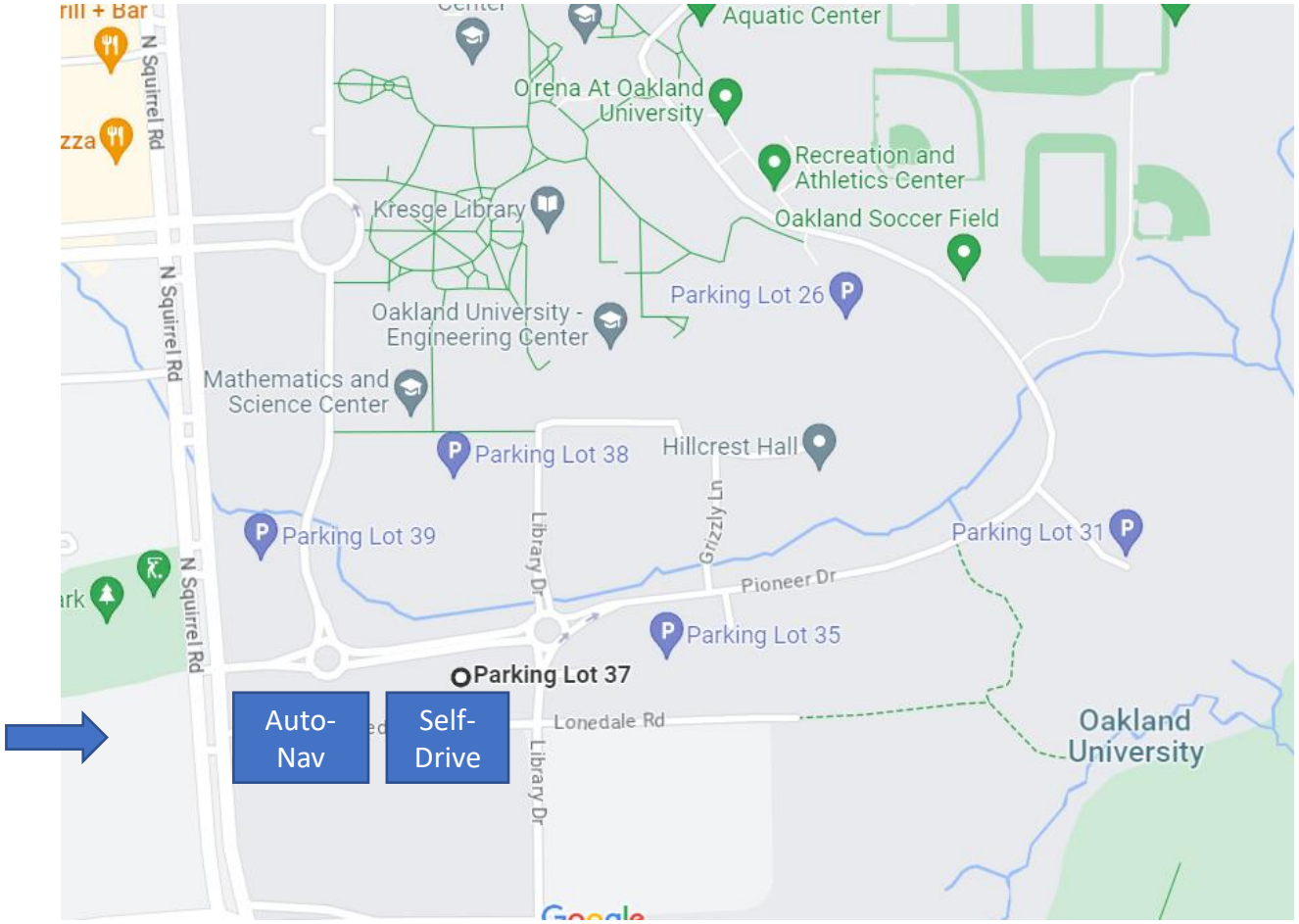
Self-Drive 2024

General Information

May 31- June 3, 2024

Self Drive Challenge 2024

Self-Drive Location 2024



Google's address: Parking Lot 37, Auburn Hills, MI 48326

Tentative Schedule

Friday May 31, 2024

8:00 am – 7:00 pm	Practice

Saturday June 1, 2024

9:00 am – 12:00 pm	Qualifications & Functions Testing
12:00 pm – 12:30 pm	Team Captains meeting **Mandatory**
1:30 pm – 2:30 pm	Self Drive Design Review
2:30 pm – 4:00 pm	Qualifications & Functions Testing
4:00 pm – 6:00 pm	*Self Drive Course open to AutoNav teams*

Sunday June 2, 2024

9:00 pm – 4:00 pm	Functions Testing / Main Course
4:00 pm – 6:00 pm	*Self Drive Course open to AutoNav teams*
6:00 pm – 7:00 pm	Faculty Meeting **Mandatory**

Monday June 3, 2024

9:00 am – 12:00 pm	Self Drive Main Course & Functions Testing
12:00 pm – 12:30 pm	*Self Drive Course open to AutoNav teams*
1:00 pm – 4:00 pm	Self Drive Main Course & Functions Testing

Design Review Schedule

Saturday, June 3, 2023

- 1:30 pm – 1:55 pm LTU
- 2:00 pm – 2:30 pm Cooper IGVC

Self-Drive has the following stages:

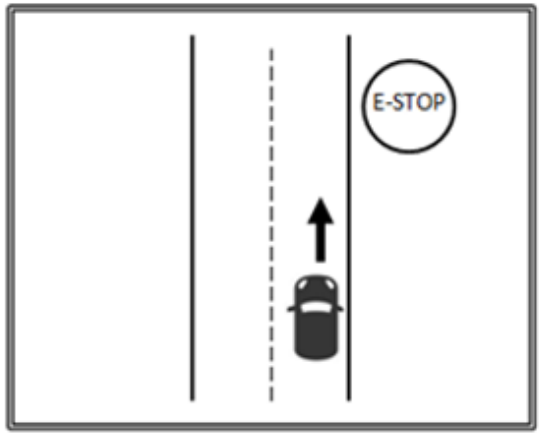
- **Qualifications Testing** – tests vehicle for safety and basic functions such as manual and e-stop tests, lane keeping, left and right turns and ability to stop at the stop sign
- **Functions Testing** – focuses on performance of each function separately. This approach offers an opportunity for teams to work on different functions in parallel during the development phase. Each function is a building block and an indicator to an overall performance
- **Self Drive Course** – combines all or most of the functions in the mixed order
- **Self Drive Design** - presentation of the written report to the panel of judges with portion dedicated to vehicle examination

Qualifications Testing

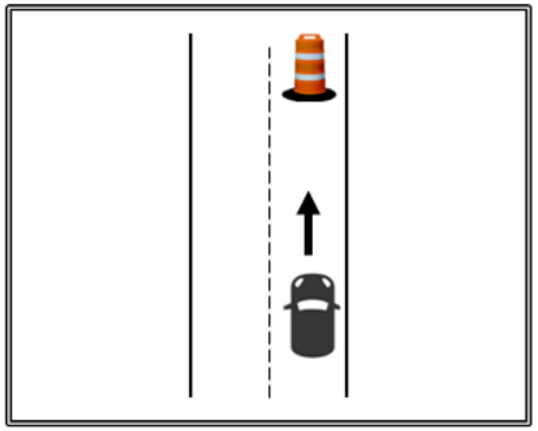
Test Type	Test ID	Name	# of Runs	Time	Penalty Points	Comments
Qualification	Q.1	E-Stop Manual				
Qualification	Q.2	E-Stop Wireless				
Qualification	Q.3	Lane Keeping (Go Straight)				
Qualification	Q.4	White Lines Detection				
Qualification	Q.5	Left Turn				
Qualification	Q.6	Right Turn				

- Unlimited number of trials

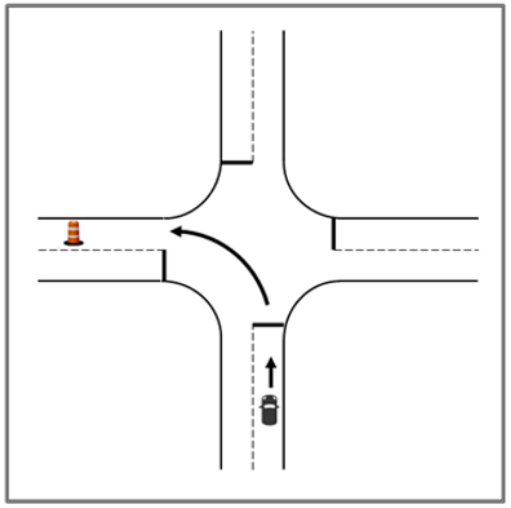
Qualifications Testing



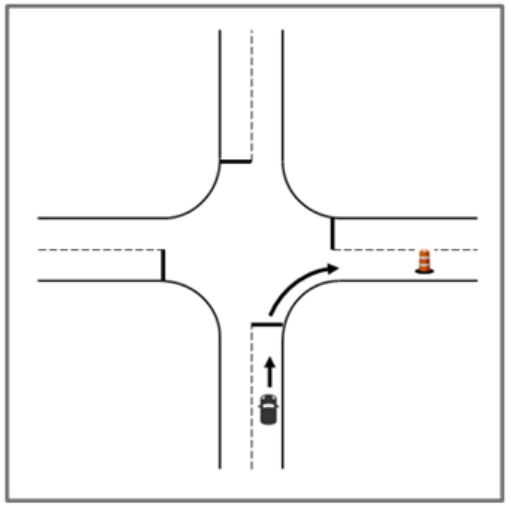
Manual and Wireless E-Stops (2 tests)



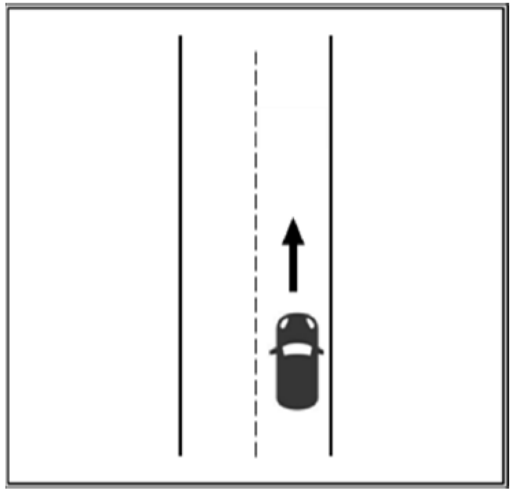
Lane Keeping



Left Turn



Right Turn



White lines detection

Qualifications Testing

Test Q.1 E-Stop Manual

1. Test Goal

This test is intended to evaluate safety features of Manual E-Stop.

