conversation 6

Robot:	Could you tell me how to navigate to 1061?
Person:	go straight to the end.
Robot:	What do I do after getting to the first end of the hall?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after getting to the first end of the hall?
Person:	the goal is on the right hand side.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `goal-R`]

Conversation 7

Robot:	Could you tell me how to navigate to 1061?
Person:	yeah straight to the end of the hall and turn right.
Robot:	What do I do after I turn right?
Person:	and the goal is
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `right`, `goal-F`]

Conversation 8	
Robot:	Could you tell me how to navigate to 1061?
Person:	turn around go straight and the goal is there.
Robot:	What do I do after turning around and going forward?
Person:	the gold on the right hand side
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to 1061?
Person:	turn around go straight and the blues on the
Robot:	What do I do after turning around and going forward?
Person:	the door is there the bull is there? i don't know.
Robot:	Sorry about that. Let me ask my previous question.
Robot:	Could you tell me how to navigate to 1061?
Person:	turn around go straight and the goal is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 9	
Robot:	Could you tell me how to navigate to 1061?
Person:	turn around go state farm. right and the bowl is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-L`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

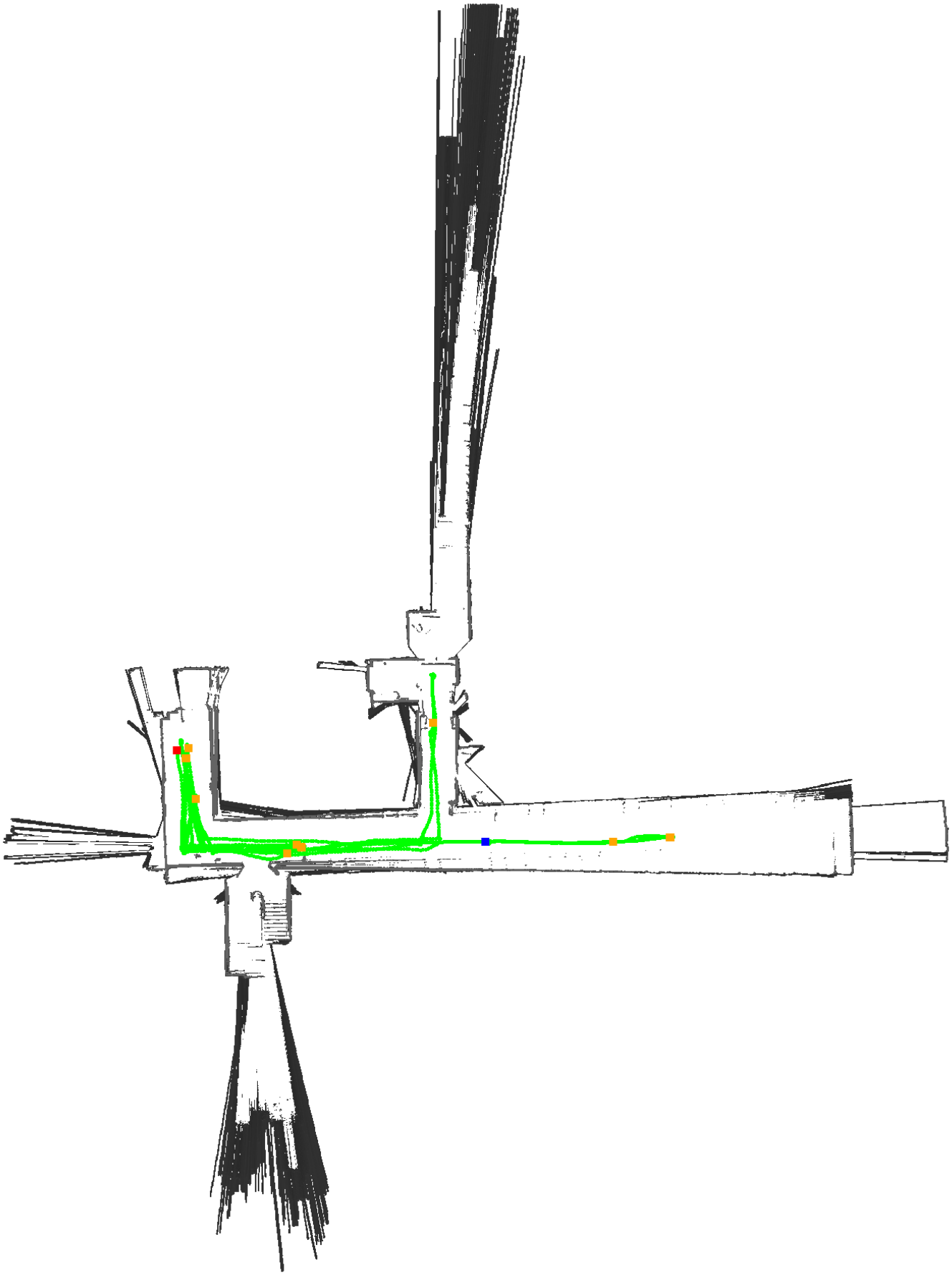

Fig. 40. Trial 40 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 41

Summary

Building: ME
Floor: 0
Volunteer: B
Goal: g040
Floor plan: Figure 73
SLAM map: Figure 41
Result: Failure
Reason: The robot failed to detect the goal door.

Sequence of Behaviors

1) WANDER (1 s)
2) APPROACH_PERSON (0 s)
3) WANDER (21 s)
4) APPROACH_PERSON (1 s)
5) WANDER (1 s)
6) APPROACH_PERSON (5 s)
7) HOLD_CONVERSATION (22 s)
8) FOLLOW_DIRECTIONS (34 s)
9) NAVIGATE_DOOR (314 s)
10) WANDER (1 s)
11) APPROACH_PERSON (1 s)
12) WANDER (1 s)
13) APPROACH_PERSON (4 s)
14) WANDER (2 s)
15) APPROACH_PERSON (12 s)
16) HOLD_CONVERSATION (14 s)
17) FOLLOW_DIRECTIONS (0 s)
18) NAVIGATE_DOOR (371 s)
19) WANDER (–)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to g040?
Person:	yeah, turn around go straight and take the first right go straight and the goal is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-R`]
Conversation 2	
Robot:	Could you tell me how to navigate to g040?
Person:	go straight and the bowl is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]

Navigate Door

Number of doors approached: 8
Number of doors labeled: 2

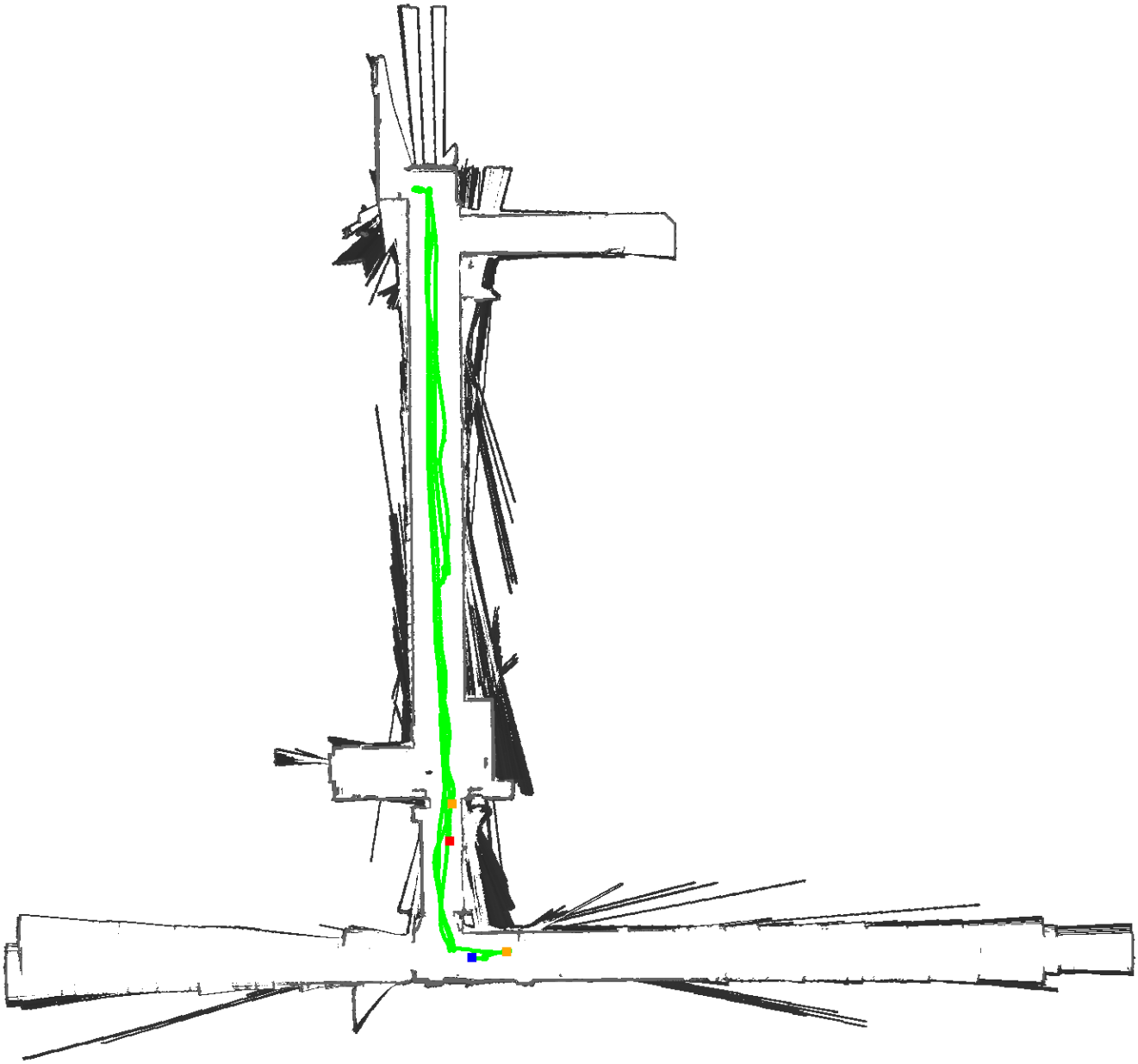

Fig. 41. Trial 41 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 42

Summary

Building: ME
Floor: 0
Volunteer: B
Goal: g005
Floor plan: Figure 73
SLAM map: Figure 42
Result: Failure
Reason: The robot failed to detect the goal door.

Sequence of Behaviors

1) WANDER (2 s)
2) APPROACH_PERSON (5 s)
3) WANDER (0 s)
4) APPROACH_PERSON (9 s)
5) HOLD_CONVERSATION (17 s)
6) FOLLOW_DIRECTIONS (37 s)
7) WANDER (30 s)
8) APPROACH_PERSON (0 s)
9) WANDER (2 s)
10) APPROACH_PERSON (5 s)
11) HOLD_CONVERSATION (14 s)
12) FOLLOW_DIRECTIONS (13 s)
13) WANDER (14 s)
14) APPROACH_PERSON (11 s)
15) HOLD_CONVERSATION (14 s)
16) FOLLOW_DIRECTIONS (1 s)
17) NAVIGATE_DOOR (281 s)
18) WANDER (17 s)
19) APPROACH_PERSON (13 s)
20) HOLD_CONVERSATION (16 s)
21) FOLLOW_DIRECTIONS (1 s)
22) NAVIGATE_DOOR (98 s)
23) WANDER (24 s)
24) APPROACH_PERSON (0 s)
25) WANDER (13 s)
26) APPROACH_PERSON (12 s)
27) HOLD_CONVERSATION (42 s)
28) FOLLOW_DIRECTIONS (17 s)
29) NAVIGATE_DOOR (306 s)
30) WANDER (7 s)
31) APPROACH_PERSON (–)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to g005?
Person:	yeah, turn left go straight and the bowl is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `goal-R`]
Conversation 2	
Robot:	Could you tell me how to navigate to g005?
Person:	yeah, turn around and the goal is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]
Conversation 3	
Robot:	Could you tell me how to navigate to g005?
Person:	go straight and the goal is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]
Conversation 4	
Robot:	Could you tell me how to navigate to g005?
Person:	yeah straight ahead. the goal is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-L`]
Conversation 5	
Robot:	Could you tell me how to navigate to g005?
Person:	yeah, turn around and the blues on your right.
Robot:	What do I do after I turn right?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right?
Person:	start over
Robot:	Sorry about that. Let's start over.
Robot:	Could you tell me how to navigate to g005?
Person:	turn around go street and bowl is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 6
Number of doors labeled: 3

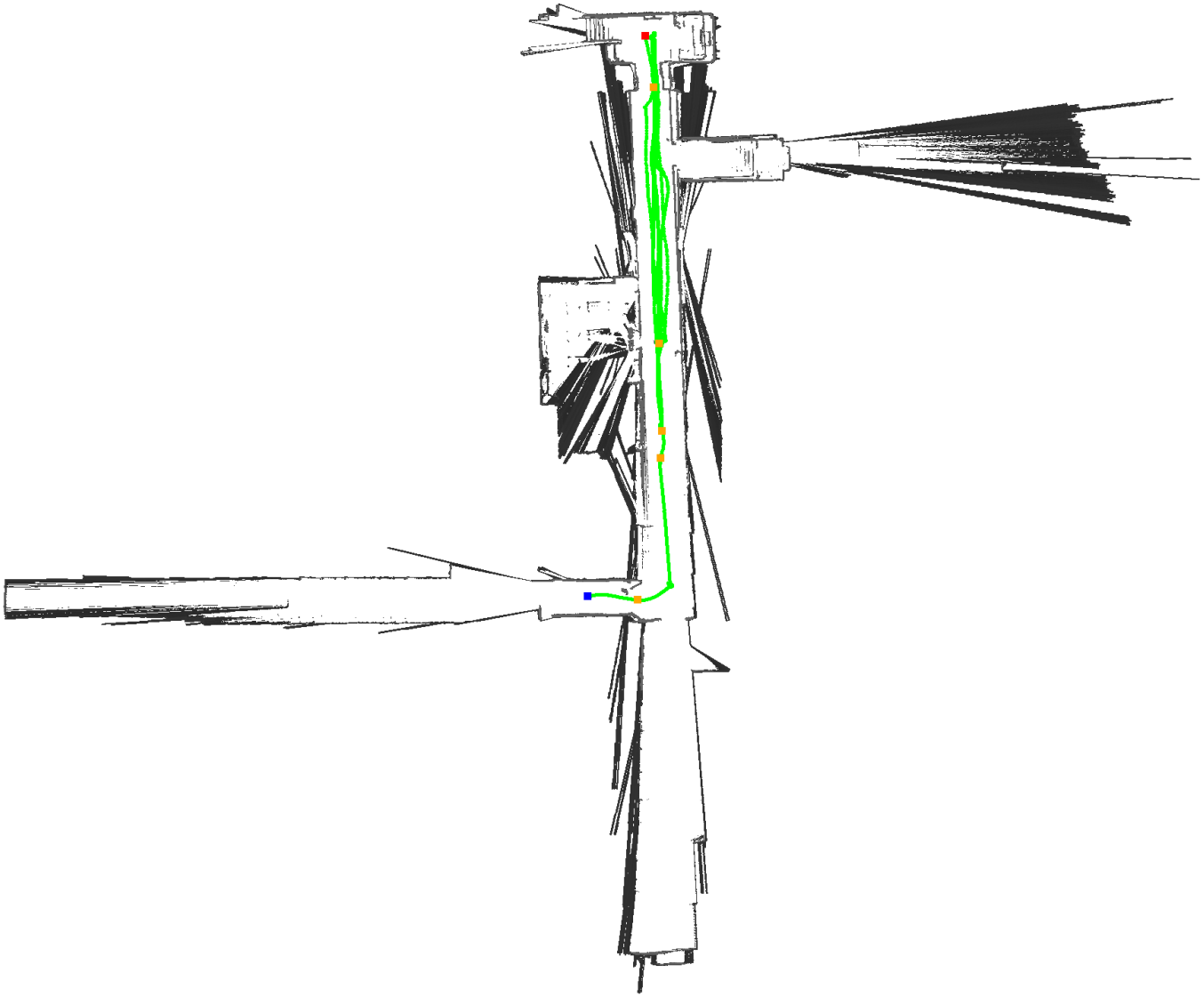

Fig. 42. Trial 42 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 43

Summary

Building: KNOY
Floor: 1
Volunteer: B
Goal: 191
Floor plan: Figure 69
SLAM map: Figure 43
Result: Success

