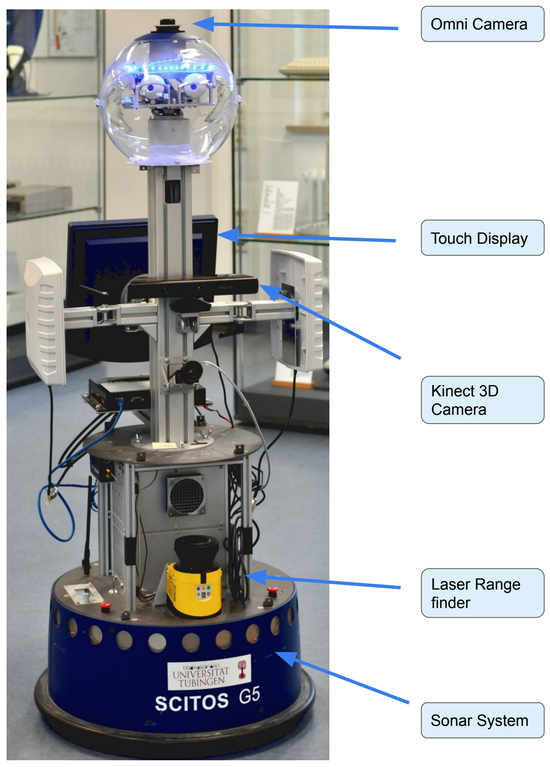
Analyze Ultrasound Sensor Reading Data to Predict the Wall-follow Robot Movement

Ziyuan Wang, Yifan Liu, Tianyue Gao, Yichen Yuan

1) Sensor readings from a wall-following robot

- The data were collected as the SCITOS G5 navigated through the room following the wall in a clockwise direction, for 4 rounds.
- The experiment record measurements of all 24 ultrasound sensors and all the corresponding class label(Moving forward, turning left, etc)
- The experiment also record the ‘simplified distance’. These simplified distances are referred to as the distance between wall



	0	1	2	3	4	5	6	7	8	9	...	15	16	17	18	19	20	21	22	23	24
0	0.438	0.498	3.625	3.645	5.0	2.918	5.0	2.351	2.332	2.643	...	0.593	0.502	0.493	0.504	0.445	0.431	0.444	0.440	0.429	Slight-Right-Turn
1	0.438	0.498	3.625	3.648	5.0	2.918	5.0	2.637	2.332	2.649	...	0.592	0.502	0.493	0.504	0.449	0.431	0.444	0.443	0.429	Slight-Right-Turn
2	0.438	0.498	3.625	3.629	5.0	2.918	5.0	2.637	2.334	2.643	...	0.593	0.502	0.493	0.504	0.449	0.431	0.444	0.446	0.429	Slight-Right-Turn
3	0.437	0.501	3.625	3.626	5.0	2.918	5.0	2.353	2.334	2.642	...	0.593	0.502	0.493	0.504	0.449	0.431	0.444	0.444	0.429	Slight-Right-Turn
4	0.438	0.498	3.626	3.629	5.0	2.918	5.0	2.640	2.334	2.639	...	0.592	0.502	0.493	0.504	0.449	0.431	0.444	0.441	0.429	Slight-Right-Turn

ultrasound reading with corresponding class label

	0	1	2	3	4
0	1.687	0.445	2.332	0.429	Slight-Right-Turn
1	1.687	0.449	2.332	0.429	Slight-Right-Turn
2	1.687	0.449	2.334	0.429	Slight-Right-Turn
3	1.687	0.449	2.334	0.429	Slight-Right-Turn
4	1.687	0.449	2.334	0.429	Slight-Right-Turn

Distance detection with corresponding class label

2) Real World applications of autopilot robotic.

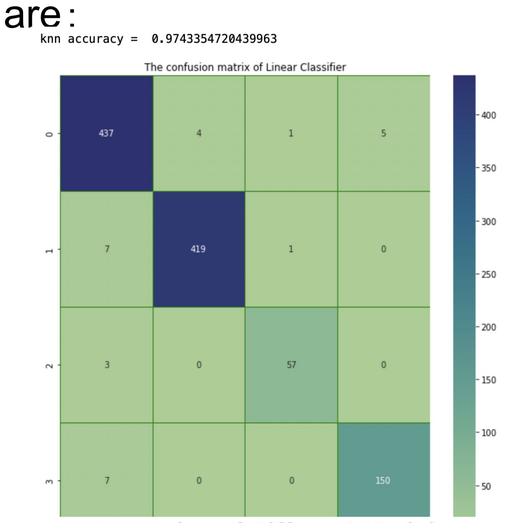
- Amazon’s first fully autonomous mobile robot.
- “Proteus”
- It could move shelf wit the setted route to the destination.