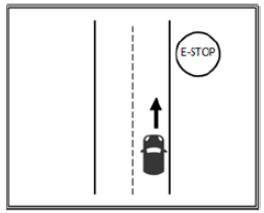


Figure 3: Qualification Testing. E-Stop Manual

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1 on the side of the road** to indicate a starting point at which vehicle is stationary
- **Barrel 2 on the side of the road** to indicate the position where E-Stop button is pressed
- **Barrel 3 on the side of the road** to indicate the maxim distance for the vehicle to come to the complete stop. The distance between Barrel 2 and Barrel 3 is 14 feet

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at Barrel 1
4. Vehicle maintains the target speed
5. Judge manually pushes E-Stop at Barrel 2
6. Vehicle comes to full stop before reaching Barrel 3.
7. End test run

4. Evaluation

Pass Criteria - vehicle is able to stop before reaching **Barrel 3**

Test Q.2 E-Stop Wireless

1. Test Goal

This test is intended to evaluate safety features of Wireless E-Stop

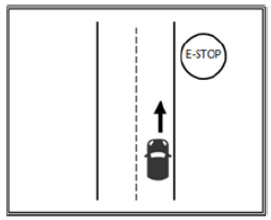


Figure 4: Qualification Testing. E-Stop Wireless

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1 on the side of the road** to indicate a starting point at which vehicle is stationary
- **Barrel 2 on the side of the road** to indicate the position where E-Stop button is pressed
- **Barrel 3 on the side of the road** to indicate the maxim distance for the vehicle to come to the complete stop. The distance between **Barrel 2** and **Barrel 3** is 14 feet

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at Barrel 1
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Judge manually pushes E-Stop at Barrel 2
6. Vehicle reaches full stop before reaching Barrel 3.
7. End test run

4. Evaluation

Pass Criteria - vehicle is able to stop before reaching **Barrel 3**

Test Q.3 Lane Keeping (Go Straight)

1. Test Goal

This test is intended to evaluate if the vehicle is able to stay within lane boundaries, without wheels crossing the line or driving on the line.

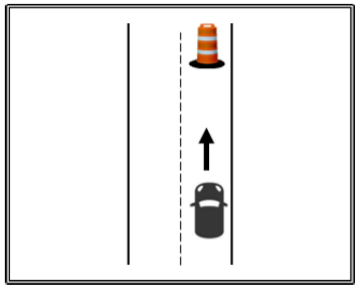


Figure 5: Qualification Testing. Lane Keeping. Go Straight

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1 on the side of the road** to indicate a starting point at which vehicle is stationary
- **Barrel 2** about 50 ft away to indicate an ending point.
- A duct tape's mark placed 3 ft from the **Barrel 2**

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Vehicle reaches full stop within 3 ft (+- 2 inches) from the **Barrel 2**
6. End test run

4. Evaluation

Pass Criteria - vehicle stays within lane boundaries without wheels crossing the lines. Vehicle reaches full stop within 3 ft (+- 2 inches) from Barrel 2.

Qualifications Testing

Test Q.4 White Lines Detection

1. Test Goal

This test is intended to evaluate detection of white lines using traditional Machine Vision algorithms. There are NO PENALTIES for crossing or moving over a line. A GUI interface with extracted white lines MUST be present during a run. This test could be performed as a stationary test per judges discretion.

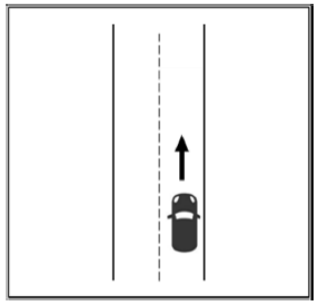


Figure 6: Qualification Testing. White Lines Detection

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. The white lines must be present on the screen.
4. End test run

4. Evaluation

Pass Criteria – GUI interface is present during the run, correct identification of the white lines in front of the vehicle

Test Q.5 Left Turn

1. Test Goal

This test is intended to evaluate if a vehicle is able to make a left turn across the traffic, merge into expected lane and drive within this lane until an obstacle is detected.

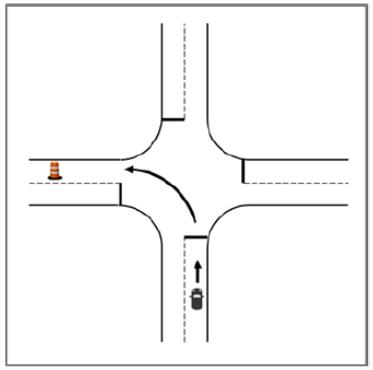


Figure 7: Qualification Testing. Left Turn

2. Test setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary. The Barrel 1 could be placed near the stop bar, or several feet away from the stop bar per judges' decision.
- **Barrel 2** to indicate an ending point. The barrel is placed about 30 ft away from the stop bar in the right lane

3.Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at Barrel 1
4. Vehicle maintains the target speed (between 3 – 5 mph)
5. Vehicle turns left across the traffic and merges into correct lane
6. Vehicle maintains the target speed (between 3 – 5 mph)
7. Vehicle reaches full stop within 5 ft from the Barrel 2
8. End test run

4. Evaluation

Pass Criteria - vehicle is able to turn left, merge into correct lane and stop without hitting abarrel or crossing boundaries

Test Q.6 Right Turn

1. Test Goal

This test is intended to evaluate if the vehicle is able to make a right turn, merge into the lane and drive within a lane until an obstacle is detected.

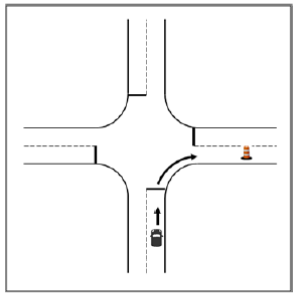


Figure 8: Qualification Testing. Right Turn

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate starting point at which vehicle is stationary. The Barrel 1 could be placed near the stop bar, or several feet away from the stop bar per judges' decision.
- **Barrel 2** to indicate an ending point. The barrel is placed about 30 ft away from the stop bar in the right lane

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at Barrel 1
4. Vehicle maintains the target speed (between 3 – 5 mph)
5. Vehicle makes right turn and merges into correct lane
6. Vehicle maintains the target speed (between 3 – 5 mph)
7. Vehicle reaches full stop within 5 ft from the Barrel 2
8. End test run

4. Evaluation

Pass Criteria - vehicle is able to turn right, merge into correct lane and stop without hitting abarrel or crossing boundaries

Qualifications Testing

Test Q.3 Lane Keeping (Go Straight)

1. Test Goal

This test is intended to evaluate if the vehicle is able to stay within lane boundaries, without wheels crossing the line or driving on the line.

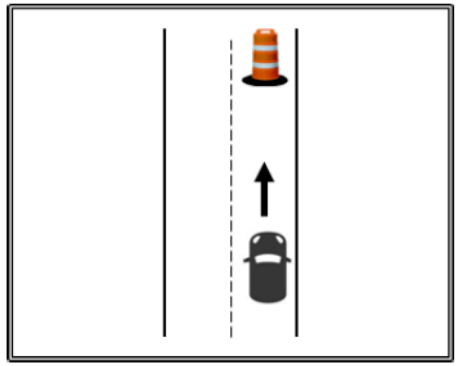


Figure 5: Qualification Testing. Lane Keeping. Go Straight

2. Test Setup

The following items shall be placed on the road:

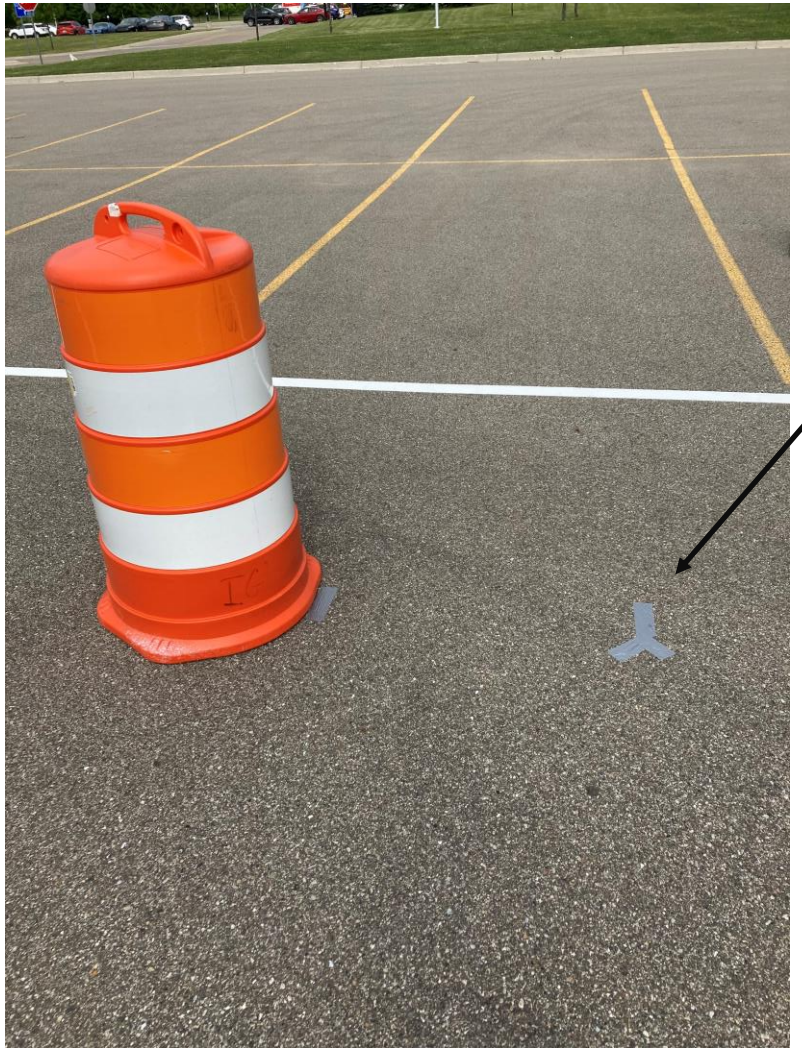
- **Barrel 1 on the side of the road** to indicate a starting point at which vehicle is stationary
- **Barrel 2** about 50 ft away to indicate an ending point.
- A duct tape's mark placed 3 ft from the **Barrel 2**

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Vehicle reaches full stop within 3 ft (+- 2 inches) from the **Barrel 2**
6. End test run

4. Evaluation

Pass Criteria - vehicle stays within lane boundaries without wheels crossing the lines. Vehicle reaches full stop within 3 ft (+- 2 inches) from Barrel 2.