Sequence of Behaviors

1) WANDER (1 s)
2) APPROACH_PERSON (0 s)
3) WANDER (67 s)
4) APPROACH_PERSON (3 s)
5) HOLD_CONVERSATION (26 s)
6) FOLLOW_DIRECTIONS (28 s)
7) WANDER (26 s)
8) APPROACH_PERSON (2 s)
9) HOLD_CONVERSATION (18 s)
10) FOLLOW_DIRECTIONS (12 s)
11) NAVIGATE_DOOR (76 s)
12) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 191?
Person:	yeah, go straight.
Robot:	What do I do after starting to go forward?
Person:	turn left and the goal is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `goal-R`]
Conversation 2	
Robot:	Could you tell me how to navigate to 191?
Person:	yes, go straight turn left and the bowl is on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `goal-R`]

Navigate Door

Number of doors approached: 1
Number of doors labeled: 1

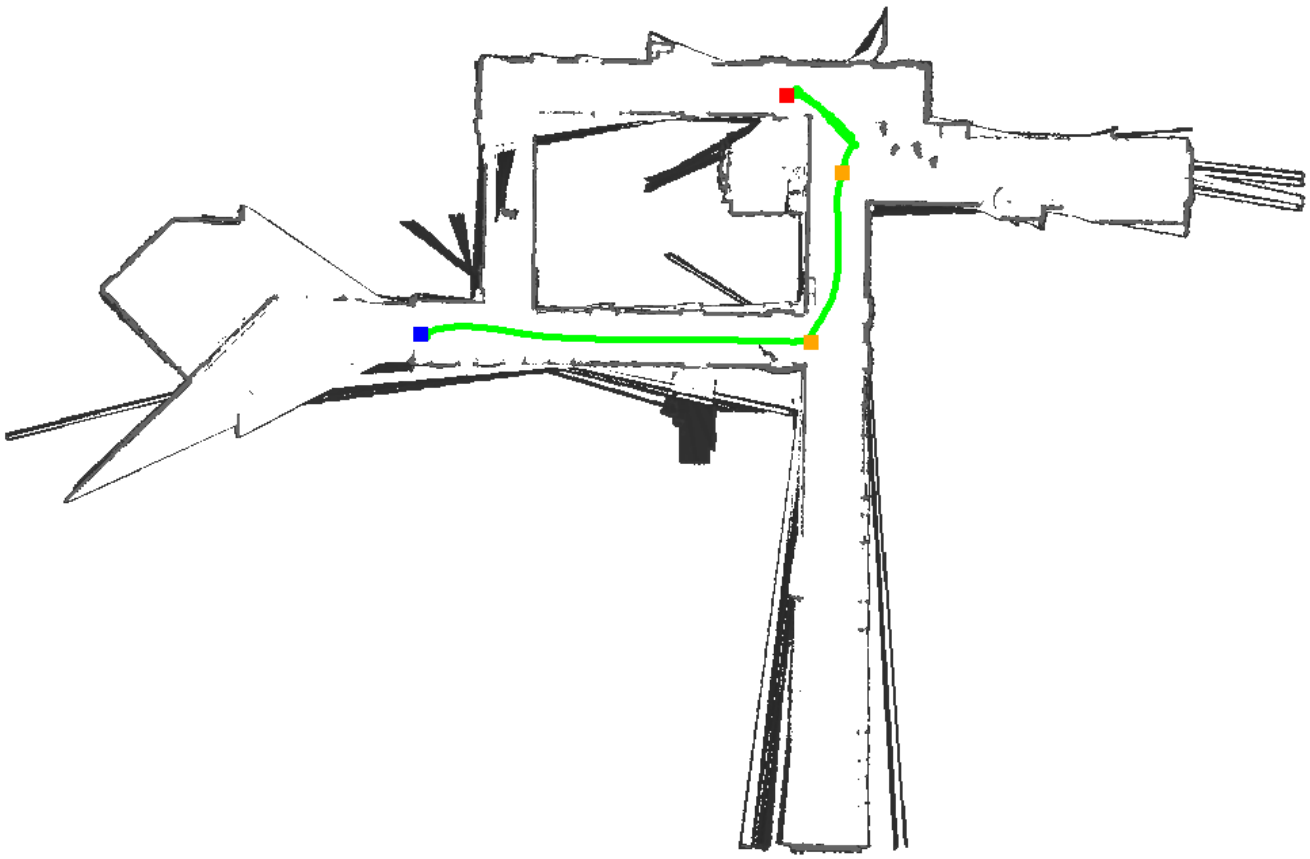

Fig. 43. Trial 43 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 44

Summary

Building: KNOY
Floor: 2
Volunteer: B
Goal: 275
Floor plan: Figure 70
SLAM map: Figure 44
Result: Success

Sequence of Behaviors

1) WANDER (100 s)
2) APPROACH_PERSON (2 s)
3) WANDER (3 s)
4) APPROACH_PERSON (5 s)
5) HOLD_CONVERSATION (37 s)
6) FOLLOW_DIRECTIONS (9 s)
7) WANDER (1 s)
8) APPROACH_PERSON (1 s)
9) WANDER (3 s)
10) APPROACH_PERSON (16 s)
11) HOLD_CONVERSATION (20 s)
12) FOLLOW_DIRECTIONS (40 s)
13) NAVIGATE_DOOR (69 s)
14) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 275?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 275?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 275?
Person:	
Robot:	I did not hear you.
Robot:	I was not able to understand your directions. Thanks anyway. Good bye!
Plan:	[□]
Conversation 2	
Robot:	Could you tell me how to navigate to 275?
Person:	yes, turn around go straight turn left and the goal be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

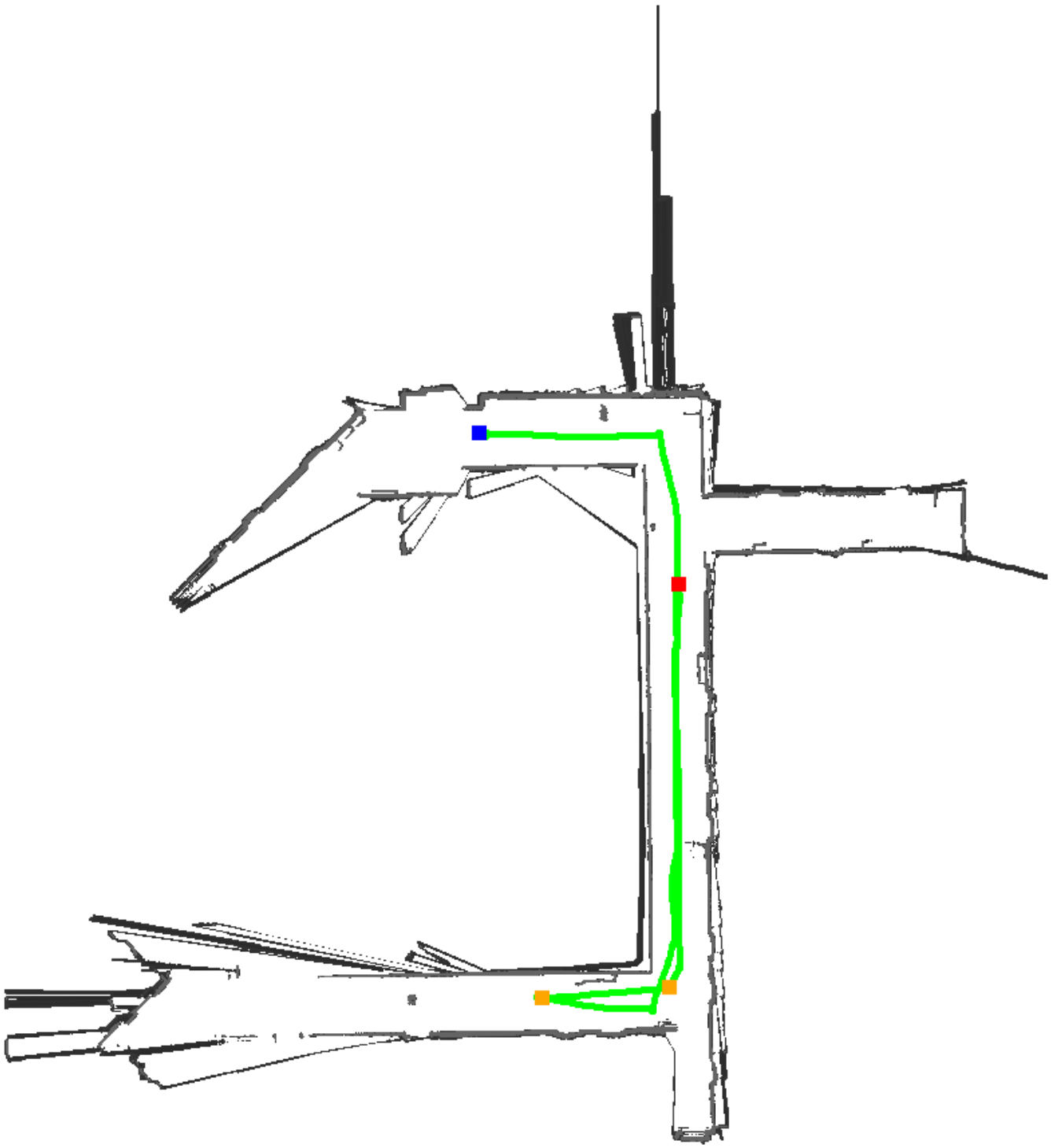

Fig. 44. Trial 44 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 45

Summary

Building: KNOY
Floor: 1
Volunteer: M
Goal: 169
Floor plan: Figure 69
SLAM map: Figure 45
Result: Success

Sequence of Behaviors

1) WANDER (28 s)
2) APPROACH_PERSON (21 s)
3) HOLD_CONVERSATION (42 s)
4) FOLLOW_DIRECTIONS (31 s)
5) NAVIGATE_DOOR (60 s)
6) WANDER (31 s)
7) APPROACH_PERSON (0 s)
8) WANDER (5 s)
9) APPROACH_PERSON (7 s)
10) WANDER (1 s)
11) APPROACH_PERSON (1 s)
12) WANDER (1 s)
13) APPROACH_PERSON (5 s)
14) WANDER (0 s)
15) APPROACH_PERSON (6 s)
16) HOLD_CONVERSATION (44 s)
17) FOLLOW_DIRECTIONS (17 s)
18) NAVIGATE_DOOR (55 s)
19) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 169?
Person:	it is behind you and then go left.
Robot:	Which direction do I start out going?
Person:	turn around and then go left.
Robot:	Sorry, I am a little confused. Could we start over? Could you tell me how to navigate to 169?
Person:	turn around and go left.
Robot:	What do I do after I turn left?
Person:	it will be the second door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-L`]

Conversation 2	
Robot:	Could you tell me how to navigate to 169?
Person:	yep, it's behind you on the right.
Robot:	What do I do after I turn right?
Person:	no, it's behind you and the door will be on the right.
Robot:	Sorry about that. Let me ask my previous question.
Robot:	Could you tell me how to navigate to 169?
Person:	turn around and go that way.
Robot:	What do I do after turning around and going forward?
Person:	it will be on the door will be on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 2
Number of doors labeled: 2

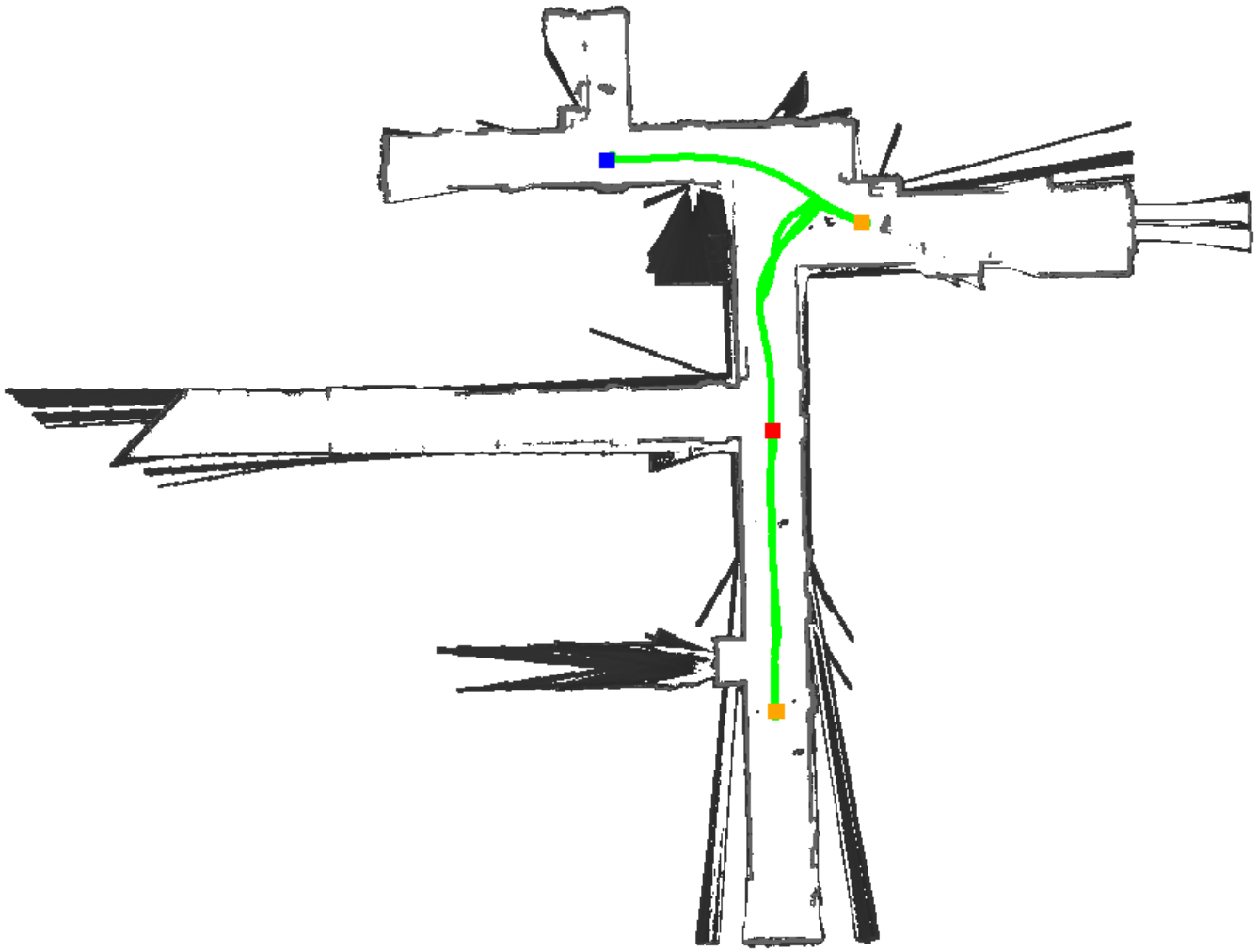

Fig. 45. Trial 45 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 46

Summary

Building: KNOY
Floor: 2
Volunteer: M
Goal: 257
Floor plan: Figure 70
SLAM map: Figure 46
Result: Success

