

## Annex A: Features of Auto Rider at Gardens by the Bay

### About the Auto Rider

Gardens by the Bay's Auto Rider is the first fully-operational self-driving vehicle in Singapore and Asia.

Through a combination of advanced sensors and lasers, this self-driving vehicle is able to navigate independently along a virtual, pre-encoded route.

The Auto Rider supplements the Gardens' existing people-mover system by enhancing connectivity and offering visitors more options of getting around and experiencing the Gardens. As the first of its kind in the region, it also demonstrates the potential of self-driving technology in Singapore.



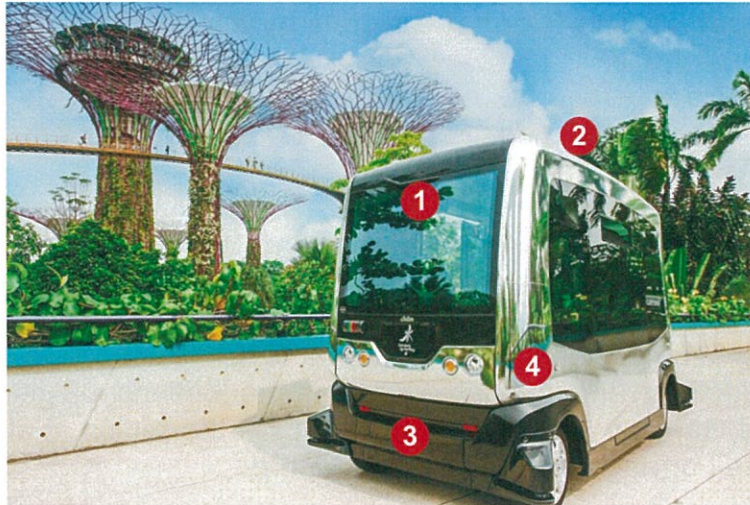
### Specifications

Dimensions	L 4m x B 2m x H 2.75m
Weight	Gross vehicle weight: 2,150kg Load capacity: 1,150kg
Speed	Maximum speed: 40 km/h Operational speed in Gardens: 8-12 km/h
Capacity	Maximum 10 pax <ul style="list-style-type: none"><li>• Seating: 6 pax</li><li>• Standing: 4 pax or 1 wheelchair</li></ul>
Other features	2 information panels showing route taken by Auto Rider 2 speakers Retractable ramp for wheelchair access

### Technology

Produced in Europe, the Auto Rider comes equipped with navigational capabilities including Lidar SLAM, Differential GPS and odometry navigation.

To suit local conditions, Gardens by the Bay has collaborated with ST Engineering to further augment the vehicles with a series of additional technologies that would enable them to navigate smoothly in the mixed-traffic environment of the Gardens, under tropical weather conditions such as rain.



### ❶ Outdoor Visual Navigation

The development focuses on programming algorithms that allow video to see and register the surrounding environment, using camera lenses located at the front and back of the vehicle.

The Outdoor Visual Navigation algorithms will work with Lidar SLAM algorithms (described below), to allow the Auto Rider to operate smoothly in a busy environment where people and other vehicles are in close proximity, under moderate rain conditions (up to 10mm/hr).

### ❷ Lidar SLAM (Simultaneous Localisation and Mapping)

The development focuses on programming algorithms that allow laser data to scan and register the position of the Auto Rider in its physical environment, using laser scanners mounted at the top of the vehicle.

The Lidar SLAM algorithms will work in tandem with the Outdoor Visual Navigation algorithms, to allow the Auto Rider to operate smoothly in a busy environment where people and other vehicles are in close proximity, under moderate rain conditions (up to 10mm/hr).

### ❸ RFID (Radio Frequency Identification) Transponder

In inclement tropical weather and heavy rainfall, a transponder-based navigation technique allows the Auto Rider to continue operating smoothly and safely.

RFID markers placed strategically across the Gardens provide support for the navigation of the vehicle.

### ❹ Navigation-technology Sensor Fusion

Individual navigation techniques can be susceptible to degradation due to multi-path effects, radio frequency interference, or visual obscuration due to weather.

The Navigation-technology Sensor Fusion tracks and compares the characteristics of the navigational cues provided by each technique, evaluates the accuracy and consistency against established criteria, and selects the most optimal combination of techniques based on the location of the vehicle and the current weather condition.