Stop within
3 ft from the barrel
(+- 2 inches)

Qualifications Testing

Q1	**E-Stop Manual Test**
Q2	**E-Stop Wireless Test**
Q3	**Lane Keeping**
Q4	**White line detection**
Q5	**Left Turn**
Q6	**Right Turn**

Functions Testing

Test Type	Test ID	Name	# of Runs	Time	Penalty Points	Comments
I. Traditional Machine Vision Tests						
Function	I.1	Pedestrian Detection				
Function	I.2	Tire Detection				
II. Traffic Sign Tests						
Function	II.1	Stop Sign Detection				
III. Intersection Tests						
Function	III.1	Lane Keeping				
Function	III.2	Left Turn				
Function	III.3	Right Turn				
IV. Parking Tests						
Function	IV.1	Parking. Pull Out				
Function	IV.2	Parking. Pull In				
Function	IV.3	Parking. Parallel				
V. VRU (Vulnerable Road User) Tests						
Function	V.1	Unobstructed STATIC Pedestrian Detection				
Function	V.2	Obstructed DYNAMIC Pedestrian Detection				
Function	V.3	STATIC Pedestrian Detection. Lane Changing				
Function	V.4	Obstacle Detection. Lane Changing				
VI. Curved Road Evaluation Tests						
Function	VI.1	Curved Road Evaluation. Lane Keeping				
Function	VI.2	Curved Road Evaluation. Lane Changing				
VII. Other Tests						
Function	VII.1	Pothole Detection				
Function	VII.2	Merging				

- 3 trials for each test
- Each test is 100 points
- Team picks the highest score out of 3 trials

Functions Testing Overall

F.I.1 Pedestrian Detection

F.I.2 Tire Detection

F.II.1 Stop Sign Detection

F.III.1 Intersection. Lane Keeping

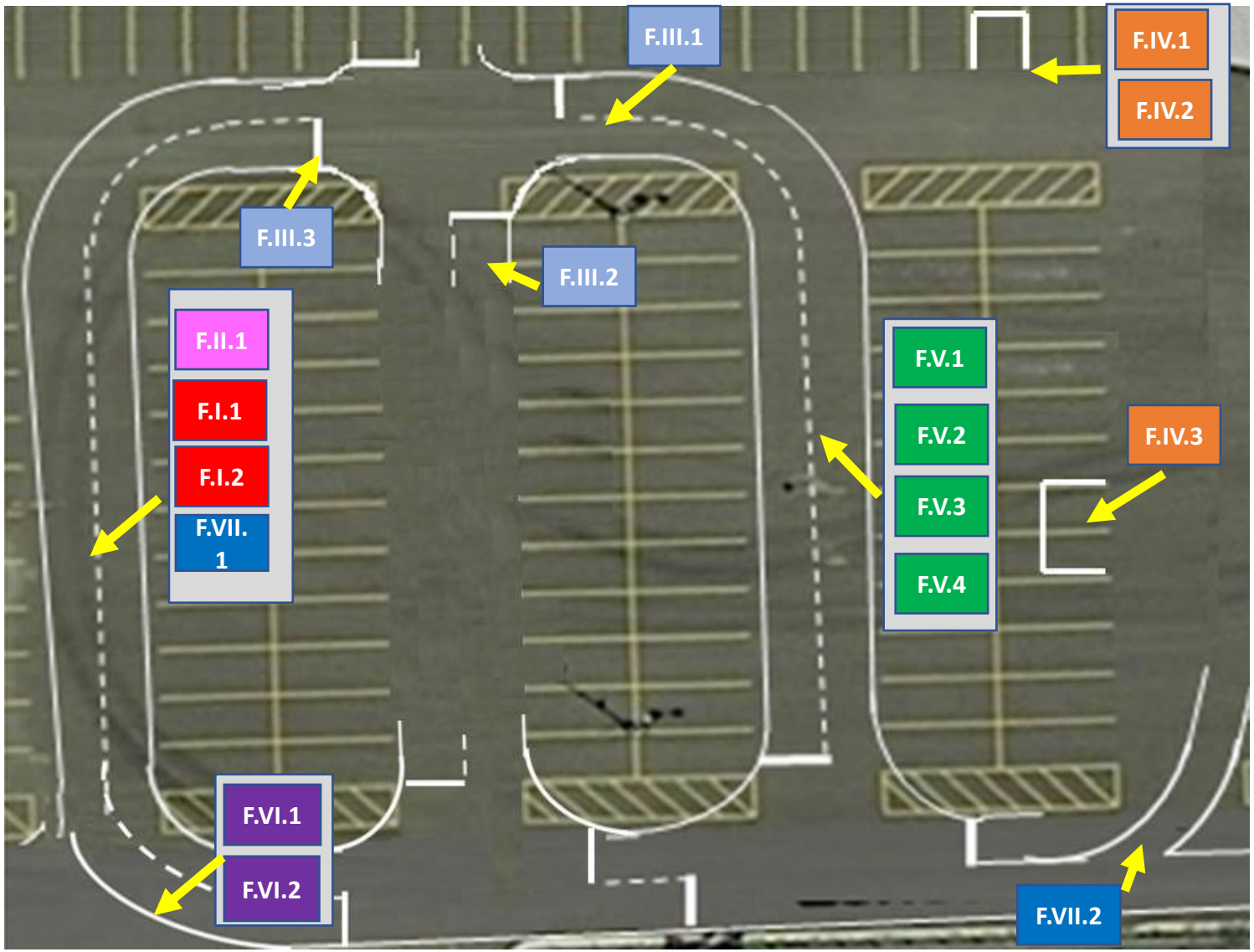
F.III.2 Intersection. Left Turn

F.III.3 Intersection. Right Turn

F.IV.1 Parking. Pull Out

F.IV.2 Parking. Pull In

F.IV.3 Parking. Parallel



F.V.1 Unobstructed Static Pedestrian Detection

F.V.2 Obstructed Dynamic Pedestrian Detection

F.V.3 Static Pedestrian Detection. Lane Changing

F.V.4 Obstacle Detection. Lane Changing

F.VI.1 Curved Road Evaluation. Lane Keeping

F.VI.2 Curved Road Evaluation. Lane Changing

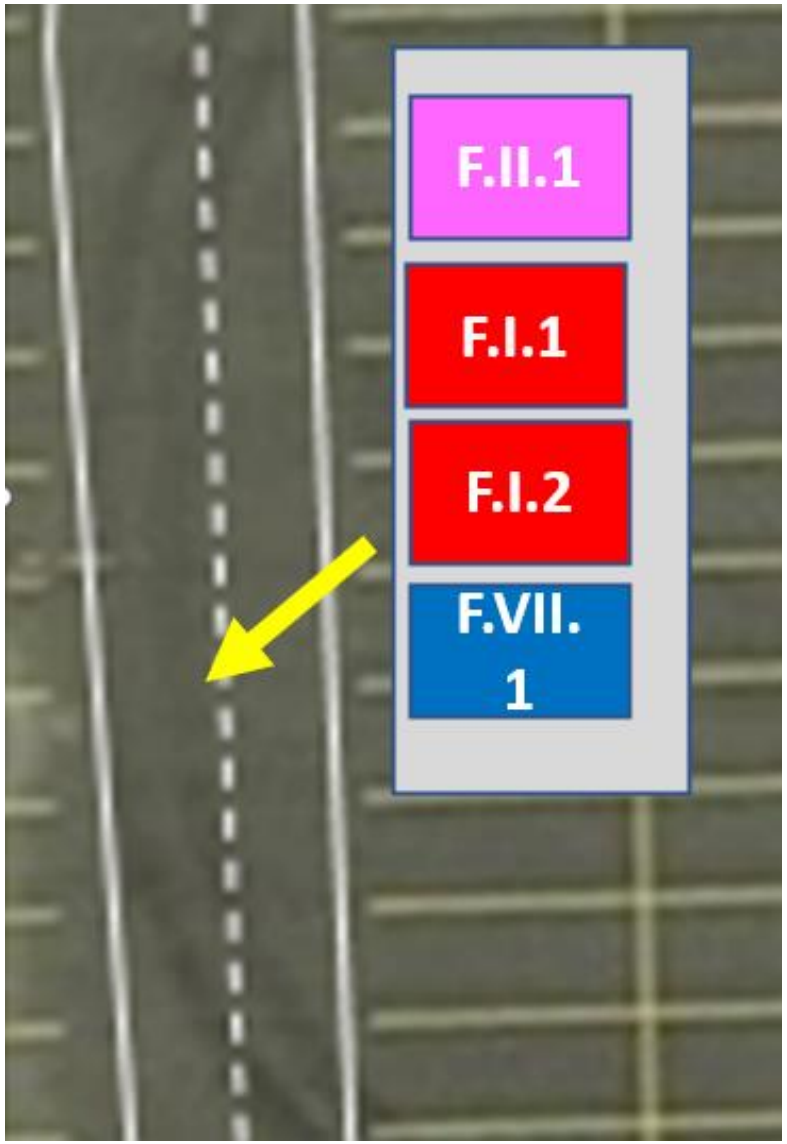
F.VII.1 Pothole Detection

F.VII.2 Merging

Machine Vision and Deep Learning Tests

I. Traditional Machine Vision Tests		
Function	I.1	Pedestrian Detection
Function	I.2	Tire Detection
II. Traffic Sign Tests		
Function	II.1	Stop Sign Detection
VII. Other Tests		
Function	VII.1	Pothole Detection

- No penalties for crossing or moving over the lines
- GUI interface must be present during the run



Machine Vision Tests

Test FI.1 Static Pedestrian Detection

1. Test Goal

This test is intended to evaluate detection of a mannequin using traditional Machine Vision algorithms. A mannequin wears ORANGE construction vest. A GUI interface with extracted orange blob MUST be present during a run. There are NO PENALTIES for crossing or moving over a line.