Sequence of Behaviors

1) WANDER (58 s)
2) APPROACH_PERSON (11 s)
3) HOLD_CONVERSATION (58 s)
4) FOLLOW_DIRECTIONS (71 s)
5) WANDER (3 s)
6) APPROACH_PERSON (4 s)
7) HOLD_CONVERSATION (106 s)
8) FOLLOW_DIRECTIONS (41 s)
9) WANDER (8 s)
10) APPROACH_PERSON (0 s)
11) WANDER (1 s)
12) APPROACH_PERSON (2 s)
13) HOLD_CONVERSATION (77 s)
14) FOLLOW_DIRECTIONS (1 s)
15) NAVIGATE_DOOR (169 s)
16) WANDER (16 s)
17) APPROACH_PERSON (3 s)
18) HOLD_CONVERSATION (17 s)
19) FOLLOW_DIRECTIONS (58 s)
20) WANDER (1 s)
21) APPROACH_PERSON (3 s)
22) HOLD_CONVERSATION (16 s)
23) FOLLOW_DIRECTIONS (77 s)
24) WANDER (6 s)
25) APPROACH_PERSON (2 s)
26) HOLD_CONVERSATION (75 s)
27) FOLLOW_DIRECTIONS (9 s)
28) NAVIGATE_DOOR (179 s)
29) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 257?
Person:	straight ahead go and then turn right.
Robot:	What do I do after I turn right?
Person:	the door will be in that hallway.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn right?
Person:	the door will be on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-L`]

Conversation 2

Robot:	Could you tell me how to navigate to 257?
Person:	turn right. so here just stand like right there.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	
Robot:	I did not hear you.
Robot:	What do I do after I turn right (this being the second right I take)?
Person:	⟨silence⟩
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `int-R`, `right`, □]

Conversation 3	
Robot:	Could you tell me how to navigate to 257?
Person:	right there next door on your left.
Robot:	What do I do after I turn left?
Person:	no, that's incorrect. the door is right there on your left.
Robot:	Sorry about that. Let me ask my previous question.
Robot:	Could you tell me how to navigate to 257?
Person:	it's right up ahead on the left.
Robot:	What do I do after I turn left?
Person:	no, the door is up ahead on your left.
Robot:	Sorry about that. Let me ask my previous question.
Robot:	Could you tell me how to navigate to 257?
Person:	go straight ahead.
Robot:	What do I do after starting to go forward?
Person:	it's on your left.
Robot:	What do I do after I turn left?
Person:	no, go straight ahead. the door is on the left.
Robot:	Sorry about that. Let me ask my previous question.
Robot:	What do I do after starting to go forward?
Person:	the door will be right there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-R`]
Conversation 4	
Robot:	Could you tell me how to navigate to 257?
Person:	yep, the turn around go right and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-R`]
Conversation 5	
Robot:	Could you tell me how to navigate to 257?
Person:	yeah, go to go, right and the door will be on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-R`]
Conversation 6	
Robot:	Could you tell me how to navigate to 257?
Person:	turn about to 70 go backwards and the door will be on the left.
Plan:	[]

Navigate Door

Number of doors approached: 5
Number of doors labeled: 5

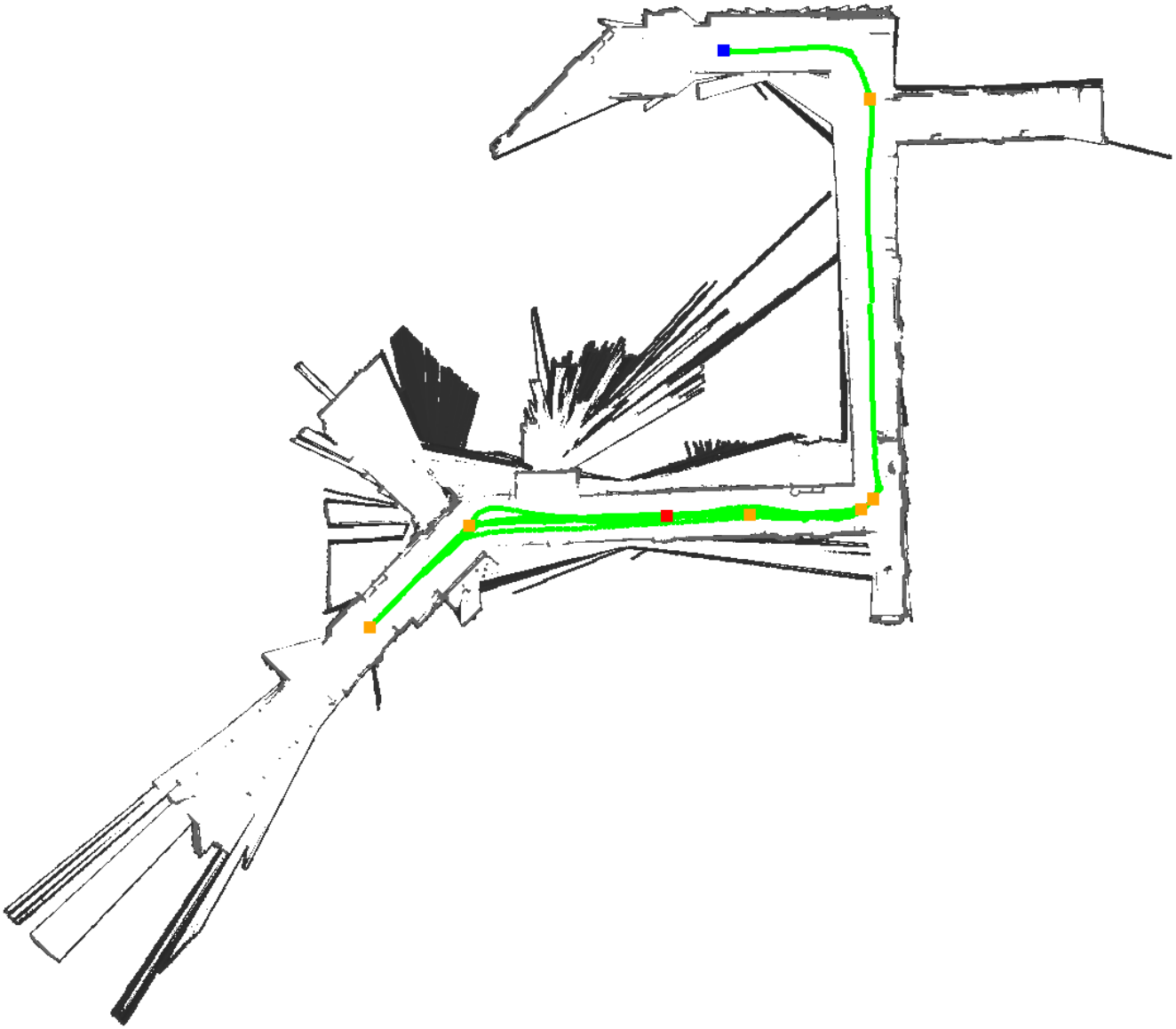

Fig. 46. Trial 46 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 47

Summary

Building: KNOY
Floor: 3
Volunteer: M
Goal: 371
Floor plan: Figure 71
SLAM map: Figure 47
Result: Success

Sequence of Behaviors

1) WANDER (11 s)
2) APPROACH_PERSON (1 s)
3) WANDER (4 s)
4) APPROACH_PERSON (11 s)
5) HOLD_CONVERSATION (13 s)
6) FOLLOW_DIRECTIONS (18 s)
7) NAVIGATE_DOOR (122 s)
8) WANDER (1 s)
9) APPROACH_PERSON (5 s)
10) HOLD_CONVERSATION (62 s)
11) FOLLOW_DIRECTIONS (12 s)
12) WANDER (14 s)
13) APPROACH_PERSON (7 s)
14) HOLD_CONVERSATION (16 s)
15) FOLLOW_DIRECTIONS (65 s)
16) WANDER (17 s)
17) APPROACH_PERSON (9 s)
18) HOLD_CONVERSATION (15 s)
19) FOLLOW_DIRECTIONS (9 s)
20) WANDER (1 s)
21) APPROACH_PERSON (0 s)
22) WANDER (20 s)
23) APPROACH_PERSON (0 s)
24) WANDER (2 s)
25) APPROACH_PERSON (10 s)
26) HOLD_CONVERSATION (16 s)
27) FOLLOW_DIRECTIONS (53 s)
28) WANDER (14 s)
29) APPROACH_PERSON (31 s)
30) HOLD_CONVERSATION (14 s)
31) FOLLOW_DIRECTIONS (17 s)
32) NAVIGATE_DOOR (100 s)
33) WANDER (6 s)
34) APPROACH_PERSON (0 s)
35) WANDER (10 s)
36) APPROACH_PERSON (0 s)
37) WANDER (1 s)
38) APPROACH_PERSON (13 s)
39) HOLD_CONVERSATION (20 s)
40) FOLLOW_DIRECTIONS (1 s)
41) NAVIGATE_DOOR (235 s)
42) WANDER (11 s)
43) APPROACH_PERSON (19 s)
44) HOLD_CONVERSATION (16 s)
45) FOLLOW_DIRECTIONS (1 s)
46) NAVIGATE_DOOR (101 s)
47) WANDER (77 s)
48) APPROACH_PERSON (14 s)
49) HOLD_CONVERSATION (58 s)
50) FOLLOW_DIRECTIONS (17 s)
51) NAVIGATE_DOOR (67 s)
52) WANDER (13 s)
53) APPROACH_PERSON (4 s)
54) WANDER (1 s)
55) APPROACH_PERSON (21 s)
56) WANDER (2 s)
57) APPROACH_PERSON (9 s)
58) HOLD_CONVERSATION (41 s)
59) FOLLOW_DIRECTIONS (17 s)
60) NAVIGATE_DOOR (39 s)
61) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 371?
Person:	turn around and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Conversation 2

Robot:	Could you tell me how to navigate to 371?
Person:	gopher turn left
Robot:	What do I do after I turn left?
Person:	turn off light.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	make a slight left and then the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `int-L`, `left`, `goal-R`]

Conversation 3

Robot:	Could you tell me how to navigate to 371?
Person:	turn around make a light left and then the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Conversation 4

Robot:	Could you tell me how to navigate to 371?
Person:	turn around make a slight left and the door will be right on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Conversation 5

Robot:	Could you tell me how to navigate to 371?
Person:	turn around at the end of the hallway make a slight left and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Conversation 6

Robot:	Could you tell me how to navigate to 371?
Person:	turn around go forward and the door will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Conversation 7

Robot:	Could you tell me how to navigate to 371?
Person:	the door is turn around go forward and the door will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-L`]

Conversation 8

Robot:	Could you tell me how to navigate to 371?
Person:	keep going forward the door will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-L`]

Conversation 9

Robot:	Could you tell me how to navigate to 371?
Person:	the door is right behind you.
Robot:	Which direction do I start out going?
Person:	turn 180 degrees.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Which direction do I start out going?
Person:	turn around completely.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `goal-F`]

Conversation 10

Robot:	Could you tell me how to navigate to 371?
Person:	turn around go forward and the doors on your left.
Robot:	What do I do after I turn left?
Person:	no gold turn around go forward and the door will be on the left.
Robot:	Sorry about that. Let me ask my previous question.
Robot:	Could you tell me how to navigate to 371?
Person:	turn around go forward and the door will be on your left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-L`]

Navigate Door

Number of doors approached: 9
Number of doors labeled: 5

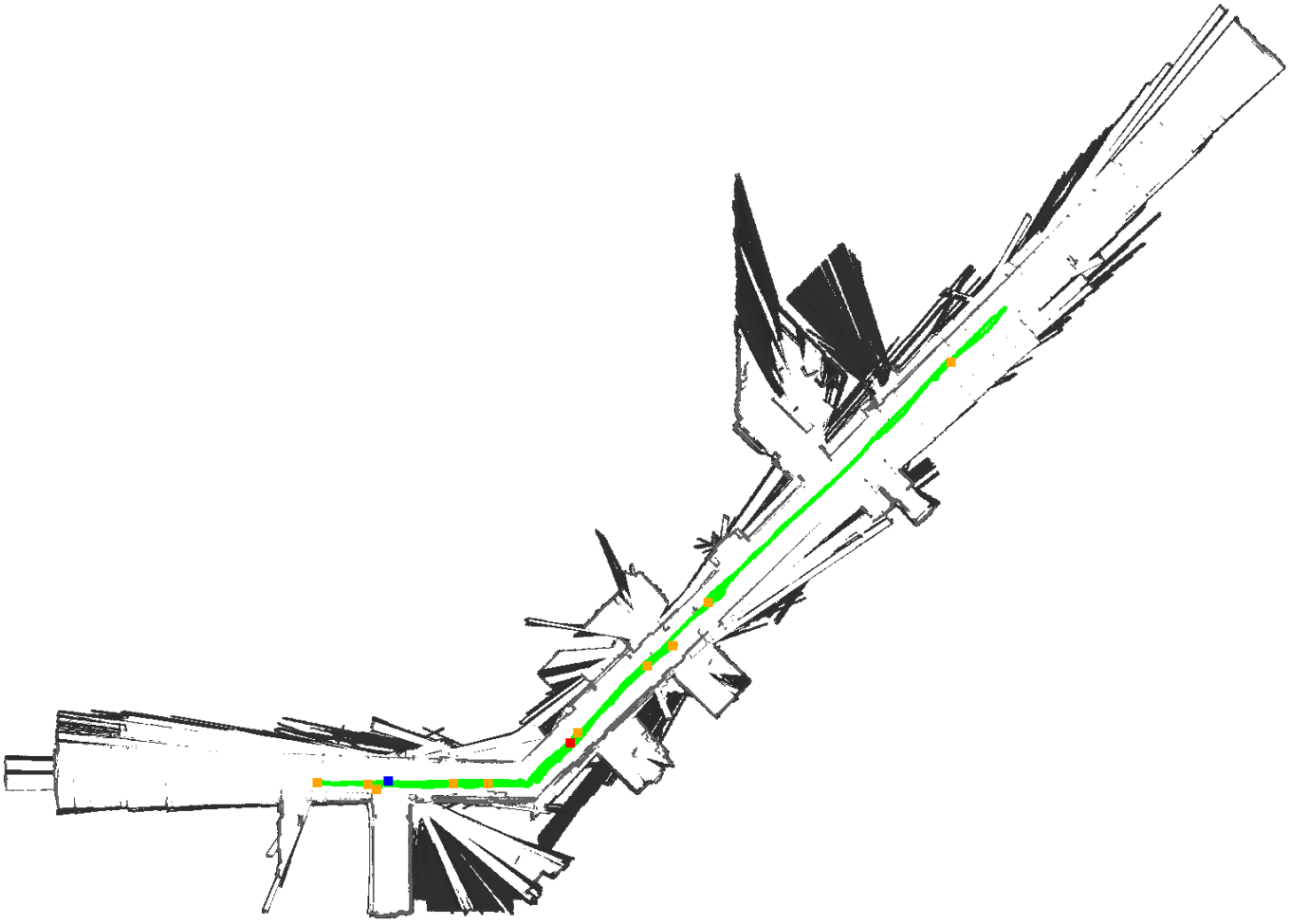

Fig. 47. Trial 47 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 48

Summary

Building: KNOY
Floor: 3
Volunteer: M
Goal: 339
Floor plan: Figure 71
SLAM map: Figure 48
Result: Success

Sequence of Behaviors

1) WANDER (2 s)
2) APPROACH_PERSON (0 s)
3) WANDER (22 s)
4) APPROACH_PERSON (2 s)
5) WANDER (3 s)
6) APPROACH_PERSON (1 s)
7) WANDER (18 s)
8) APPROACH_PERSON (1 s)
9) WANDER (14 s)
10) APPROACH_PERSON (2 s)
11) WANDER (1 s)
12) APPROACH_PERSON (4 s)
13) WANDER (0 s)
14) APPROACH_PERSON (0 s)
15) WANDER (2 s)
16) APPROACH_PERSON (4 s)
17) WANDER (0 s)
18) APPROACH_PERSON (2 s)
19) WANDER (2 s)
20) APPROACH_PERSON (18 s)
21) HOLD_CONVERSATION (23 s)
22) FOLLOW_DIRECTIONS (109 s)
23) WANDER (28 s)
24) APPROACH_PERSON (5 s)
25) HOLD_CONVERSATION (21 s)
26) FOLLOW_DIRECTIONS (82 s)
27) NAVIGATE_DOOR (32 s)
28) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 339?
Person:	go straight ahead. take a left at the end of the hallway make another left at the end of that hallway, and then the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `end`, `left`, `end`, `left`, `goal-R`]