- Delivery robot, “KIWI”
- The delivery robot was tested in the campus dorm.
- Students could order food form application, and this autopilot robot could delivery the food to their apt or dorm.
- This will help to reduce the physical connect and save human resource.

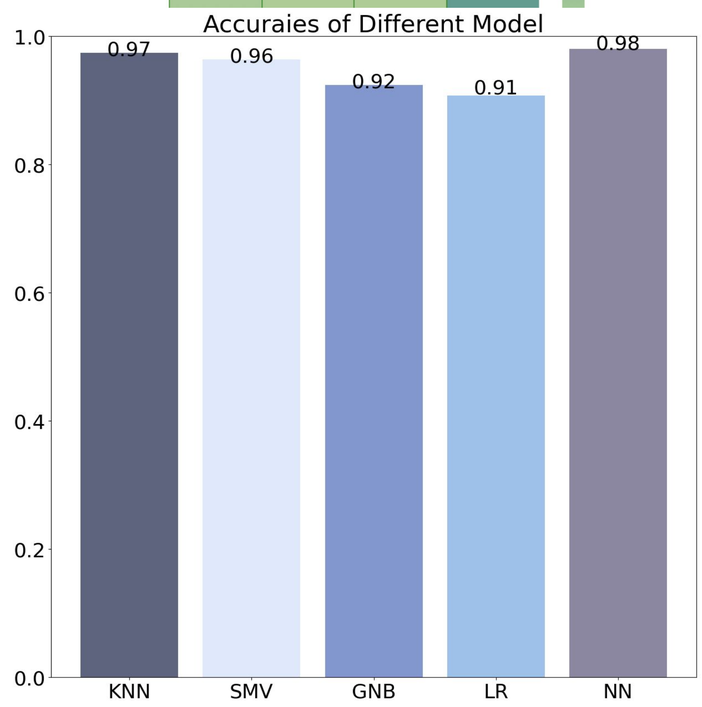
3) The Machine learning algorithm: KNN Classifier

- Different machine learning algorithms will have different effects on different projects, so we tested five possible machine learning algorithms. The five algorithms are:

1. Linear Classification
2. Support Vector Machine
3. KNN Classification
4. Neutral Network
5. Gaussian Naive Bayes

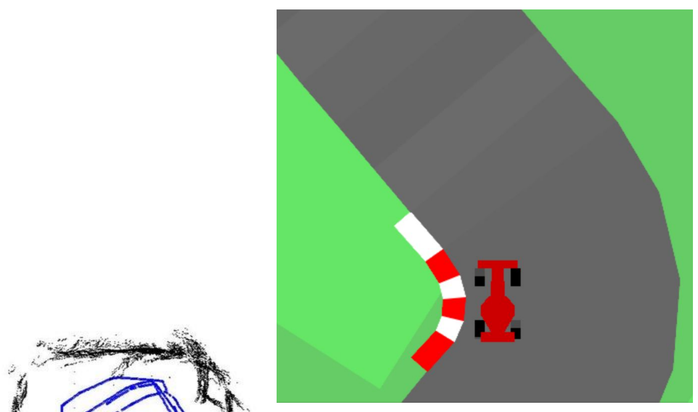


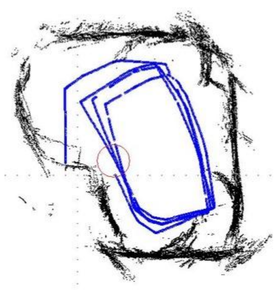
- After testing, KNN Classification got the highest accuracy of 98%.
- Simple introduction to KNN Classification: The principle behind nearest neighbor methods is to find a predefined number of training samples closest in distance to the new point, and predict the label from these.

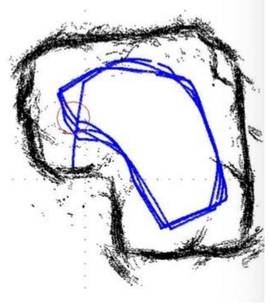


4) Model Simulation

- Although the data is limited, we have made a racing car simulator. Through machine learning, it has been able to roughly run along the route by itself.And users can get the location of the car on the track in real time.







- Future work: Add more functions, such as access control system, to enable users to temporarily change direction.