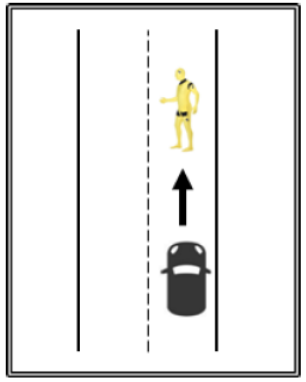


Figure 9: Machine Vision Tests. Static Pedestrian Detection

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate starting point at which vehicle is stationary

3. Test Script
   1. Begin test run
   2. Judge pushes 'start' button
   3. The extracted orange blob is present on the screen.
   4. End test run

4. Evaluation
   Fail Criteria – no GUI interface is present during the run, incorrect identification of the shape/object
   Penalties – no penalties for crossing or moving over the lines, in case if vehicle is moving during the test

Test FI.2 Tire Detection

1. Test Goal

This test is intended to evaluate detection of a small item present in a current lane using traditional Machine Vision algorithms. A GUI interface with extracted shape of a tire MUST be present during a run. There are NO PENALTIES for crossing or moving over a line.

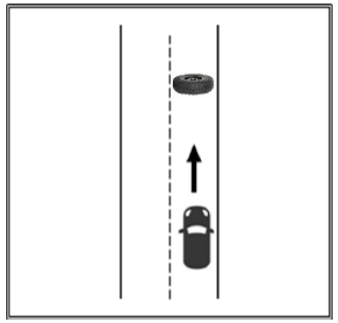


Figure 10: Machine Vision Tests. Tire Detection

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate starting point at which vehicle is stationary

3.Test Script
   1. Begin test run
   2. Judge pushes 'start' button
   3. The extracted tire is present on the screen
   4. End test run

4. Evaluation

Fail Criteria – no GUI interface is present during the run, incorrect identification of the tire
Penalties – no penalties for crossing or moving over the lines, if vehicle is moving during the test

Machine Vision and Deep Learning Tests

Test FII.1 Stop Sign Detection

1. Test Goal

This test is intended to evaluate Stop Sign classification detection and accuracy. Any type of algorithm could be used for this test. Before test, a RANDOM picture might be put on top of a STOP sign. A forgery sign could be red in color with random letters, be a different color with same letters, or be a different picture. Examples used in the previous years: "Soup" and "IGVC" signs. A GUI interface shell display a relevant classification as "Stop Sign" or "Unknown". There are NO PENALTIES for crossing or moving over a lane.

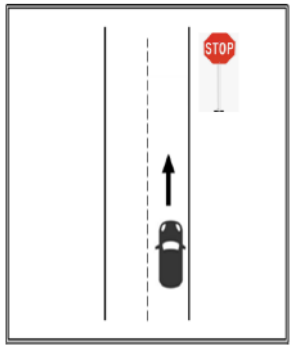


Figure 11: Functions Testing, Stop Sign Detection

2. Test Setup

- **Barrel 1** to indicate starting point at which vehicle is stationary
- **3 different "Stop" signs are being tested randomly**

3. Test Script

1. Begin test run
2. The 1st judge inside of the vehicle pushes a 'start' button
3. The extracted sign is shown on the screen with a correct identification
4. The 2nd judge removes a current sign, and puts a new "stop" sign. It could be a fake or a real sign.
5. The extracted sign is shown on the screen with a correct identification
6. The 2nd judge removes a current sign, and puts a new "stop" sign. It could be a fake or a real sign.
7. End test run

4. Evaluation

Fail Criteria – no GUI interface is present during the run, incorrect identification of any of 3 signs, keyboard touching between the sign changes. To pass the test, all 3 signs must be correctly identified.

Penalties – no penalties for crossing or moving over the lines, if vehicle is moving during the test

Test FVII.1 Pothole Detection

1. Test Goal

This test is intended to evaluate Ego vehicle's ability to detect a pothole and safely change lane.

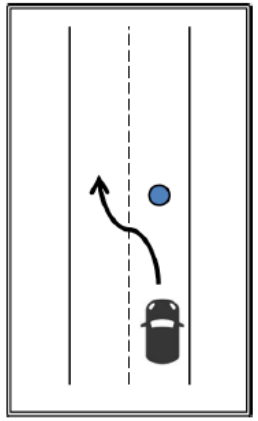


Figure 25: Functions Testing, Pothole Detection

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **Pothole** (2 feet diameter solid white circle or plastic mirror)
- **Barrel 2** to indicate an ending point

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Vehicle detects pothole and safely moves into the next lane
6. Vehicle maintains the target speed in the new lane (between 4 – 5 mph)
7. Vehicle reaches full stop within 3 ft from the **Barrel 2**
8. End test run

4. Evaluation

Fail Criteria – run over the pothole

Penalties - hits barrel at the end of the run (25 points), stops further or closer than 3 ft to the Barrel 2 (10 points)

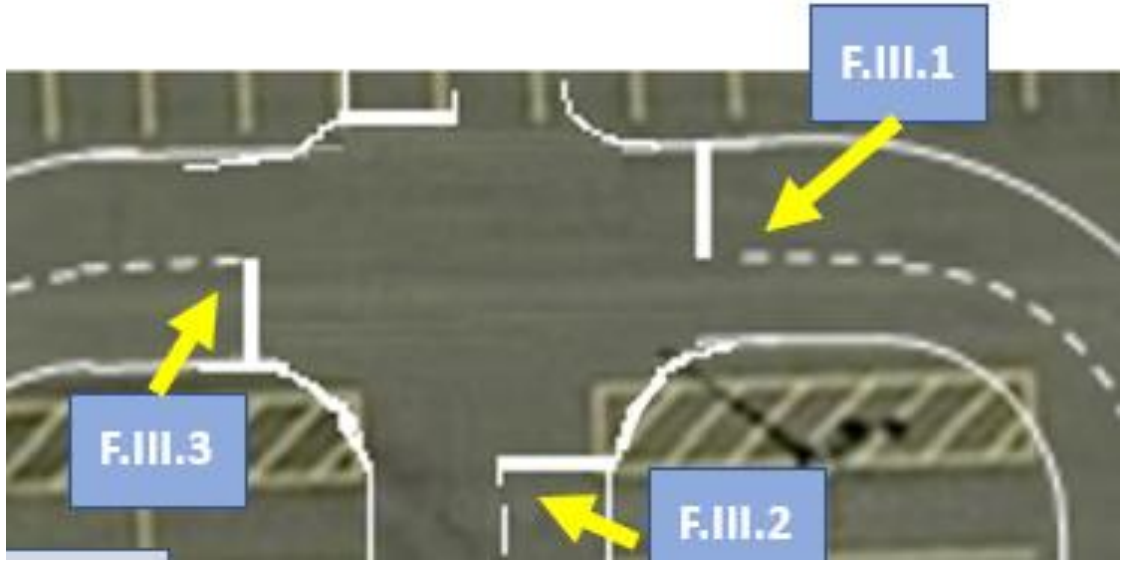
Intersection Tests

Fail criteria for a vehicle:

- Crosses white parallel lines
- Crosses perpendicular white line
- Stops further than 30 cm from a perpendicular line

Penalties:

- Hits barrel at the end of the run (25 points)
- Stops further than 3 ft to the barrel (10 points)



III. Intersection Tests		
Function	III.1	Lane Keeping
Function	III.2	Left Turn
Function	III.3	Right Turn

Intersection Tests

Test FIII.1. Lane Keeping

1. Test Goal

This test is intended to evaluate if the vehicle is able maneuver within lane boundaries, without wheels crossing the line or driving on the line. Additionally, this test evaluates if the vehicle stops at the "Stop" sign at the intersection, goes straight through intersection, and stops before an obstacle placed on the road.

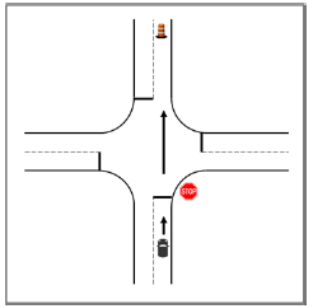


Figure 12: Intersection Tests, Lane Keeping

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **'Stop'** sign
- **Barrel 2** to indicate an ending point
- Duct tape's dashed line to indicate 30 cm from the perpendicular line

3.Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Vehicle reaches full stop within 30 cm from perpendicular white line next to the "Stop" sign. A vehicle's bumper should be within two lines at the time when a vehicle reaches full stop.
6. Vehicle takes off from full stop
7. Vehicle maintains the target speed (between 4 – 5 mph)
8. Vehicle reaches full stop within 3 ft the **Barrel 2**
9. End test run

4. Evaluation

Fail Criteria – crosses white parallel lines, crosses perpendicular white line, stops further than 30 cm from a perpendicular line

Penalties – hits barrel at the end of the run (25 points), stops further than 3 ft from the barrel (10 points)

50

A vehicle's bumper should be within two lines at the time when a vehicle reaches full stop

Intersection Tests

Test FIII.1. Lane Keeping

1. Test Goal

This test is intended to evaluate if the vehicle is able maneuver within lane boundaries, without wheels crossing the line or driving on the line. Additionally, this test evaluates if the vehicle stops at the "Stop" sign at the intersection, goes straight through intersection, and stops before an obstacle placed on the road.

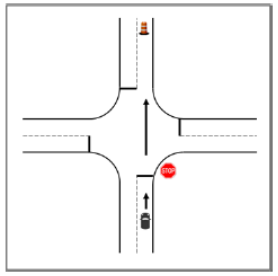


Figure 12: Intersection Tests. Lane Keeping

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **'Stop'** sign
- **Barrel 2** to indicate an ending point
- Duct tape's dashed line to indicate 30 cm from the perpendicular line

3.Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Vehicle reaches full stop within 30 cm from perpendicular white line next to the "Stop" sign. A vehi bumper should be within two lines at the time when a vehicle reaches full stop.
6. Vehicle takes off from full stop
7. Vehicle maintains the target speed (between 4 – 5 mph)
8. Vehicle reaches full stop within 3 ft the **Barrel 2**
9. End test run

4. Evaluation

Fail Criteria – crosses white parallel lines, crosses perpendicular white line, stops further than 30 cm from a perpendicular line

Penalties – hits barrel at the end of the run (25 points), stops further than 3 ft from the barrel (10 points)

50

Test FIII.2. Intersection Testing. Left Turn

1. Test Goal

This test is intended to evaluate if a vehicle is able to stop at the 'Stop' traffic sign, make a left turn across the traffic, merge into expected lane and drive within this lane until an obstacle is detected.