Conversation 2	
Robot:	Could you tell me how to navigate to 339?
Person:	turn around go forward and the door will be on sorry turn around go forward make a slight left and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-L`, `left`, `goal-R`]

Navigate Door

Number of doors approached: 1
Number of doors labeled: 1

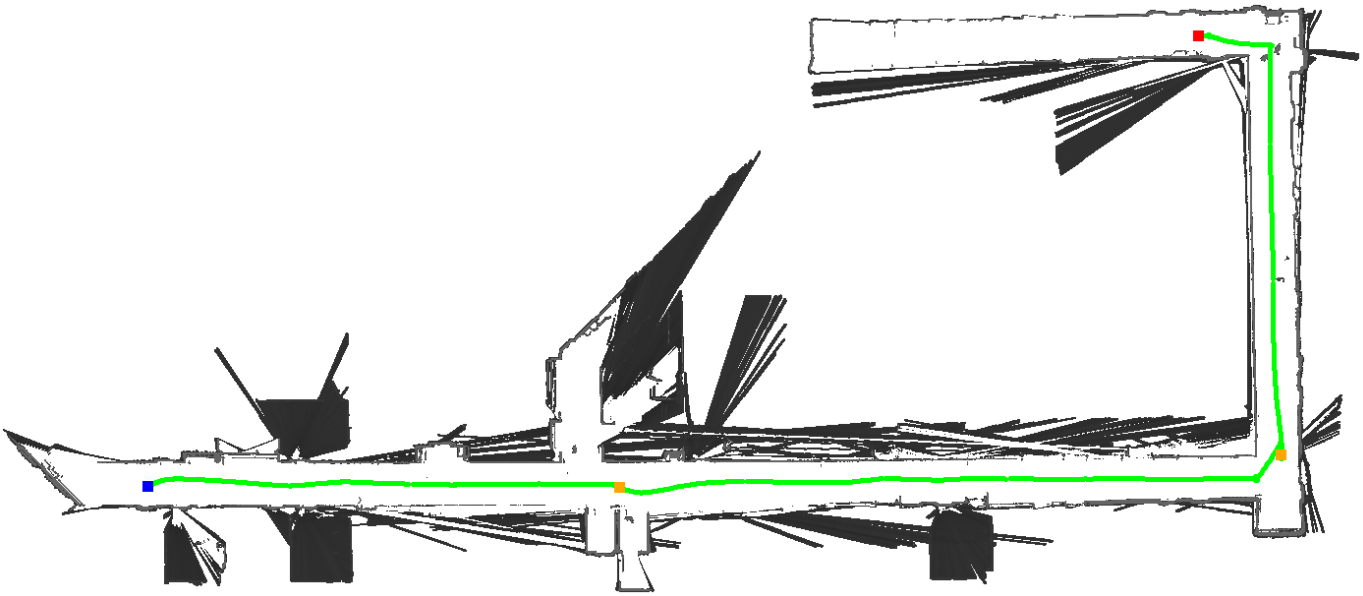

Fig. 48. Trial 48 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 49

Summary

Building: KNOY
Floor: 4
Volunteer: M
Goal: 453
Floor plan: Figure 72
SLAM map: Figure 49
Result: Failure
Reason: The robot detected the goal door, but failed to localize it properly. This was likely due to the door being open and in a unique position: at the center of a three-way intersection where the hallways were spaced at ≈45°and ≈135°from one another.

Sequence of Behaviors

1) WANDER (1 s)
2) APPROACH_PERSON (2 s)
3) WANDER (1 s)
4) APPROACH_PERSON (1 s)
5) WANDER (0 s)
6) APPROACH_PERSON (5 s)
7) HOLD_CONVERSATION (18 s)
8) FOLLOW_DIRECTIONS (28 s)
9) NAVIGATE_DOOR (107 s)
10) WANDER (6 s)
11) APPROACH_PERSON (2 s)
12) WANDER (1 s)
13) APPROACH_PERSON (1 s)
14) WANDER (2 s)
15) APPROACH_PERSON (0 s)
16) WANDER (20 s)
17) APPROACH_PERSON (2 s)
18) HOLD_CONVERSATION (67 s)
19) FOLLOW_DIRECTIONS (17 s)
20) NAVIGATE_DOOR (105 s)
21) WANDER (296 s)
22) APPROACH_PERSON (1 s)
23) WANDER (5 s)
24) APPROACH_PERSON (7 s)
25) WANDER (12 s)
26) APPROACH_PERSON (1 s)
27) WANDER (1 s)
28) APPROACH_PERSON (2 s)
29) WANDER (3 s)
30) APPROACH_PERSON (4 s)
31) WANDER (2 s)
32) APPROACH_PERSON (2 s)
33) WANDER (1 s)
34) APPROACH_PERSON (12 s)
35) HOLD_CONVERSATION (13 s)
36) FOLLOW_DIRECTIONS (17 s)
37) NAVIGATE_DOOR (114 s)
38) WANDER (20 s)
39) APPROACH_PERSON (3 s)
40) WANDER (2 s)
41) APPROACH_PERSON (0 s)
42) WANDER (2 s)
43) APPROACH_PERSON (23 s)
44) HOLD_CONVERSATION (15 s)
45) FOLLOW_DIRECTIONS (17 s)
46) NAVIGATE_DOOR (148 s)
47) WANDER (–)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 453?
Person:	go straight take a left and it'll be the it'll be a door on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `goal-L`]
Conversation 2	
Robot:	Could you tell me how to navigate to 453?
Person:	turn around go forward and the door will be directly in front of you.
Robot:	What do I do after turning around and going forward?
Person:	the door will be in front of you.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after turning around and going forward?
Person:	the door will be stopped at the inn at the intersection and the door will be there.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-F`]
Conversation 3	
Robot:	Could you tell me how to navigate to 453?
Person:	turn around go forward and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]
Conversation 4	
Robot:	Could you tell me how to navigate to 453?
Person:	turn around go forward and the door will be on your right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `goal-R`]

Navigate Door

Number of doors approached: 7
Number of doors labeled: 1

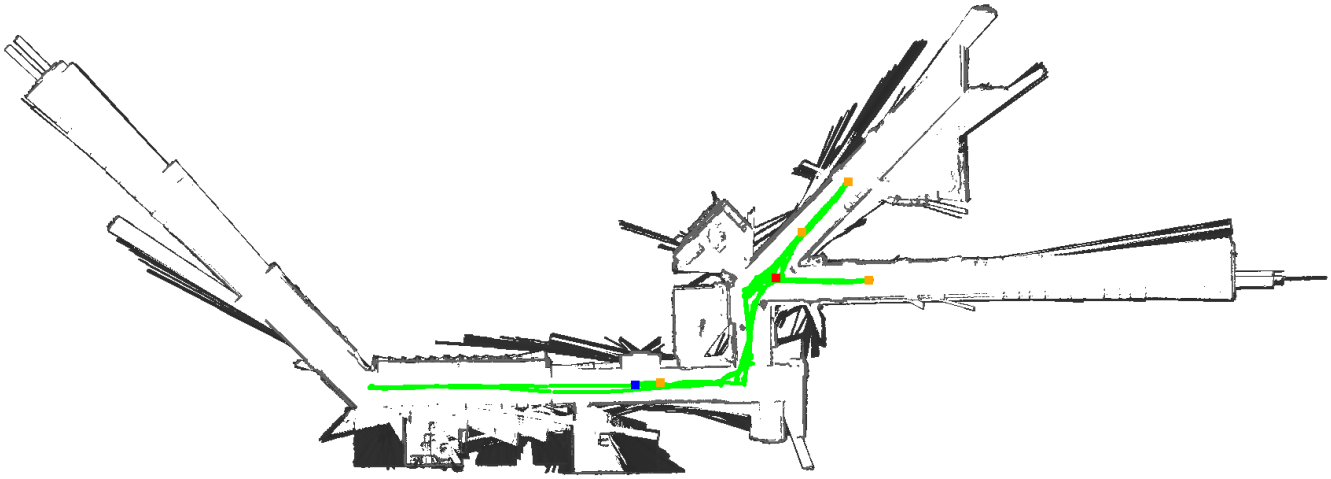

Fig. 49. Trial 49 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 50

Summary

Building: ME
Floor: 2
Volunteer: N
Goal: 2051
Floor plan: Figure 75
SLAM map: Figure 50
Result: Success

Sequence of Behaviors

1) WANDER (60 s)
2) APPROACH_PERSON (1 s)
3) WANDER (0 s)
4) APPROACH_PERSON (0 s)
5) WANDER (1 s)
6) APPROACH_PERSON (14 s)
7) HOLD_CONVERSATION (23 s)
8) FOLLOW_DIRECTIONS (29 s)
9) WANDER (65 s)
10) APPROACH_PERSON (7 s)
11) HOLD_CONVERSATION (103 s)
12) FOLLOW_DIRECTIONS (219 s)
13) WANDER (67 s)
14) APPROACH_PERSON (1 s)
15) WANDER (1 s)
16) APPROACH_PERSON (0 s)
17) WANDER (17 s)
18) APPROACH_PERSON (2 s)
19) WANDER (2 s)
20) APPROACH_PERSON (0 s)
21) WANDER (8 s)
22) APPROACH_PERSON (0 s)
23) WANDER (25 s)
24) APPROACH_PERSON (22 s)
25) HOLD_CONVERSATION (79 s)
26) FOLLOW_DIRECTIONS (0 s)
27) WANDER (56 s)
28) APPROACH_PERSON (0 s)
29) WANDER (6 s)
30) APPROACH_PERSON (2 s)
31) HOLD_CONVERSATION (26 s)
32) FOLLOW_DIRECTIONS (0 s)
33) NAVIGATE_DOOR (137 s)
34) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 2051?
Person:	yeah, go straight and take a right.
Robot:	What do I do after I turn right?
Person:	bedroom would be on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-R`, `right`, `goal-L`]

Conversation 2	
Robot:	Could you tell me how to navigate to 2051?
Person:	yes stone at home and the room is on the light.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	Could you tell me how to navigate to 2051?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 2051?
Person:	turn around go straight.
Robot:	What do I do after turning around and going forward?
Person:	look for the room on the right.
Robot:	What do I do after I turn right?
Person:	look for the room.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	keep going.
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	go straight.
Robot:	I did not understand that.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, □]

Conversation 3	
Robot:	Could you tell me how to navigate to 2051?
Person:	go straight.
Robot:	What do I do after starting to go forward?
Person:	keep going.
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after starting to go forward?
Person:	go forward.
Robot:	I did not understand that.
Robot:	What do I do after starting to go forward?
Person:	
Robot:	I did not hear you.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, □]

Conversation 4	
Robot:	Could you tell me how to navigate to 2051?
Person:	go straight.
Robot:	What do I do after starting to go forward?
Person:	the room will be on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `goal-L`]

Navigate Door

Number of doors approached: 4
Number of doors labeled: 3

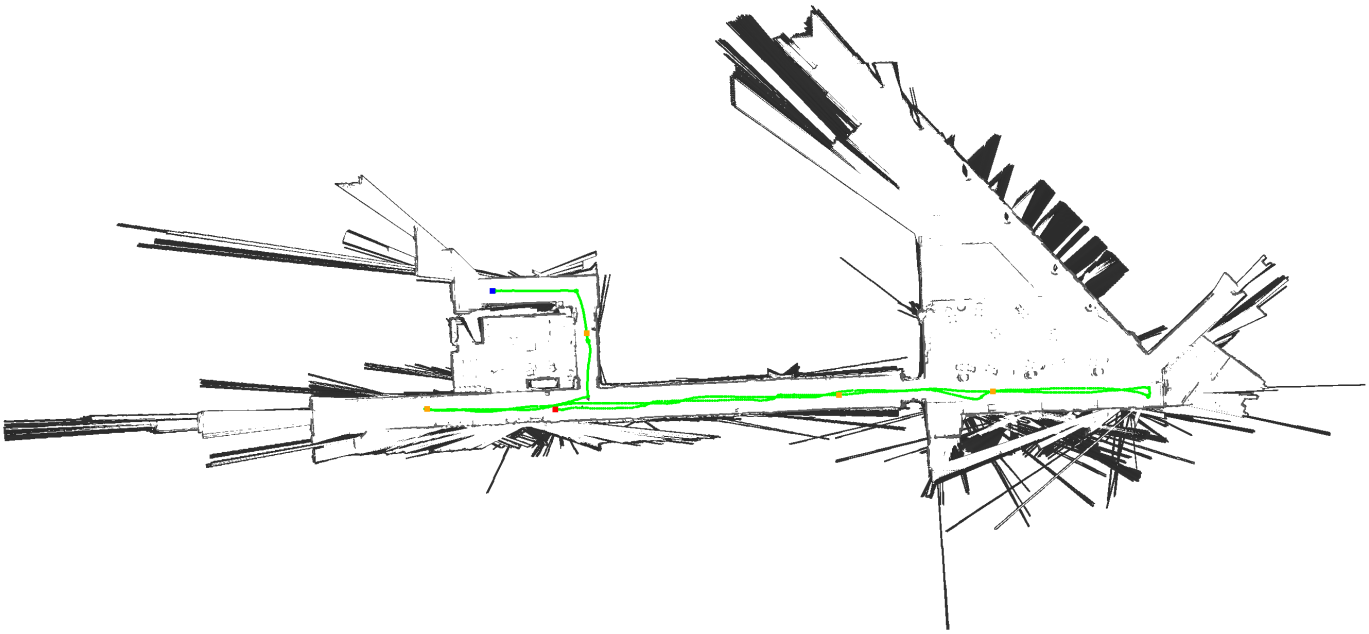

Fig. 50. Trial 50 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 51

Summary

Building: ME
Floor: 1
Volunteer: N
Goal: 1079
Floor plan: Figure 74
SLAM map: Figure 51
Result: Success

Sequence of Behaviors

1) WANDER (60 s)
2) APPROACH_PERSON (8 s)
3) HOLD_CONVERSATION (77 s)
4) FOLLOW_DIRECTIONS (16 s)
5) WANDER (23 s)
6) APPROACH_PERSON (11 s)
7) HOLD_CONVERSATION (37 s)
8) FOLLOW_DIRECTIONS (35 s)
9) WANDER (37 s)
10) APPROACH_PERSON (0 s)
11) WANDER (2 s)
12) APPROACH_PERSON (11 s)
13) HOLD_CONVERSATION (21 s)
14) FOLLOW_DIRECTIONS (11 s)
15) WANDER (1 s)
16) APPROACH_PERSON (4 s)
17) HOLD_CONVERSATION (21 s)
18) FOLLOW_DIRECTIONS (36 s)
19) NAVIGATE_DOOR (225 s)
20) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1

Robot:	Could you tell me how to navigate to 1079?
Person:	go straight take a left.
Robot:	What do I do after I turn left?
Person:	bakelite
Robot:	I did not understand that.
Robot:	I understand verbal directions, like turn-around and turn left. I understand intersections like an elbow or end of hallway. I understand words like goal or destination.
Robot:	You can give me instructions in small chunks or all at once. If I misunderstand something, you can tell me that my interpretation was wrong or incorrect and I will back up one step. If I totally misunderstand, you can ask me to start over.
Robot:	What do I do after I turn left?
Person:	go straight and turn right.
Robot:	What do I do after I turn right?
Person:	what app
Robot:	I did not understand that.
Robot:	What do I do after I turn right?
Person:	room will be on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `int-R`, `right`, `goal-L`]

Conversation 2

Robot:	Could you tell me how to navigate to 1079?
Person:	
Robot:	I did not hear you.
Robot:	Could you tell me how to navigate to 1079?
Person:	turn left and go straight.
Robot:	What do I do after I turn left?
Person:	go straight and turn right.
Robot:	What do I do after I turn right?
Person:	the room is on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `int-R`, `right`, `goal-L`]

Conversation 3

Robot:	Could you tell me how to navigate to 1079?
Person:	turn around and take a right.
Robot:	What do I do after I turn right?
Person:	the room will be on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-L`]