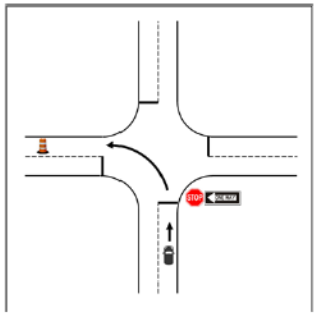


Figure 13: Intersection Testing. Left Turn

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **'Stop'** sign
- **'One Way'** sign
- **Barrel 2** to indicate an ending point
- Duct tape's dashed line to indicate 30 cm from the perpendicular line

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at Barrel 1
4. Vehicle maintains the target speed (between 4-5 mph)
5. Vehicle reaches full stop within 30 cm from perpendicular white line next to the "Stop" sign. A vehicl bumper should be within two lines at the time when a vehicle reaches full stop.
6. Vehicle takes off from full stop
7. Vehicle turns left across the traffic and merges into correct lane
8. Vehicle maintains the target speed (between 4 – 5 mph)
9. Vehicle reaches full stop within 3 ft from the **Barrel 2**
10. End test run

4. Evaluation

Fail Criteria – crosses white parallel lines, crosses perpendicular white line, makes a wrong turn, stops further than 30 cm from a perpendicular line

Penalties – hits barrel at the end of the run (25 points), stops further than 3 ft from the barrel (10 points)

Test FIII.3. Intersection Testing. Right Turn

1. Test Goal

This test is intended to evaluate if a vehicle is able to stop at the 'Stop' traffic sign, make a right turn, merge into the lane and drive within a lane until an obstacle is detected.

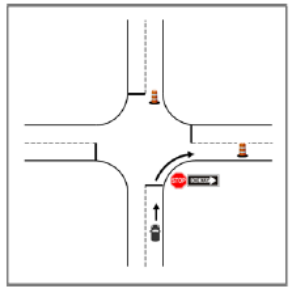


Figure 14: Intersection Testing. Right Turn

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **'Stop'** sign
- **Barrel 2** to indicate an ending point
- Duct tape's dashed line to indicate 30 cm from the perpendicular line

3. Test Script

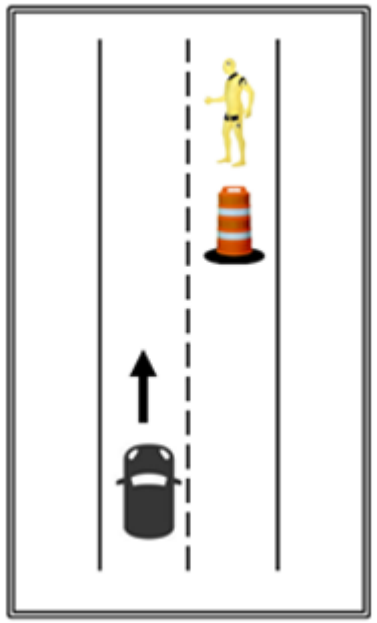
1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Vehicle reaches full stop within 30 cm perpendicular white line next to the "Stop" sign. A vehicle's bumper should be within two lines at the time when a vehicle reaches full stop.
6. Vehicle takes off from full stop
7. Vehicle turns right and merges into correct lane
8. Vehicle maintains the target speed (between 4 – 5 mph)
9. Vehicle reaches full stop within 3 ft from the **Barrel 2**
10. End test run

4. Evaluation

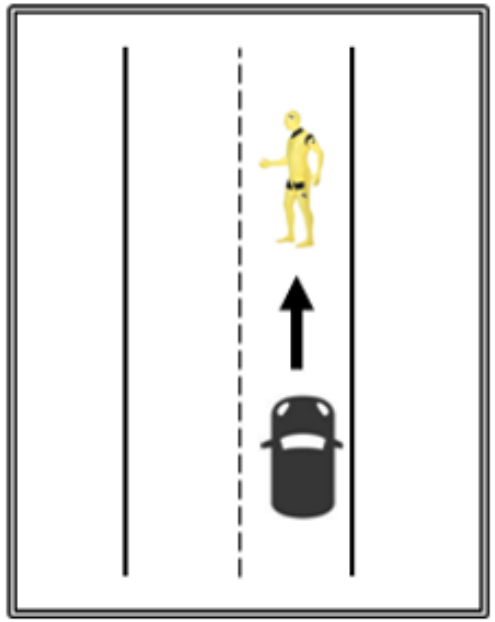
Fail Criteria – crosses white parallel lines, crosses perpendicular white line, makes a wrong turn, stops further than 30 cm from a perpendicular line

Penalties – hits barrel at the end of the run (25 points), stops further than 3 ft from the barrel (10 points)

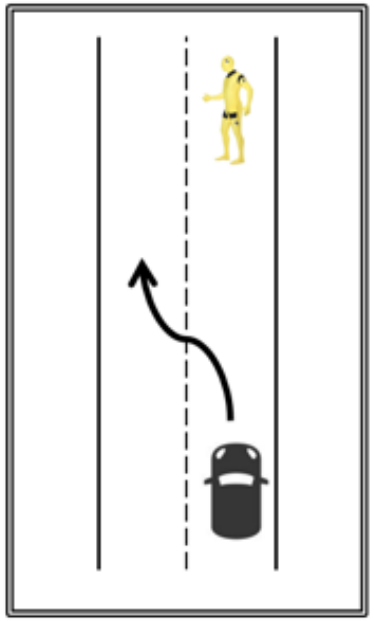
Functions Testing
Pedestrian and Obstacle detection



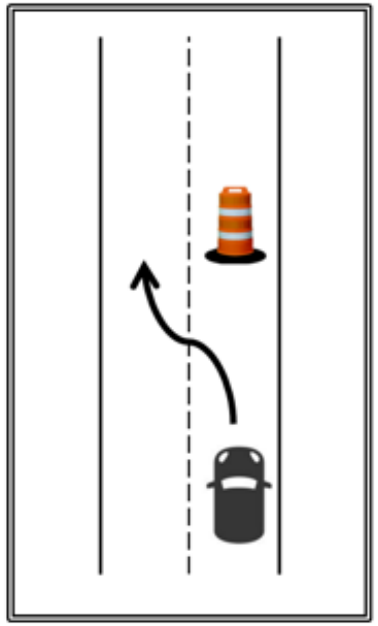
Obstructed Pedestrian Detection. Stop



Unobstructed Pedestrian Detection. Stop



Pedestrian Detection. Lane change



Obstacle Detection. Lane change

Road User and Obstacles Tests

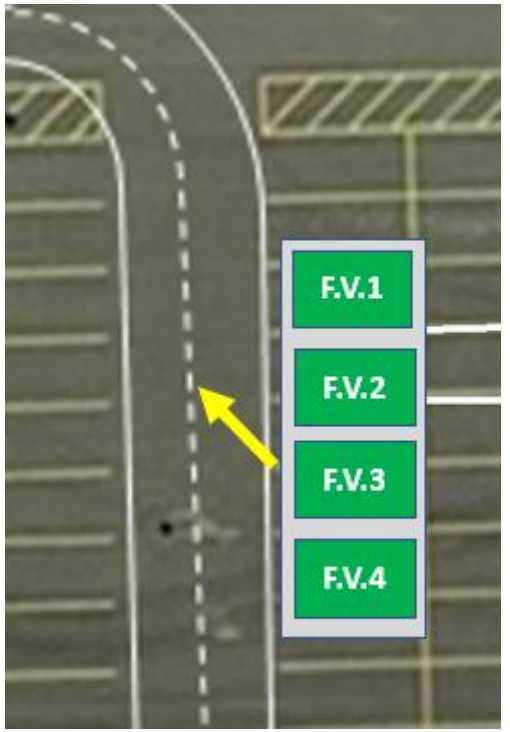
Fail criteria:

- Fails to stop within 5 ft from the mannequin

Penalties:

- 10 points reduction if lane change is completed closer than 10 feet from the obstacle

V. VRU (Vulnerable Road User) Tests		
Function	V.1	Unobstructed STATIC Pedestrian Detection
Function	V.2	Obstructed DYNAMIC Pedestrian Detection
Function	V.3	STATIC Pedestrian Detection. Lane Changing
Function	V.4	Obstacle Detection. Lane Changing



Road User and Obstacles Tests

Test FV.1 Unobstructed STATIC pedestrian detection

1. Test Goal

This test evaluates ability of Ego vehicle to stop if a pedestrian is detected within boundaries of a current lane.

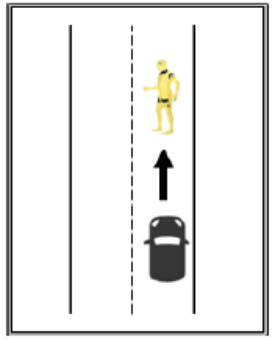


Figure 18: Functions Testing. Unobstructed Static Pedestrian Detection

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **Mannequin**

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at Barrel 1
4. Vehicle maintains the target speed (between 4 – 5 mph)
5. Vehicle reaches full stop within 5 ft from the Mannequin
6. End test run

4. Evaluation

Fail Criteria – fails to stop 5 ft from the mannequin, or hits mannequin
Penalties – hits barrel at the end of the run (25 points), stops closer than 5 ft from the Mannequin (10 points)

Test FV.2 Obstructed DYNAMIC pedestrian detection

1. Test Goal

This test evaluates ability of Ego vehicle to stop if an obstructed by barrel pedestrian (mannequin) suddenly starts crossing an Ego's vehicle lane.

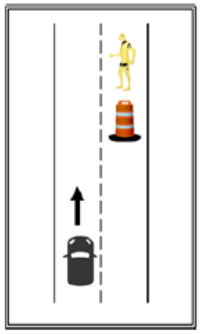


Figure 19: Functions Testing. Obstructed Dynamic Pedestrian Detection

2. Test Setup

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **Barrel 2** placed in adjacent lane, with Mannequin behind it
- **Barrel 3** to indicate an ending point
- **Mannequin**

3. Test Script

1. Begin test run
2. Judge 1 inside an Ego's vehicle pushes 'start' button
3. Vehicle takes off from full stop at Barrel 1
4. Vehicle maintains the target speed (between 3 – 5 mph)
5. Judge 2 rolls out Mannequin from behind Barrel 2 and stops Mannequin in Ego's vehicle lane
6. Vehicle reaches full stop within 5 ft from the Mannequin
7. Judge 2 pulls back Mannequin behind Barrel 2
8. Vehicle takes off from the full stop
9. Vehicle maintains the target speed (between 3 – 5 mph)
10. Vehicle reaches full stop within 3 ft from the Barrel 2
11. End test run

4. Evaluation
Fail Criteria – fails to stop 5 ft from the mannequin, or hits mannequin
Penalties – hits barrel at the end of the run (25 points), stops closer than 5 ft from the Mannequin (10 points)

Road User and Obstacles Tests

Test FV.3 STATIC Pedestrian Detection. Lane Changing

1. Test Goal

This test imitates a situation of a broken vehicle in a current lane with STATIC pedestrian standing in FRONT of barrel(s) in the same lane as Ego vehicle. Ego vehicle must slow down, and safely change into an adjacent lane.

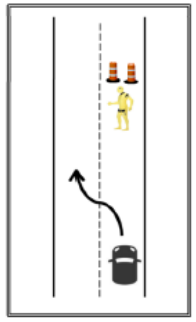


Figure 20: Functions Testing. Pedestrian Detection. Lane Changing

2. Test Setup
There will be a distance of approximately 85 ft between the mannequin/barrel when mannequin will start crossing the road.
The following items shall be placed on the road:
- **Barrel 1** to indicate starting point at which vehicle is stationary
- **Mannequin** to indicate obstacle
- **Barrels 1 and 2 to indicate a broken vehicle in a current lane**
- **Barrel 3** to indicate end of a run

3. Test Script
1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 3 -5 mph)
5. Vehicle detects **Mannequin**
6. Vehicle performs safe transition into the next lane 10 ft away from the Mannequin
7. Vehicle maintains the target speed in the new lane (between 3-5 mph)
8. Vehicle reaches full stop within 3 ft from the obstacle (**Barrel 3**)
9. End test run

4. Evaluation
Fail Criteria –hits mannequin, crosses white solid line
Penalties – hits barrel at the end of the run (25 points), lane change completed closer than 10 feet from the obstacle (10 points)

Test FV4. Obstacle detection. Lane Changing

1. Test Goal

This test evaluates Ego vehicle's ability to safely change lane if a stationary object is present within a current lane.

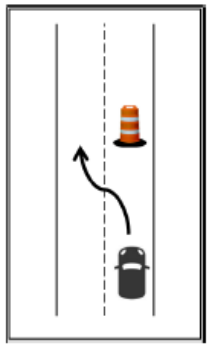


Figure 21: Functions Testing. Obstacle Detection. Lane Changing

2. Test Setup
The following items shall be placed on the road:
- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **Barrel 2** to indicate obstacle
- **Barrel 3** to indicate an ending point

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 3 – 5 mph)
5. Vehicle detects obstacle (**Barrel 2**) and safely moves into the next lane
6. Vehicle maintains the target speed in the new lane (between 3 – 5 mph)
7. Vehicle reaches full stop within 3 ft from the obstacle (**Barrel 3**)
8. End test run

4. Evaluation
Fail Criteria –hits Barrel 2, crosses white solid line
Penalties – hits Barrel 3 at the end of the run (25 points), lane change completed closer than 10 feet from the obstacle (10 points)

Curved Road Evaluation Tests

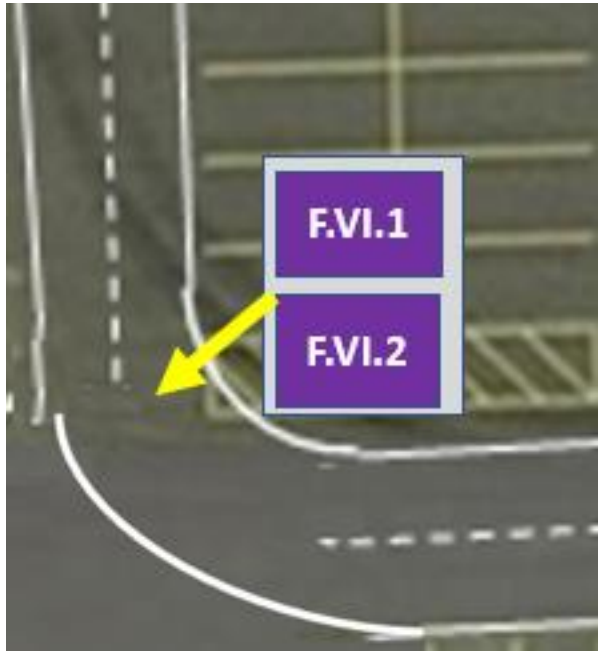
Fail criteria:

- Line excursion
- Hits 1st obstacle barrel

Penalties:

- Stops further than 3 ft from the last barrel (10 points)
- Hits last barrel (25 points)

VI. Curved Road Evaluation Tests		
Function	VI.1	Curved Road Evaluation. Lane Keeping
Function	VI.2	Curved Road Evaluation. Lane Changing



Curved Road Evaluation Tests

Test FVI.1 Curved Road Evaluation. Lane Keeping

1. Test Goal

This test is intended to evaluate Ego vehicle's ability to stay in the lane on a curved road, and be able to stop at the obstacle within a current lane. This test consists of 4 possible case scenarios: driving in right lane on the left curve, driving in left lane on the left curve, driving in right lane on the right curve and driving in left lane on the right curve. Any of above scenarios could be chosen at judges' discretion.

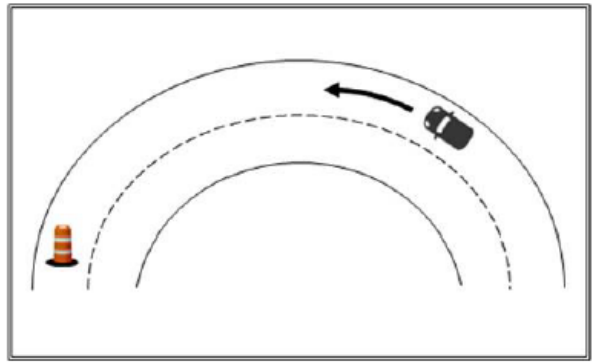


Figure 22: Functions Testing. Curved Road Evaluation. Lane Keeping

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **Barrel 2** to indicate an ending point

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 3 – 5 mph)
5. Vehicle reaches full stop within 3 ft from the **Barrel 2**
6. End test run

4. Evaluation

Fail Criteria – crosses white solid line
Penalties – hits barrel at the end of the run (25 points), stops further or closer than 3 ft to the Barrel 2 (10 points)

Curved Road Evaluation Tests

Test FVI.2 Curved Road Evaluation. Lane Changing

1. Test Goal

This test is intended to evaluate if a vehicle is able to perform a lane change on the curved road if obstacles are detected. This test consists of 4 possible case scenarios: changing right lane on the left curve, changing left lane on the left curve, changing right lane on the right curve and changing left lane on the right curve. Any of above scenarios could be chosen as this year's test.

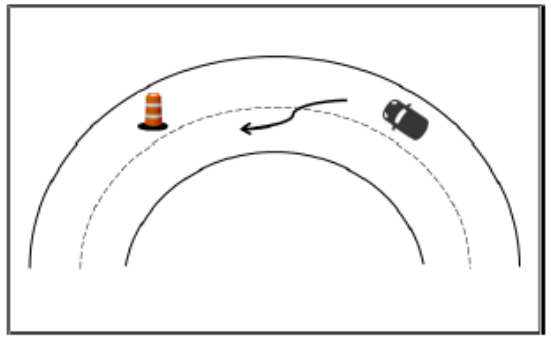


Figure 23: Functions Testing. Curved Road Evaluation. Lane Changing

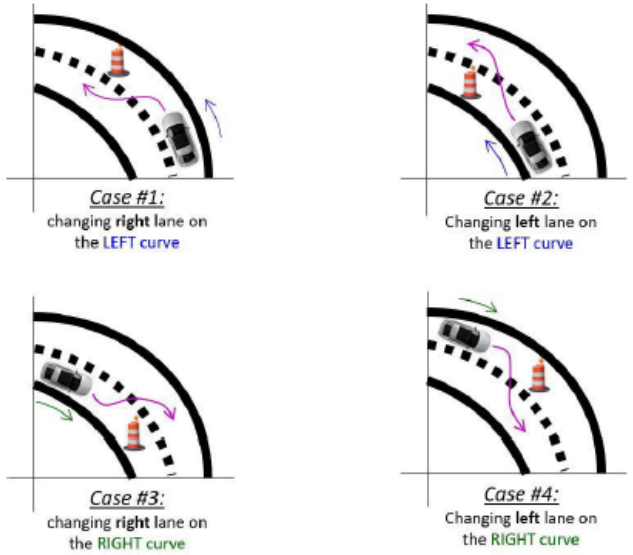


Figure 24: Types of Curved Road Evaluation scenarios

2. Test Setup

The following items shall be placed on the road:

- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **Barrel 2** to indicate an obstacle in current lane
- **Barrel 3** to indicate an ending point

3. Test Script

1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 3 – 5 mph)
5. Vehicle detects obstacle (**Barrel 2**), and safely moves into the next lane
6. Vehicle maintains the target speed in the new lane (between 3 – 5 mph)
7. Vehicle reaches full stop within 3 ft from the obstacle (**Barrel 3**)
8. End test run

4. Evaluation
Fail Criteria – crosses white solid line, hits Barrel 2
Penalties - hits Barrel 3 at the end of the run (25 points), stops further or closer than 3 ft to the Barrel 2 (10 points)

Merging Test

Fail criteria:

- Line excursion

Penalties:

- Stops less than 3 ft from the last barrel (10 points)
- Hits last barrel (25 points)

Test FVII.2 Merging

1. Test Goal

This test is intended to evaluate if a vehicle is able to perform a merge onto a representative highway.