Conversation 4

Robot:	Could you tell me how to navigate to 1079?
Person:	turn around and take a right.
Robot:	What do I do after I turn right?
Person:	bedroom will be on the left.
Robot:	Thanks for your help. Have a great day!
Plan:	[`turn-around`, `forward`, `int-R`, `right`, `goal-L`]

Navigate Door

Number of doors approached: 5
Number of doors labeled: 4

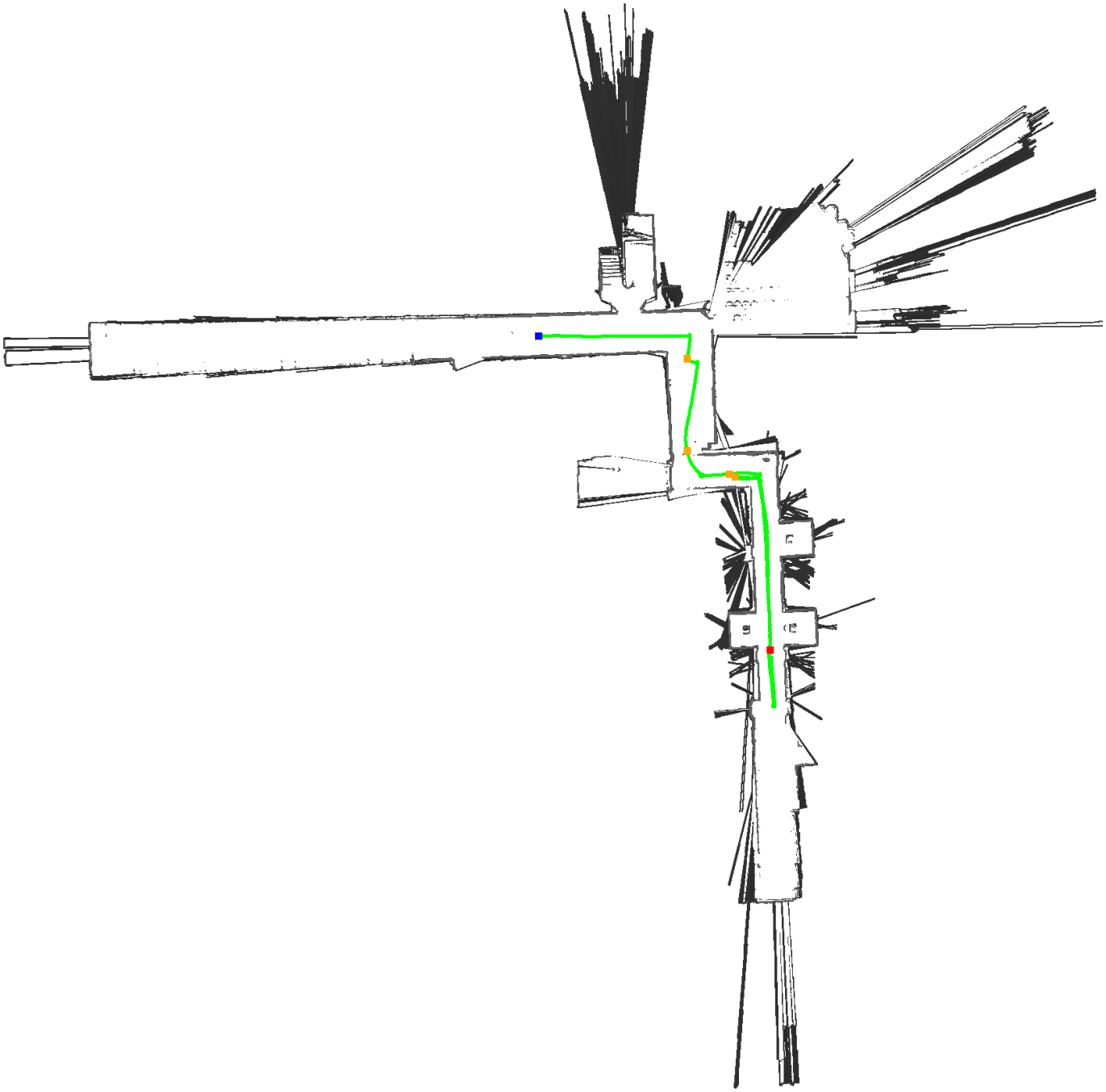

Fig. 51. Trial 51 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

Trial 52

Summary

Building: ME
Floor: 1
Volunteer: N
Goal: 1051
Floor plan: Figure 74
SLAM map: Figure 52
Result: Success

Sequence of Behaviors

1) WANDER (46 s)
2) APPROACH_PERSON (15 s)
3) HOLD_CONVERSATION (21 s)
4) FOLLOW_DIRECTIONS (50 s)
5) NAVIGATE_DOOR (40 s)
6) ACHIEVE_GOAL (N/A)

Conversations

Conversation 1	
Robot:	Could you tell me how to navigate to 1051?
Person:	go straight and take a left.
Robot:	What do I do after I turn left?
Person:	the room will be on the right.
Robot:	Thanks for your help. Have a great day!
Plan:	[`forward`, `int-L`, `left`, `goal-R`]

Navigate Door

Number of doors approached: 1
Number of doors labeled: 1

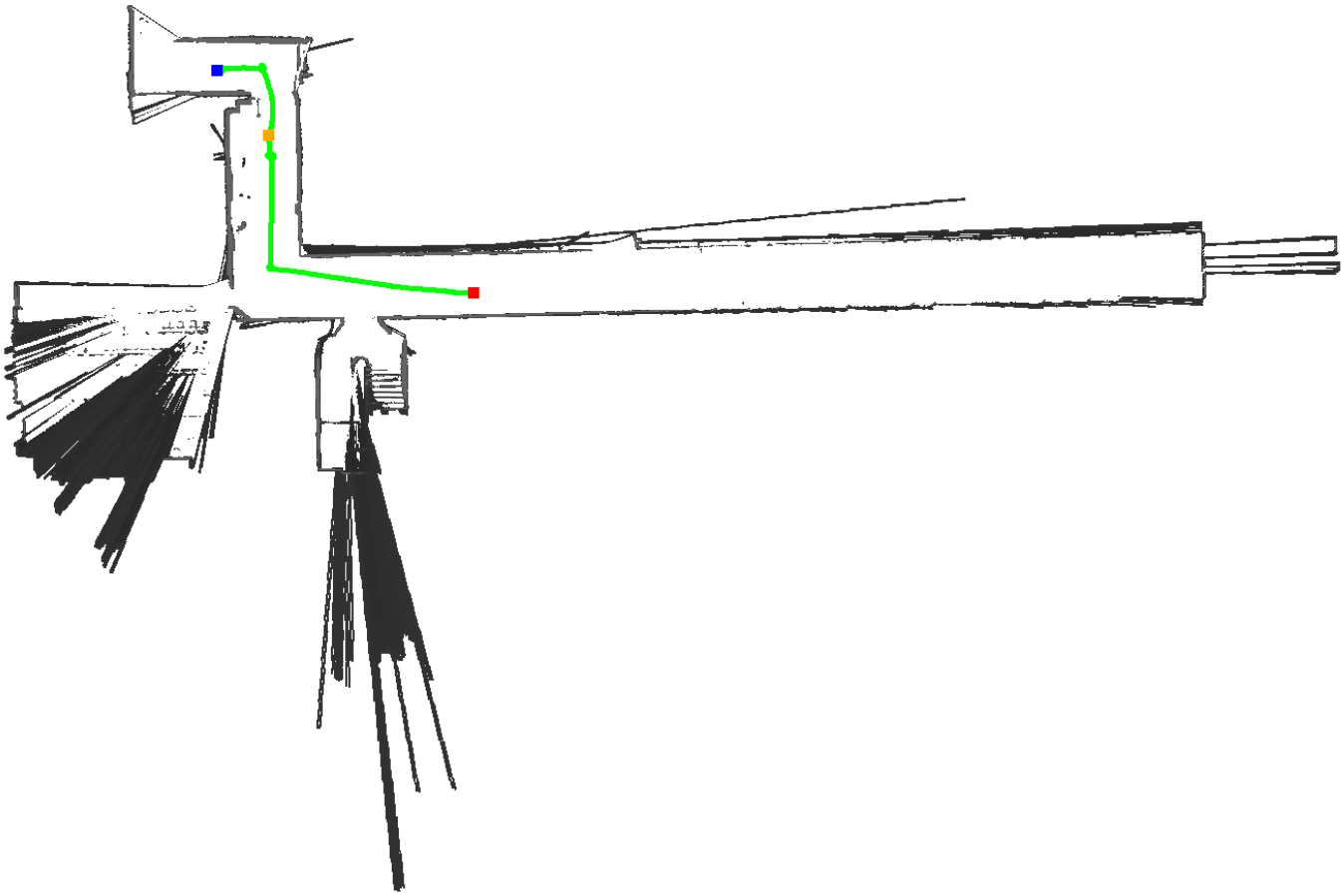

Fig. 52. Trial 52 SLAM map. Blue point indicates the robot's starting position. Red point indicates the robot's ending position. Orange point(s) indicate where the robot stopped to converse with the person. Green is the robot's path.

II. Building Floor Plans

Areas of the map that are green represent areas that the robot can drive in. Areas of the map that are red represent areas that the robot cannot drive in. These include carpeted areas and hallways that are narrower than the robot's circumscribed radius.

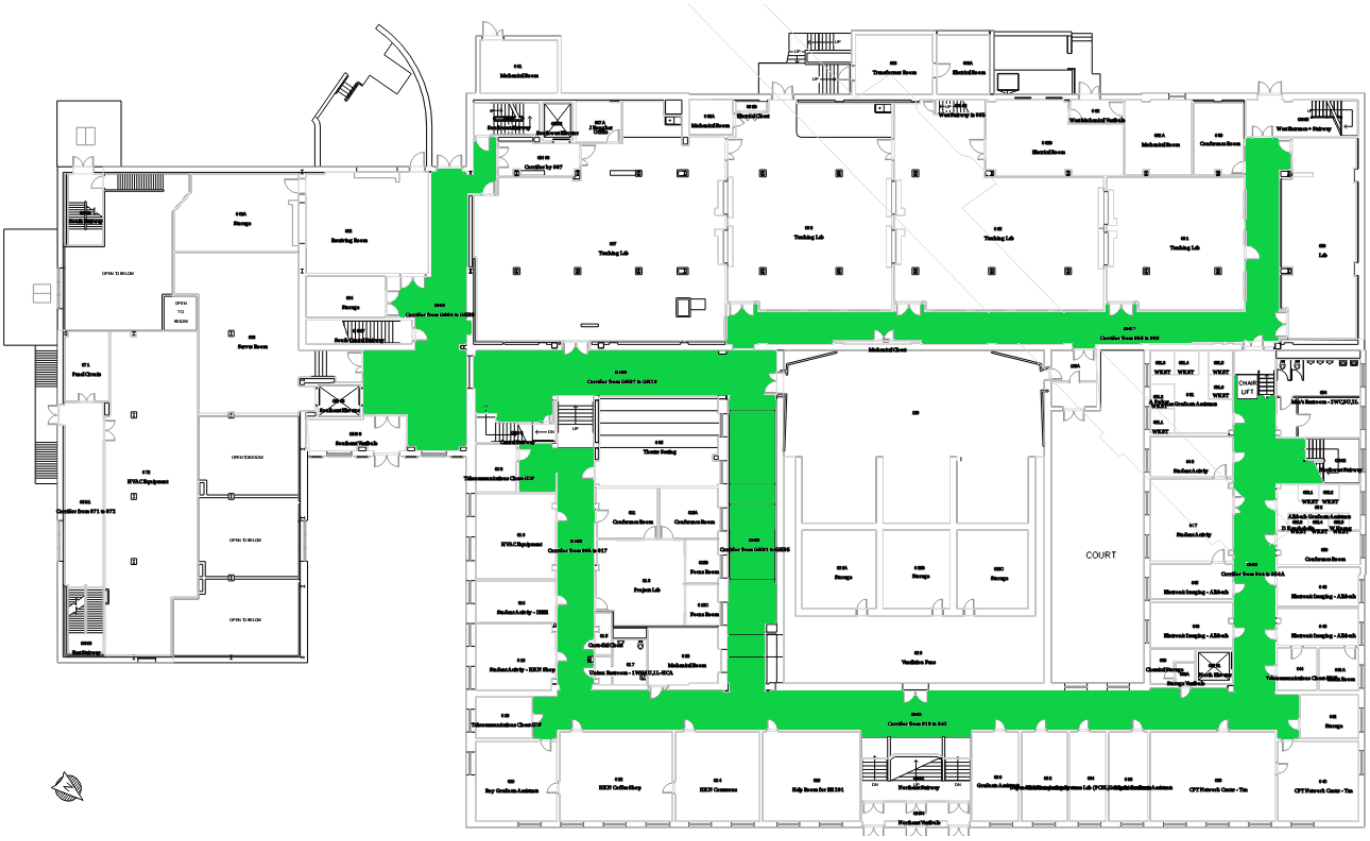

Fig. 53. Building Name: EE. Floor Number: 0.

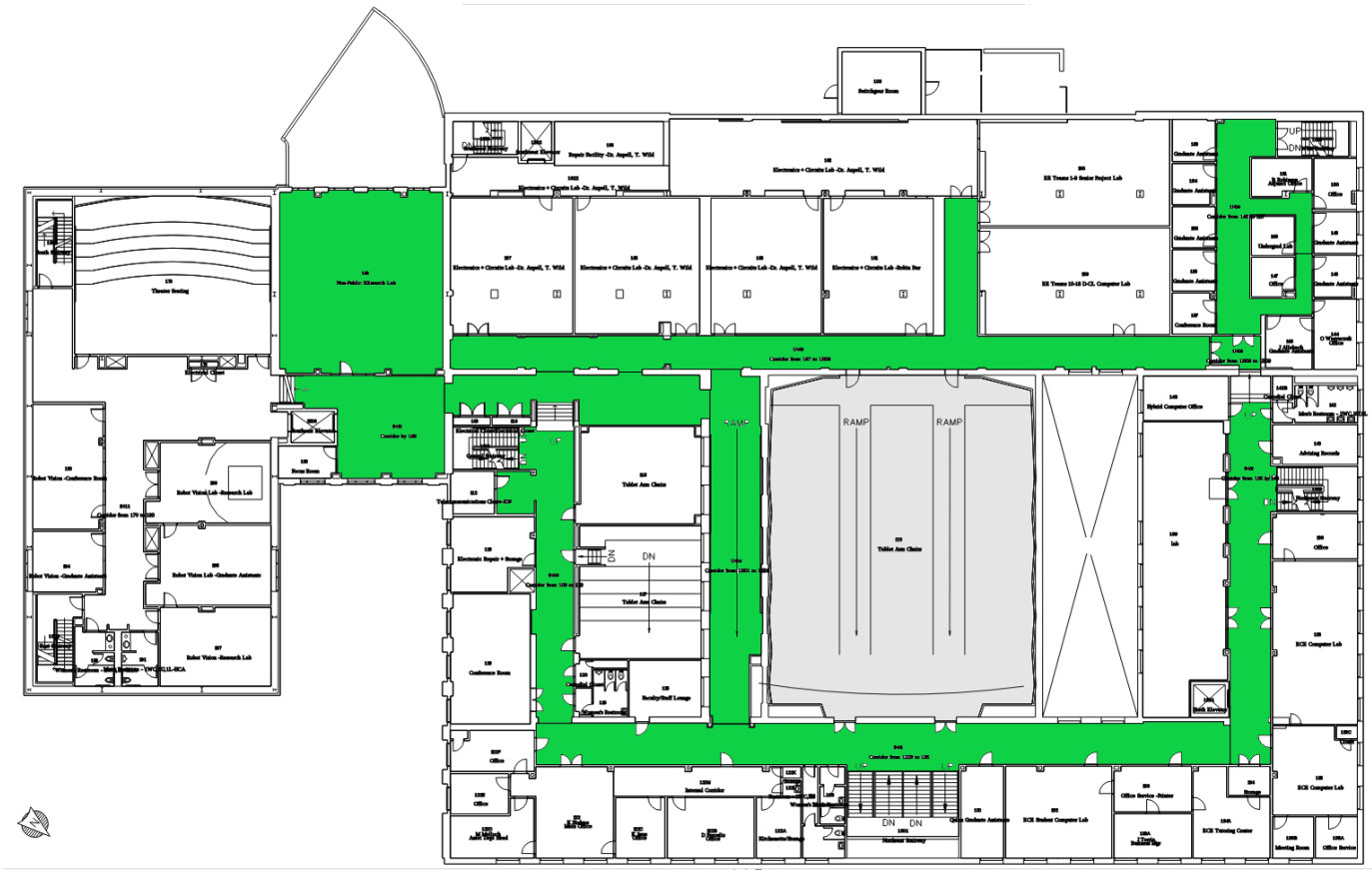

Fig. 54. Building Name: EE. Floor Number: 1.