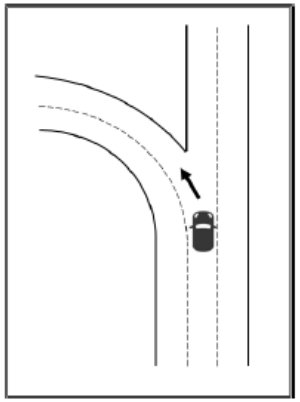


Figure 26: Functions Testing, Merging without Waypoints

2. Test Setup

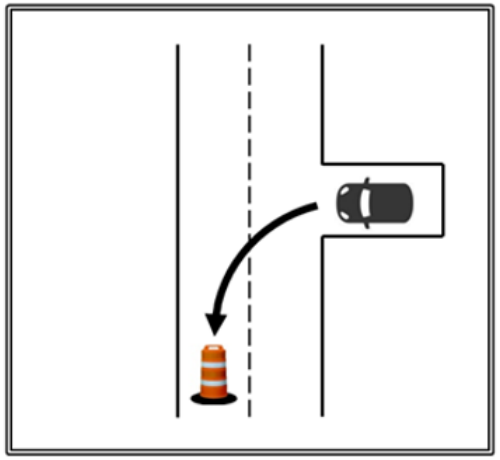
The following items shall be placed on the road:
- **Barrel 1** to indicate a starting point at which vehicle is stationary
- **Barrel 2** to indicate an ending point

3. Test Script

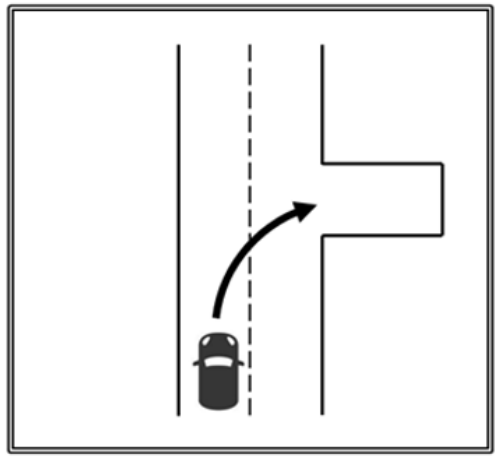
1. Begin test run
2. Judge pushes 'start' button
3. Vehicle takes off from full stop at **Barrel 1**
4. Vehicle maintains the target speed (between 3 – 5 mph)
5. Vehicle merges into the next lane
6. Vehicle maintains the target speed (between 3 – 5 mph)
7. Vehicle reaches full stop within 3 ft from the obstacle (**Barrel**)
8. End test run

4. Evaluation
   Fail Criteria – crosses white lines
   Penalties - hits barrel at the end of the run (25 points), stops further or closer than 3 ft to the barrel (10 points)

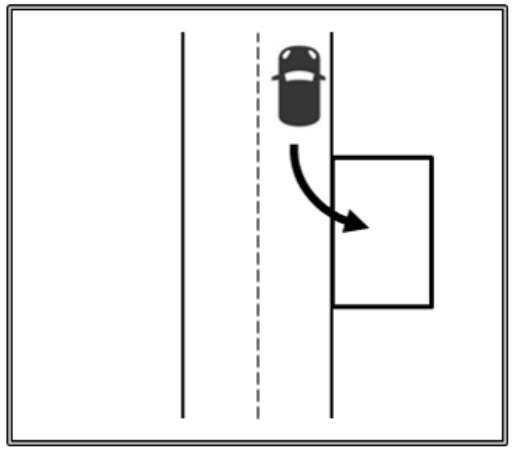
Functions Testing
Parking



Parking. Pull Out

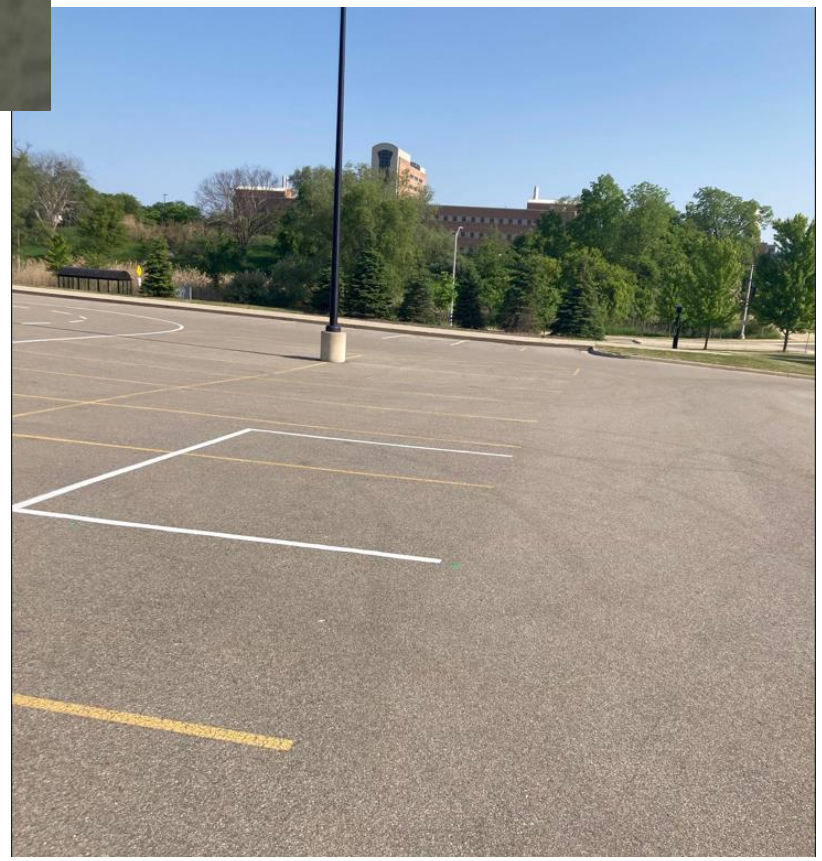


Parking. Pull In

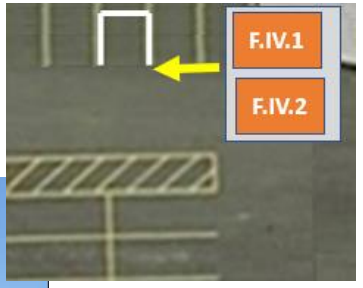


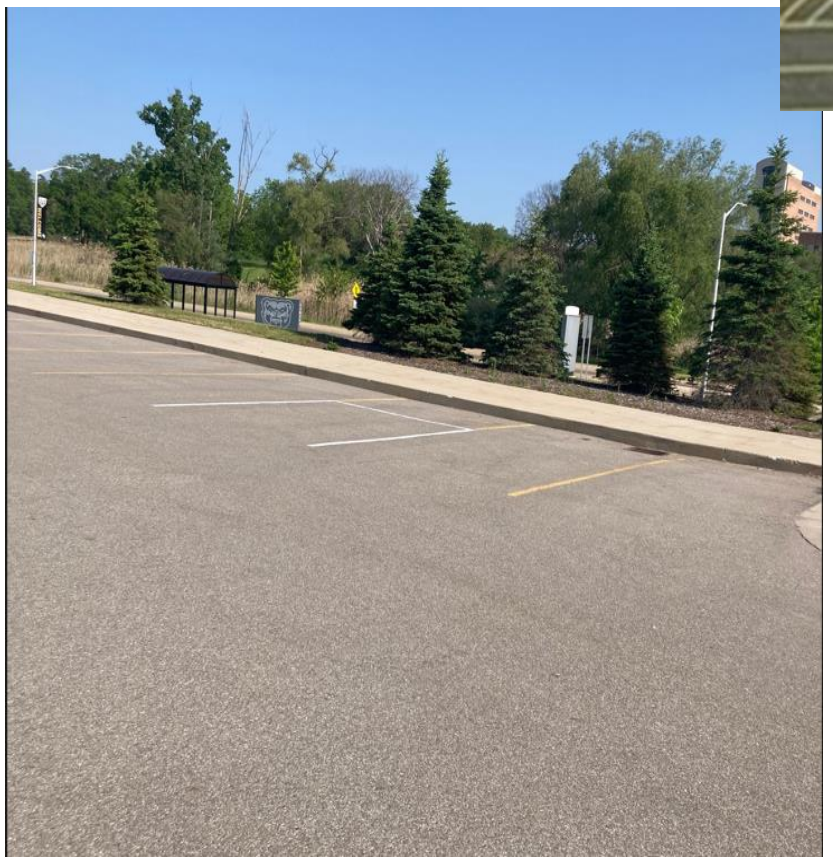
Parking. Parallel

Functions Testing
Parking



Parking. Parallel





Parking. Pull in and Pull Out

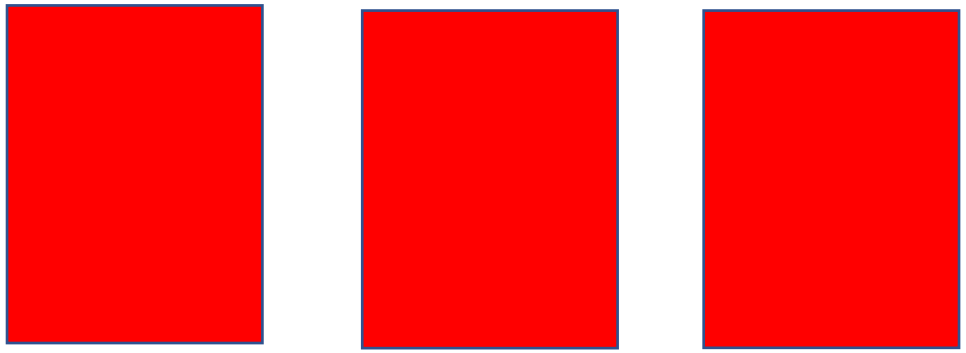
Self-Drive Course Penalties

	Traffic Violations	Ticket Value Points	E-Stop	Measurement
1	Hold-up Traffic	End of Run	Yes	>60 secs. to 88 ft
2	Lane Excursion	- 25	Yes	Yes
3	Crash/Obstacle Displacement	End of Run	Yes	Yes
4	Sideswipe/Obstacle Touch	- 25	No	No
5	Student's Choice E-Stop	- 10	Yes	Yes
6	Judge's Choice E-Stop	- 0	Yes	Yes
7	Blocking Traffic	- 5	Yes	Yes
8	Too slow, did not average 1 mph	Disqualified	No	No