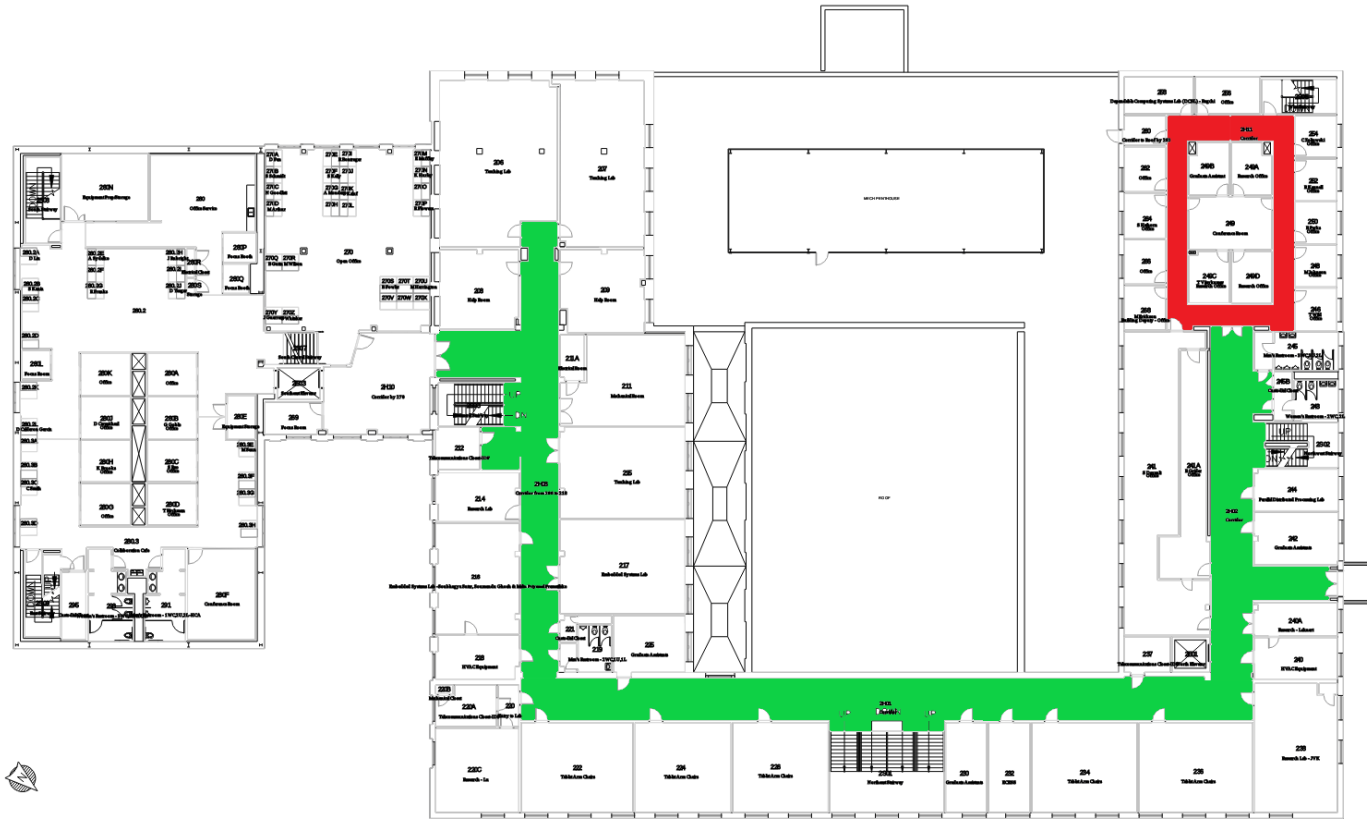

Fig. 55. Building Name: EE. Floor Number: 2.

Fig. 56. Building Name: EE. Floor Number: 3.

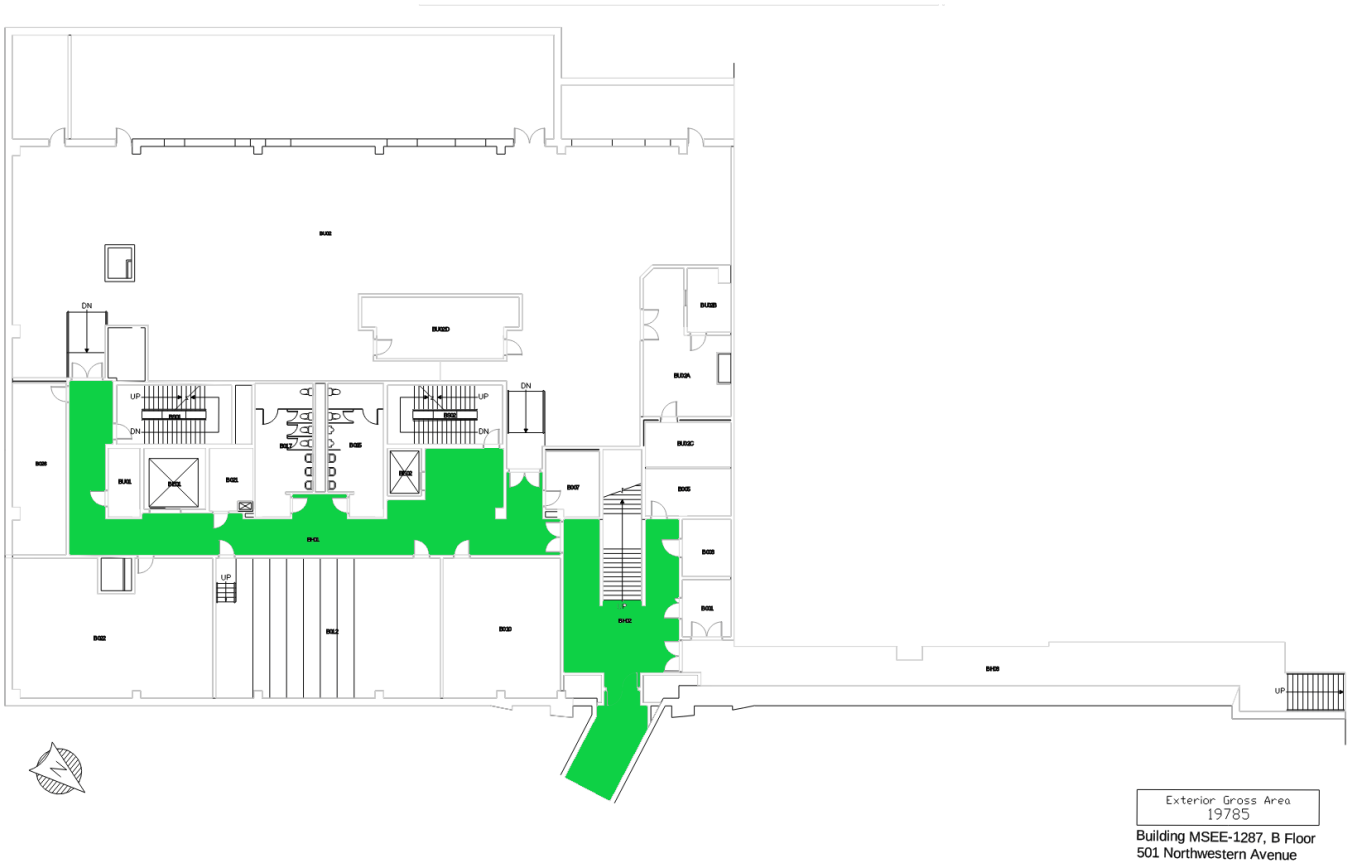

Fig. 57. Building Name: MSEE. Floor Number: 0.

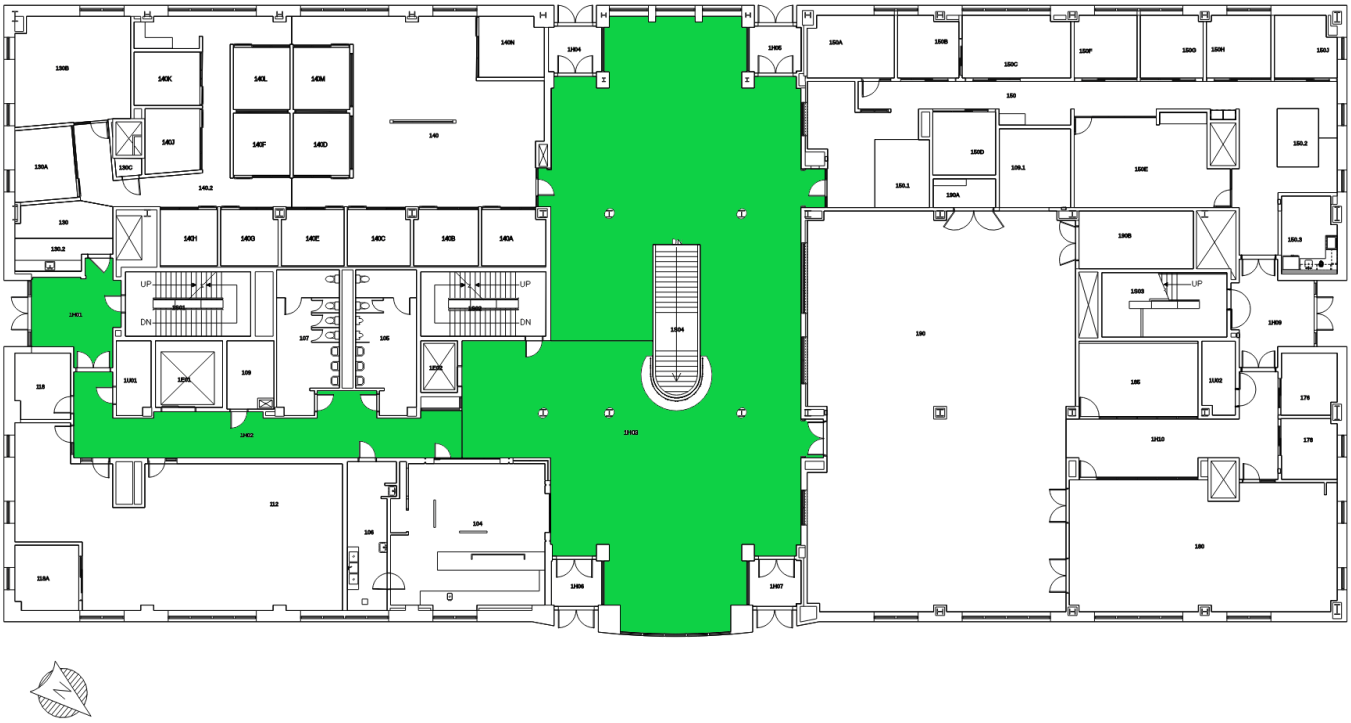

Fig. 58. Building Name: MSEE. Floor Number: 1.

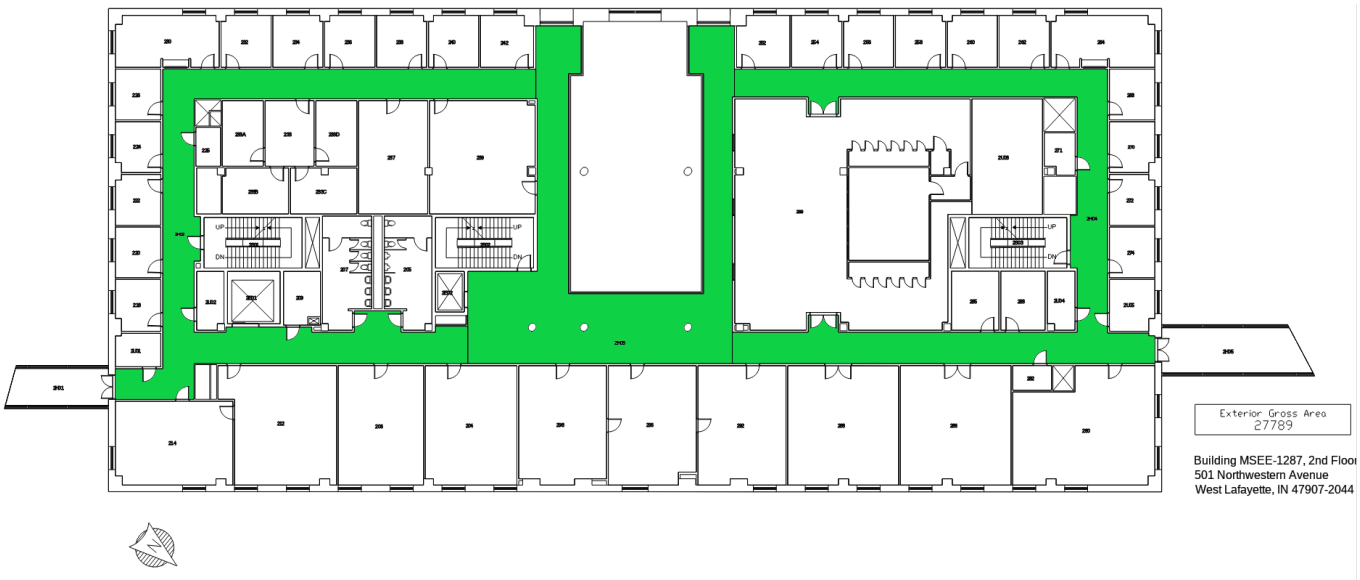

Fig. 59. Building Name: MSEE. Floor Number: 2.

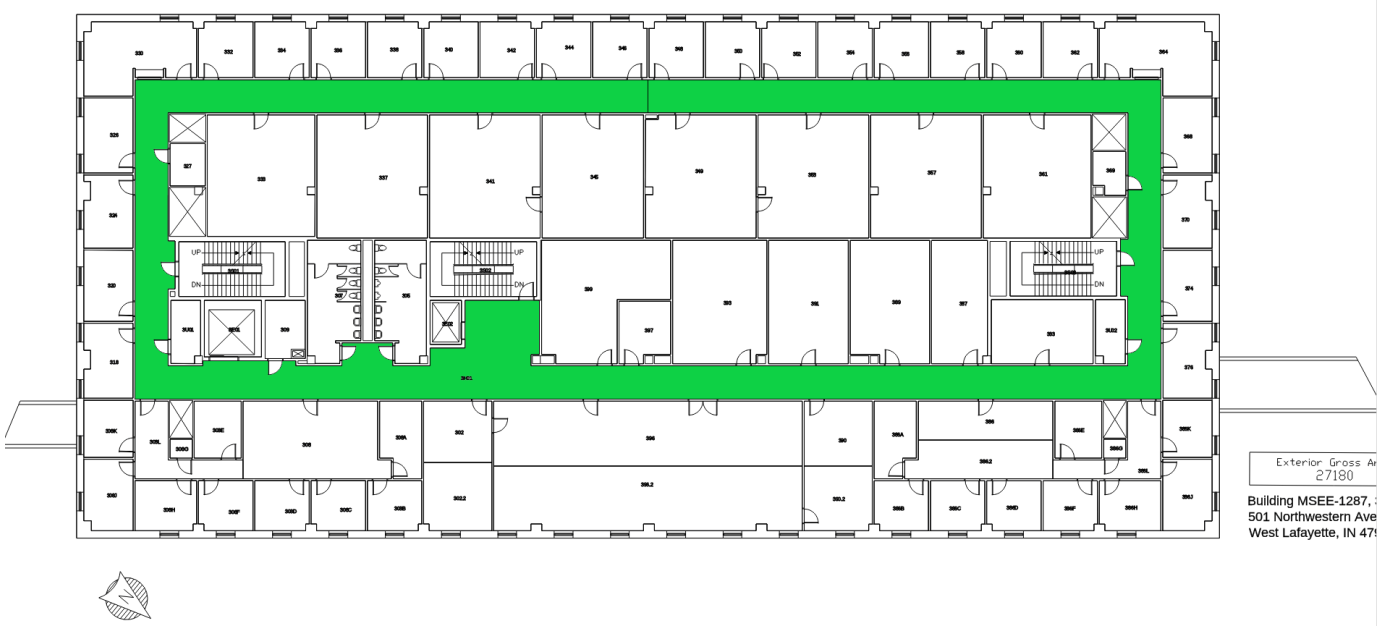

Fig. 60. Building Name: MSEE. Floor Number: 3.

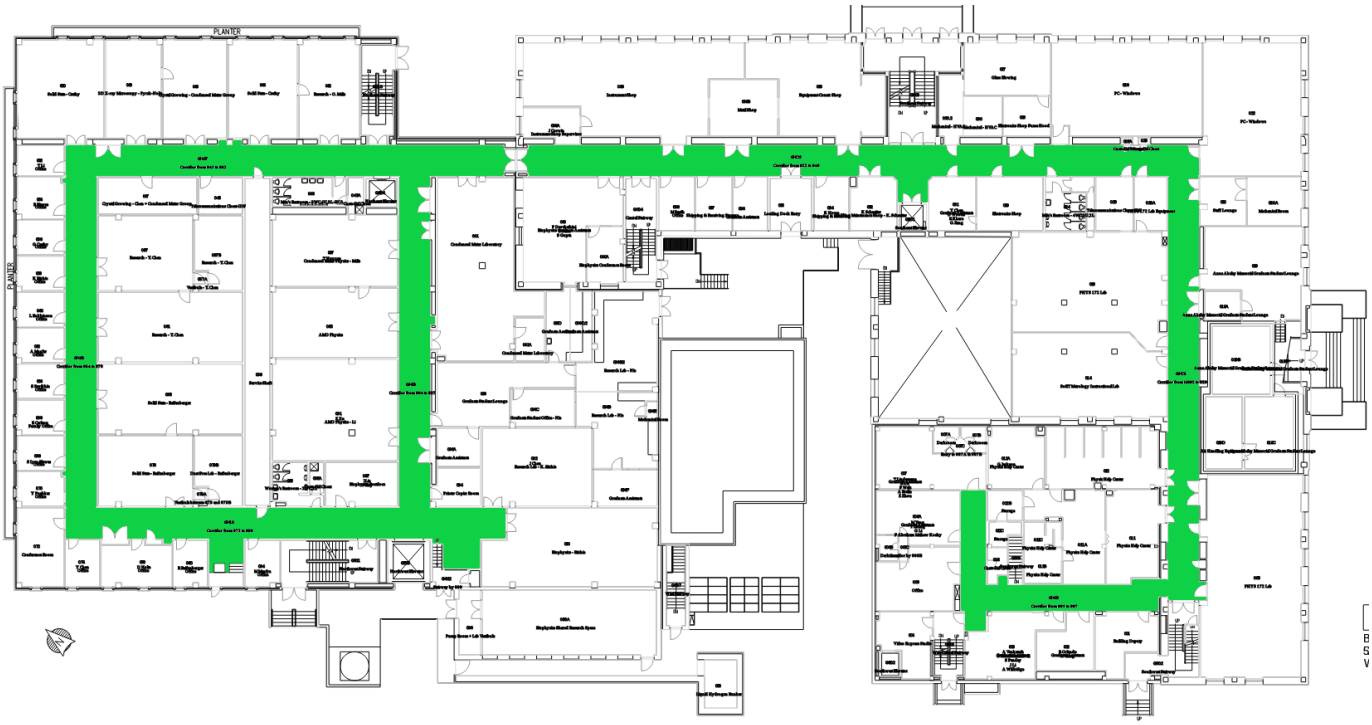

Fig. 61. Building Name: PHYS. Floor Number: 0.

Fig. 62. Building Name: PHYS. Floor Number: 1.

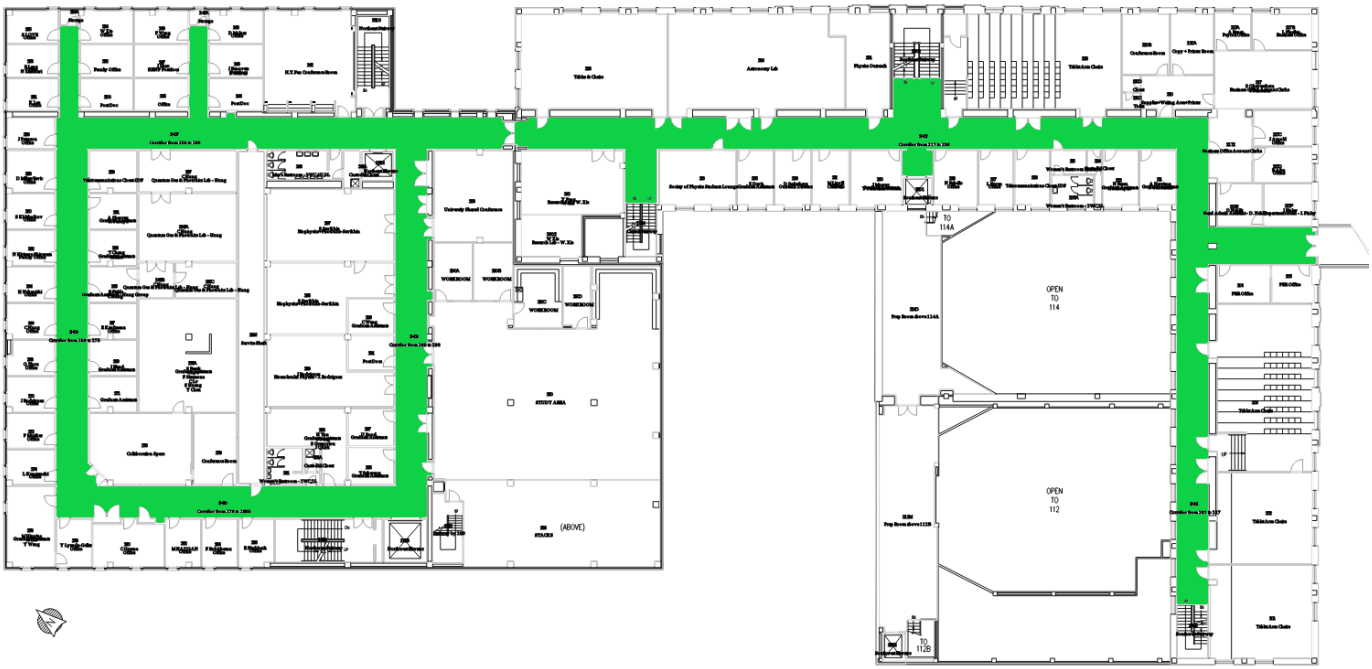

Fig. 63. Building Name: PHYS. Floor Number: 2.

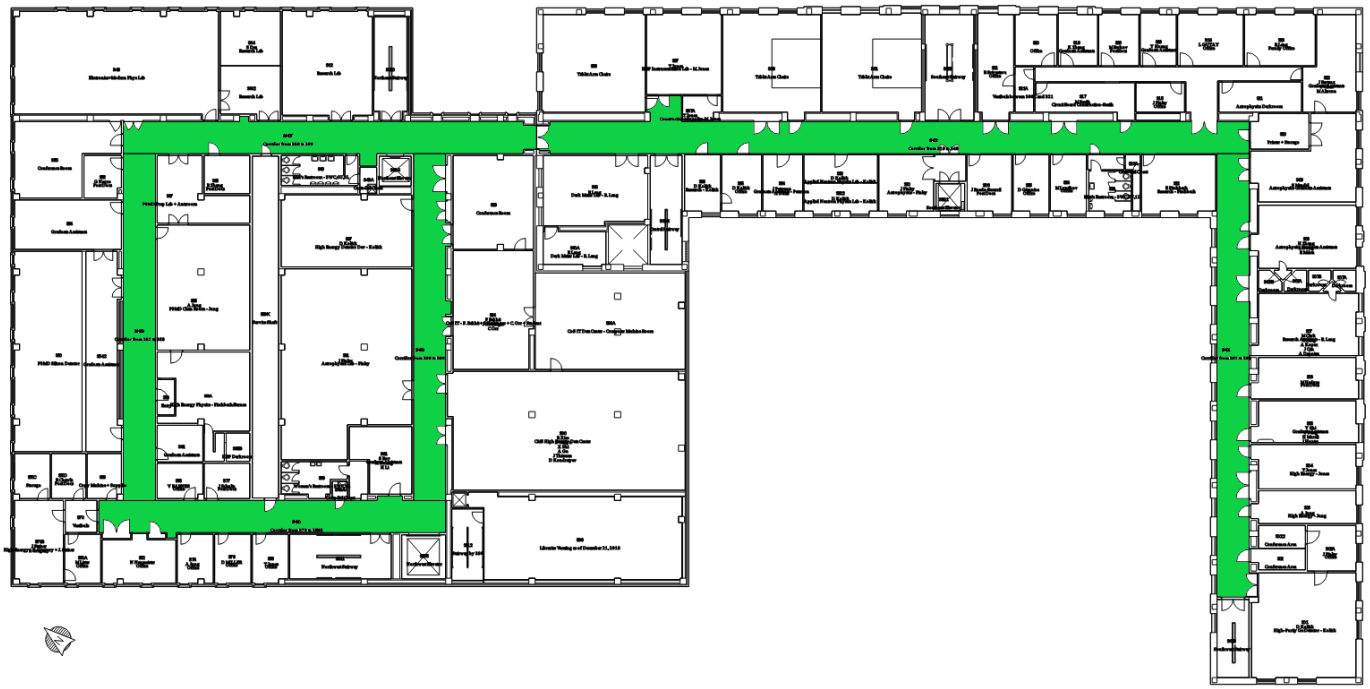

Fig. 64. Building Name: PHYS. Floor Number: 3.

Fig. 65. Building Name: HAMP. Floor Number: 1.

Fig. 66. Building Name: HAMP. Floor Number: 2.

Fig. 67. Building Name: HAMP. Floor Number: 3.

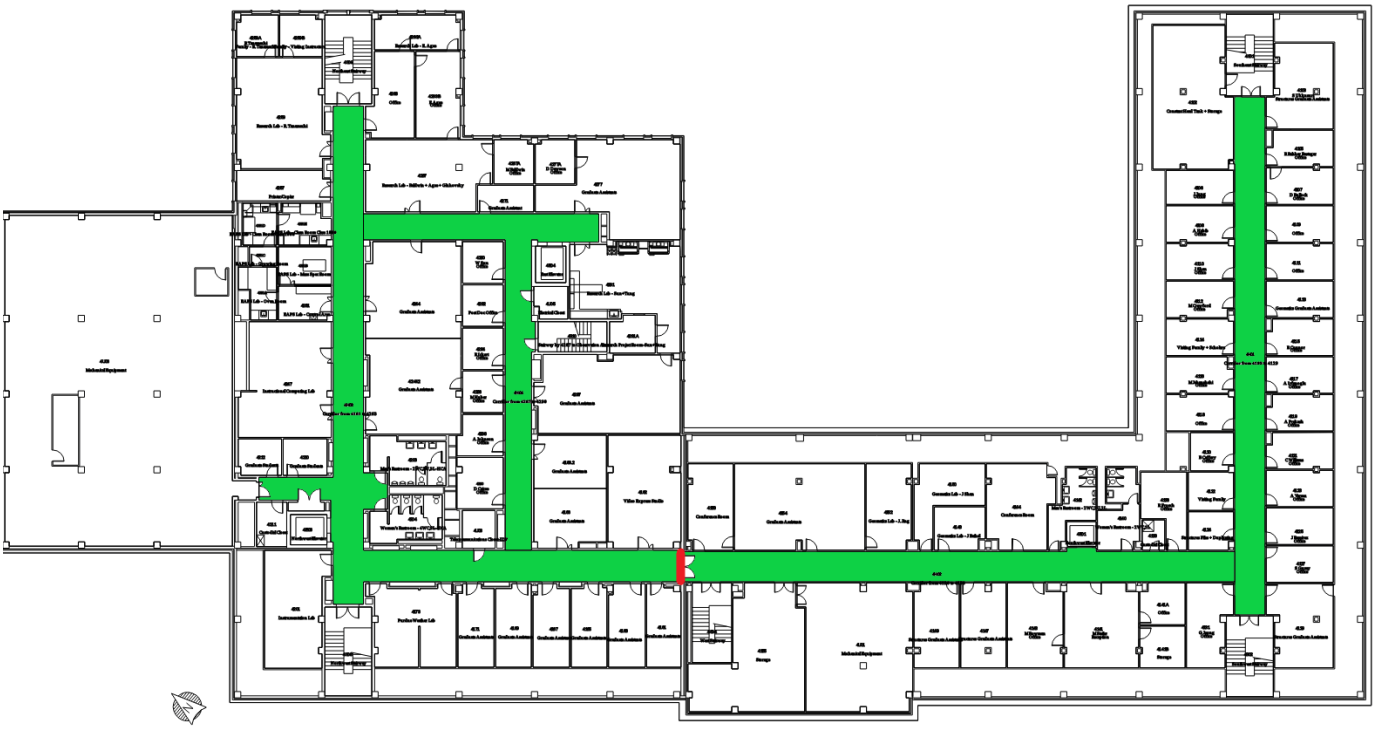

Fig. 68. Building Name: HAMP. Floor Number: 4.

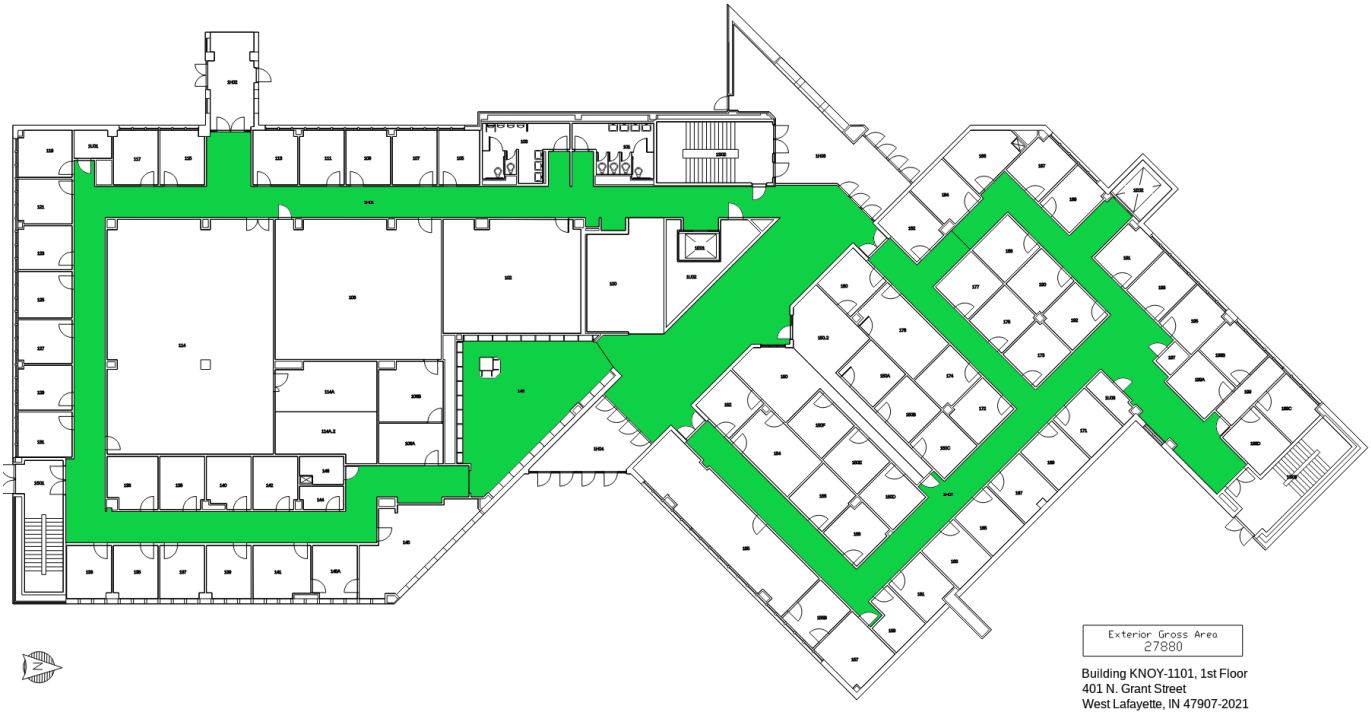

Fig. 69. Building Name: KNOY. Floor Number: 1.