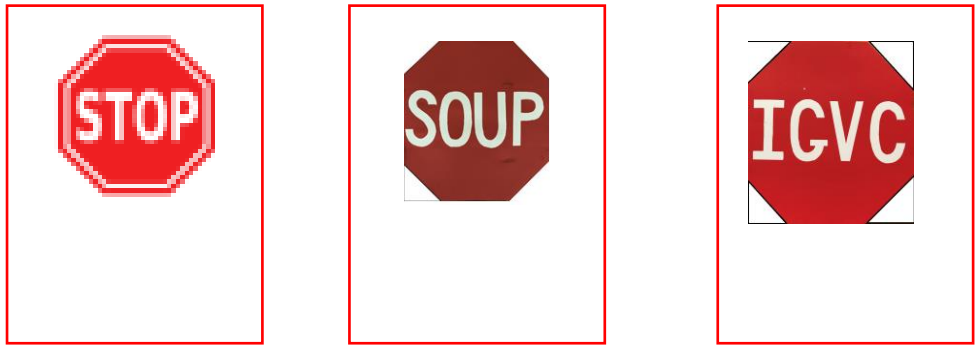
Table 1: Traffic Violation Laws

Self Drive Challenge 2024 Course

- You choose your own stop sign for one of the 2nd round's stop signs.
- Each team might end up with a different sign on the course



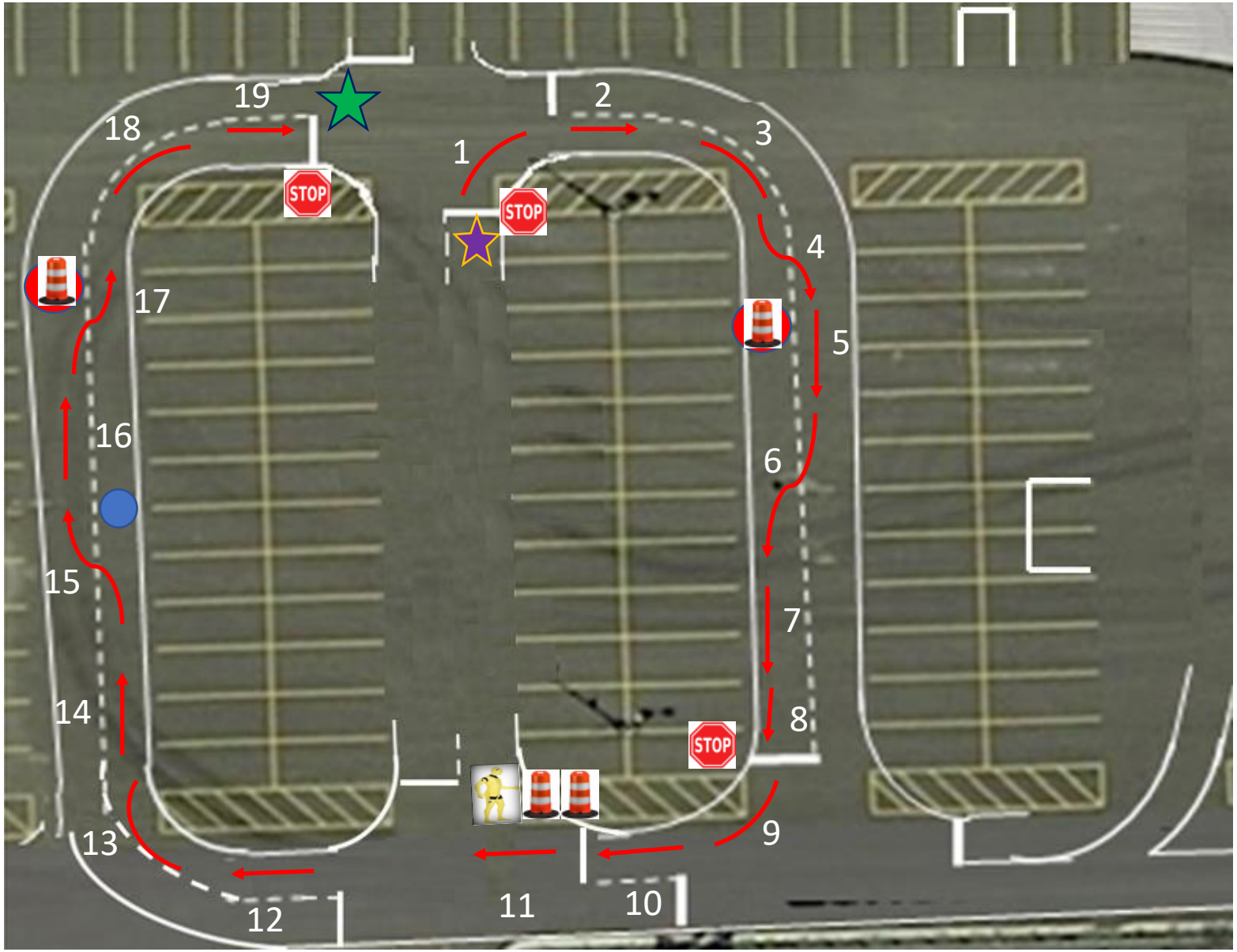
- You will be given 3 cards, and your team will choose which one to flip.
- The one you flip will be your sign. The 3 choices are: "Stop", "Soup" and "IGVC"



Self Drive Challenge 2024 Course

- Self Drive Challenge course consists of two consecutive rounds run together. The 1st round has total 1900 points available, and the 2nd round has total 1100 points available
- Total maximum score is 3000
- If there is a tie, the team with shorter time wins

Self Drive Challenge 2024 Course – 1st round



Rounds:

1st round

Obstacle in the 1st round

start

finish

pothole

Points available in 1st round:

19 points,
100 points each

Penalties:

- Line excursion -25
- Sideswipe/obstacle touch -25

End of Run

- Crush/Obstacle displacement

Obstacles:

Barrels

Mannequin

Signs:

STOP

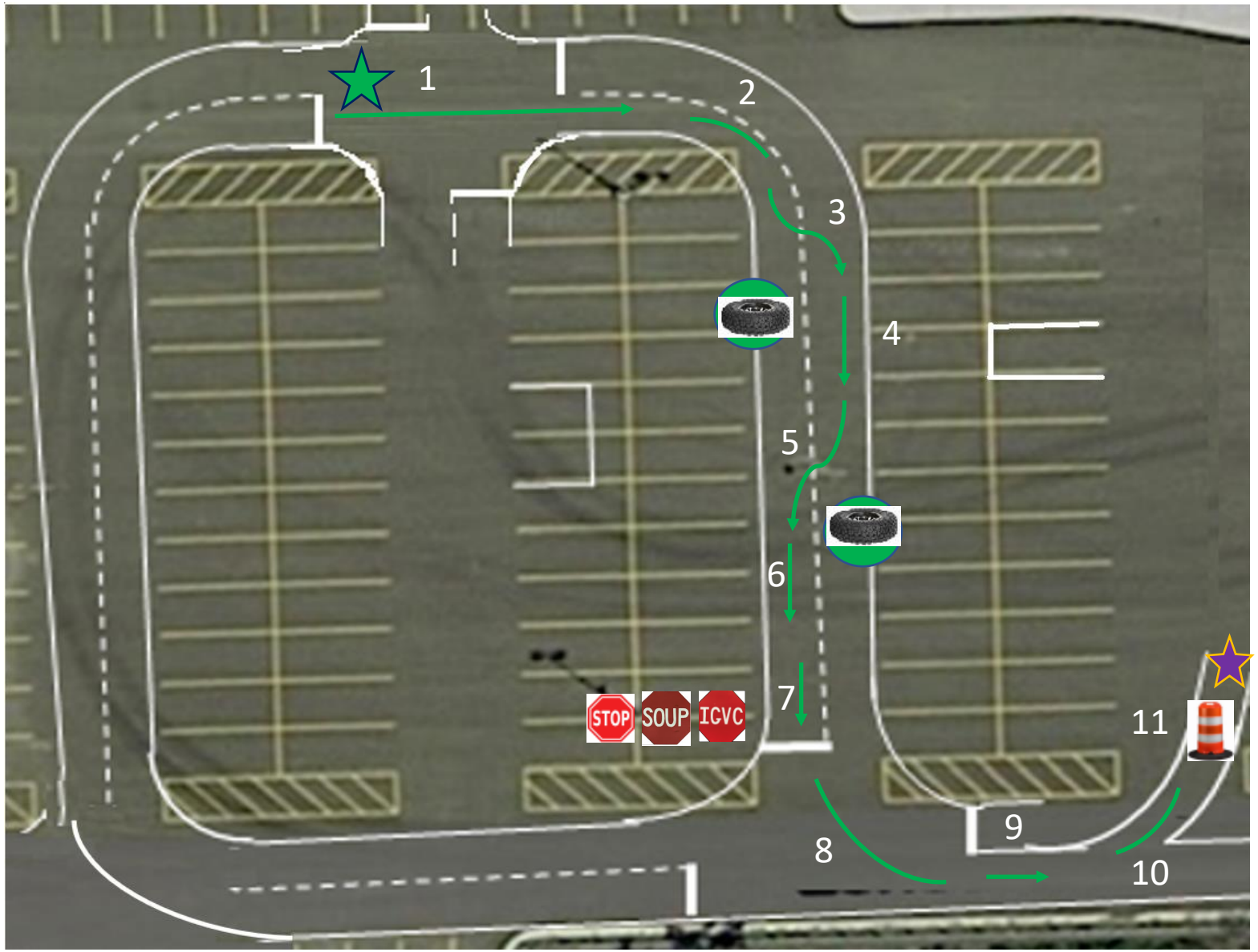
Direction of travel:

straight

change lane

intersection turn

Self Drive Challenge 2024 Course – 2nd round



Points available in 2nd round:

11 points,
100 points each

Penalties:

- Line excursion -25
- Sideswipe/obstacle touch -25
- Incorrect identification of the sign -25

End of Run

- Crush/Obstacle displacement

2nd round

start

finish

Obstacles:

Tire

Barrel

Signs:

Direction of travel:

straight

change lane

intersection turn