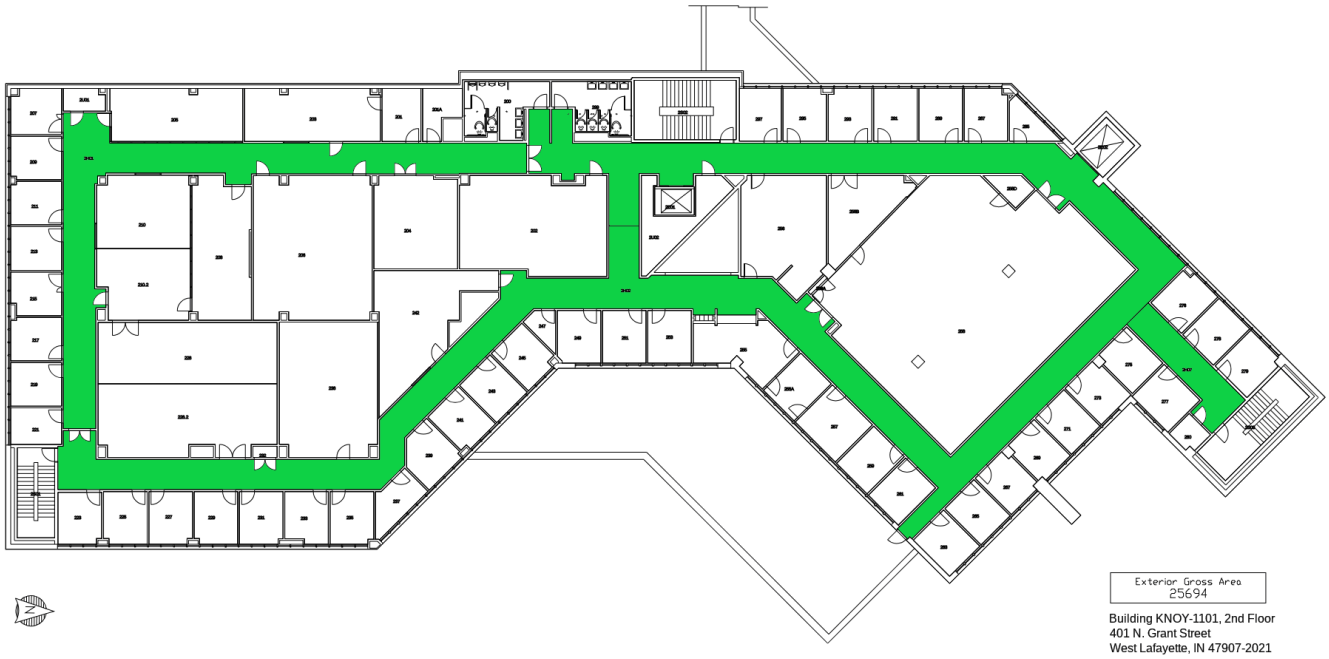

Fig. 70. Building Name: KNOY. Floor Number: 2.

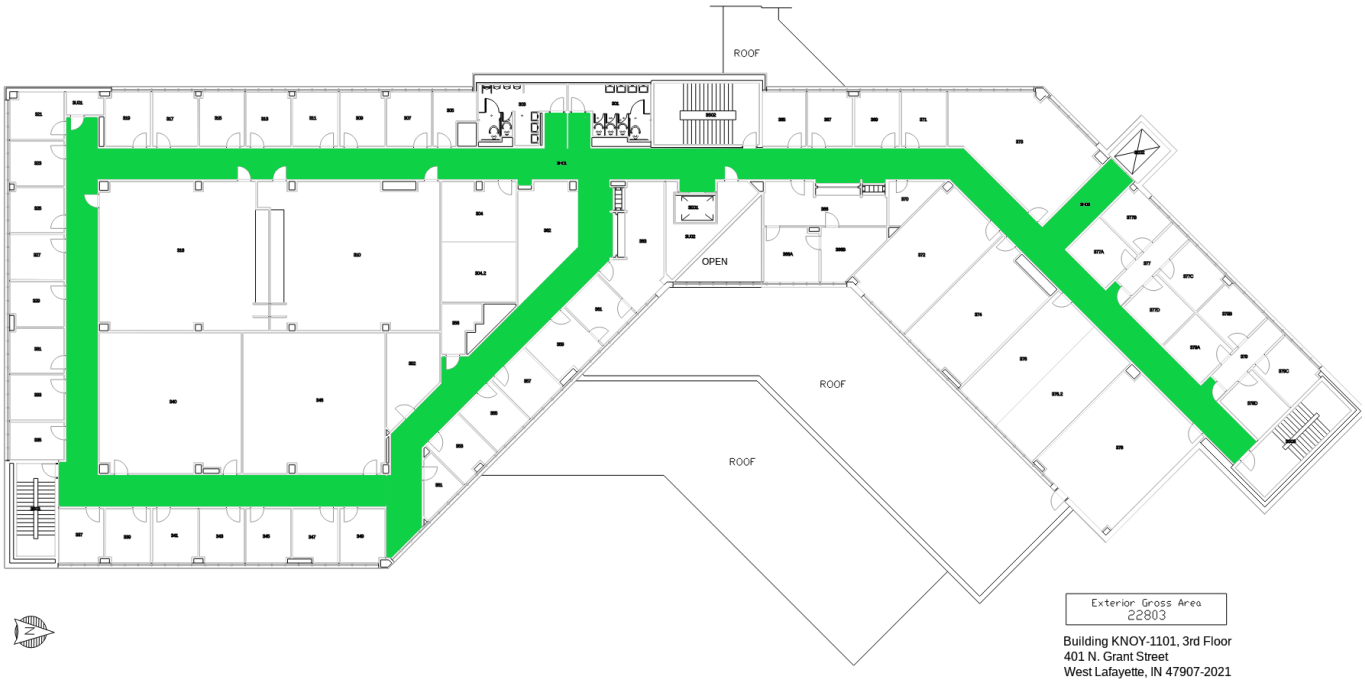

Fig. 71. Building Name: KNOY. Floor Number: 3.

Fig. 72. Building Name: KNOY. Floor Number: 4.

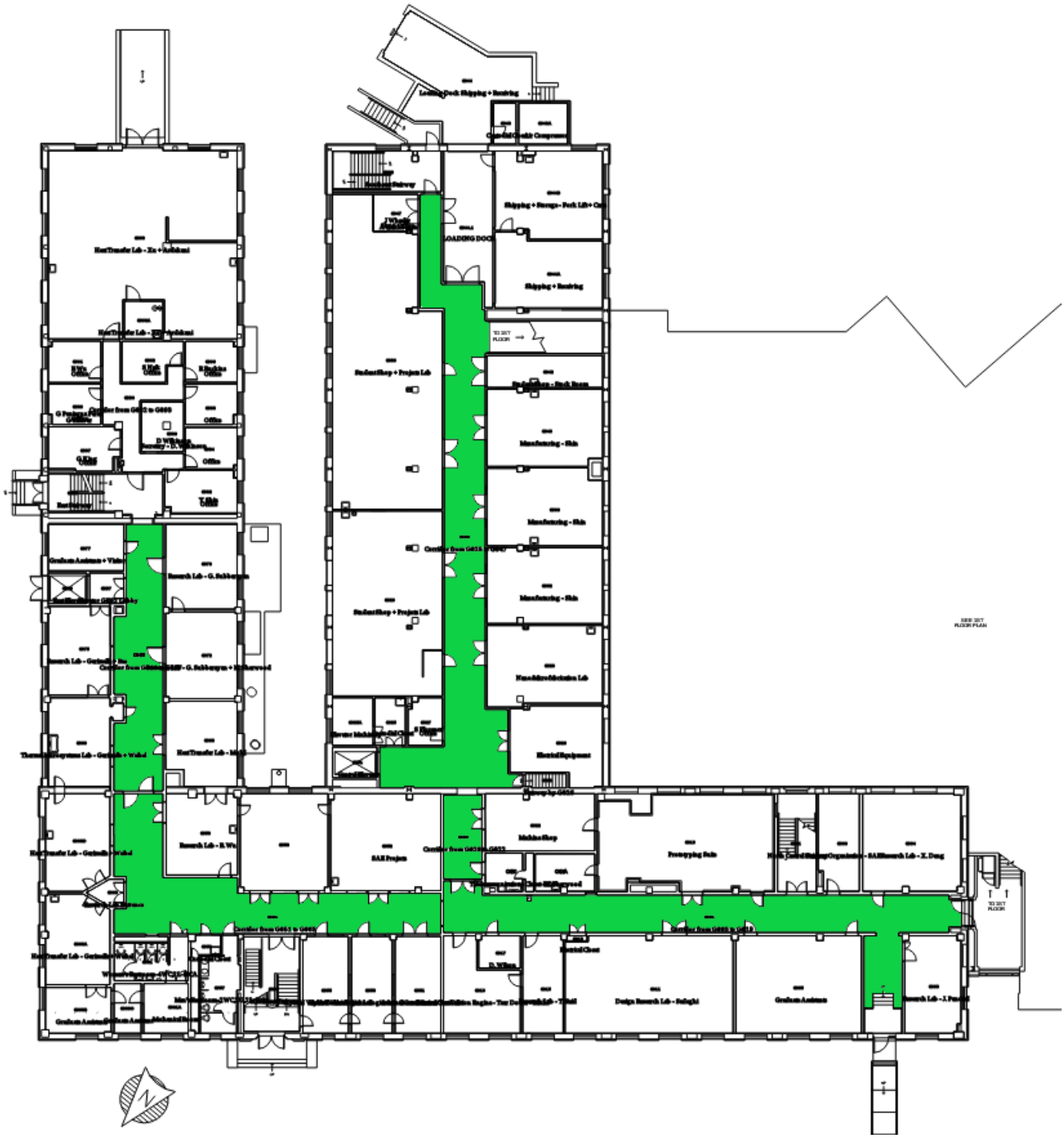

Fig. 73. Building Name: ME. Floor Number: 0.

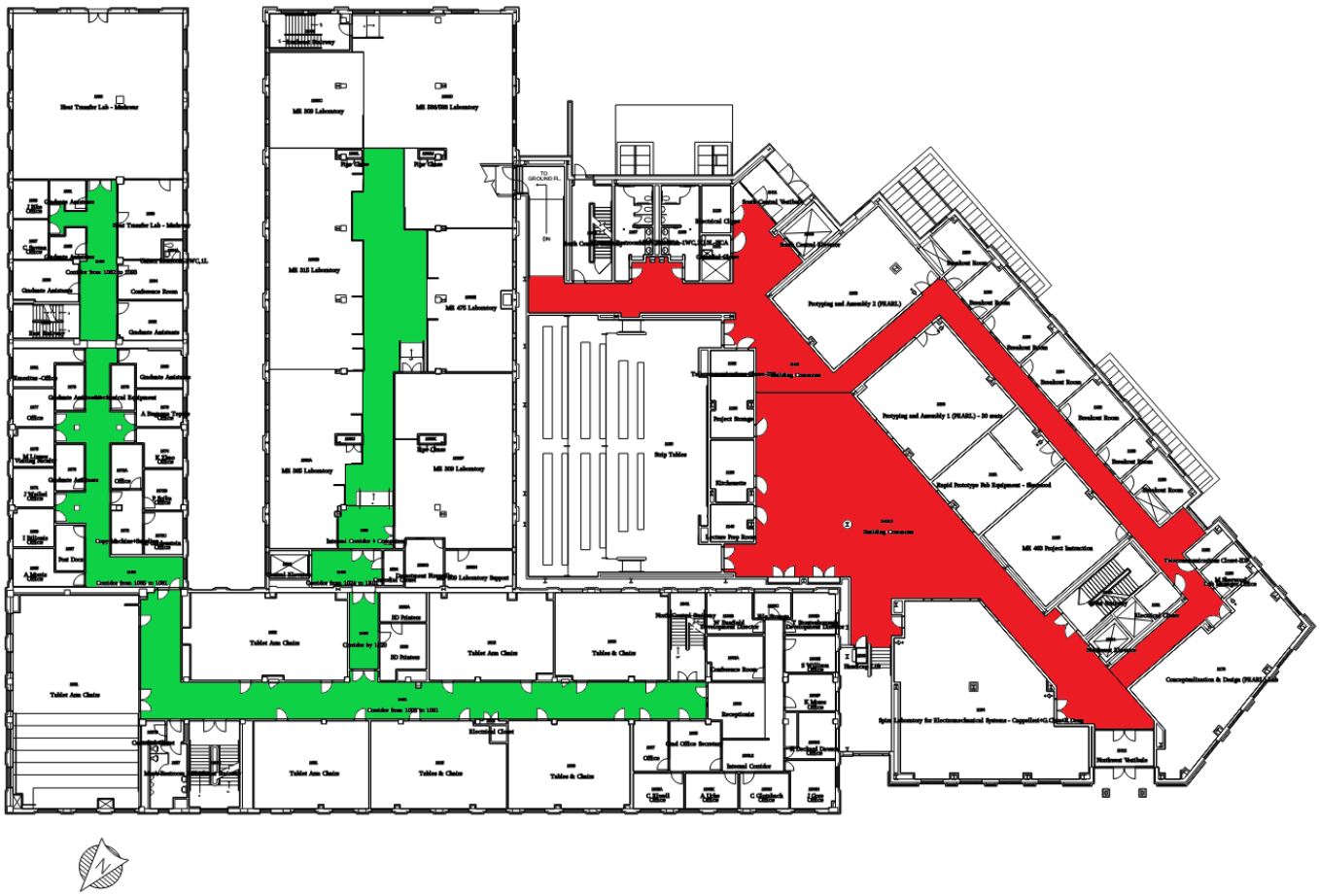

Fig. 74. Building Name: ME. Floor Number: 1.

Spin Laboratory for Electromechanical Systems - Rooms
Technicians
Computer Lab
Computer Lab
Workroom + Copy Area
Storage - Legal
Student Commons
Graduate Assistant
Graduate Assistant
Student Lounge + Kitchen
Tutoring Room
Tutoring Room
Tutoring Room
Tablet Arm Chairs
Undergraduate Student Commons
Conference Room
Conference Room
Conference Room
Conference Room
Conference Room
Table & Chairs
Table & Chairs
MS Business Office
Waiting Area
Office
Office
Office

SEE 1ST FLOOR PLAN
SEE 2ND FLOOR PLAN
SEE ROOF PLAN
Graduate Assistants
Research Lab - A. Mercouroff,K. Zhao,M. Gonzalez,H. Zhao,M. Jia
Research Lab - J. Chai + L. Pan
Graduate Assistants
Graduate Assistants Offices
Toilet Aux Clean
Hallway Corridor + Waiting Area
Corridor from 3003 to 3001
Computer Lab
Elevator Chase
Graduate Assistants
Graduate Assistants
Graduate Assistants