First driverless vehicles for public launched in Singapore

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For greater safety, the steering wheel has been removed and replaced with an in-vehicle touchscreen for alternate selection of destination, and researchers will shadow the two driverless buggies on electric bicycles. Credit: SMART

For the first time, two SMART-NUS enhanced driverless buggies to ferry passengers, free-of-charge, around Chinese and Japanese Gardens, as part of the Smart and Connected Jurong Lake District (JLD) Pilots and Trials initiative.

Fancy a stroll in the Chinese and Japanese Gardens? Why not up the ante, book a ride online and take a driverless buggy ride through the gardens? Making this a reality are researchers and engineers from the Singapore-MIT Alliance for Research and Technology (SMART), and the National University of Singapore (NUS), as Singapore builds up to be the world's first Smart Nation.

This is the first time, not one, but two driverless vehicles are being deployed, free-of-charge for public use. Visitors can obtain Mobility-on-Demand (MoD) by booking any of these vehicles via the online booking website - www.smartnusav.com. From this website, commuters can monitor the locations of the vehicles. The buggies will also feature vehicle-to-vehicle communications that will allow each vehicle to know where the other vehicle is. This allows the buggies to know if there is a possibility of overlapping paths, and for each buggy to intelligently determine how best to move so as to improve the overall efficiency of the fleet.

The driverless buggy trial is part of the Smart and Connected JLD Pilots and Trials initiative, which was launched by the Infocomm Development Authority of Singapore (IDA), in collaboration with URA, EDB and other government agencies such as BCA, HDB, JTC, LTA, NEA, NLB, NParks and SLA. LTA and its partners will use the trial results to better understand the potential opportunities and challenges that autonomous vehicle (AV) technology has for Singapore, and how it can be shaped to suit our needs. The trial also aims to generate awareness of AVs, as well as to help refine the comfort and other aspects of the vehicle based on public feedback.

Dubbed DJ (Driverless Jockey) and BX (Buggy Xtreme), these two golf buggies which have been fitted with no more than $30,000 worth of technology, are set to ferry up to 3 passengers per trip. Travelling up to a driverless speed of 10km/h, DJ and BX will ply the footpaths (see

Factsheet) of the 26.5ha gardens (size of 26 football pitches) from 8am to 2pm from Thursday to Saturday, starting
23 Oct to 1 Nov 2014. Details of extension will be updated on the booking website. The SMART-NUS team targets to fulfil 100 trips within this period and will consolidate feedback to improve the driverless mobility experience. Passengers have to complete a short online survey on the onboard computer before and after the trip.

SMART Project Lead, Dr James Fu said: "Operationally, these autonomous buggies will be closely monitored by the team throughout the whole deployment. Our researchers will shadow the movements of the buggies on electric bicycles. This is to provide an additional level of safety as well as to provide passengers with further elaboration on our research work should any queries arise. This public deployment is very useful to our continued research work as we will not only be gaining invaluable feedback from the public but to also further identify any other limitations of our system through the prolonged deployment."

NUS collaborator from the Department of Mechanical Engineering, Associate Prof Marcelo Ang said: "Having tested the SMART-NUS buggies at the NUS campus for close to four years, we are confident that these buggies will provide the public a safe and comfortable journey within the park. Mobility should be available to all - the elderly, young, or the disabled. We hope that the public will see the usefulness of these vehicles as a possible solution to the 'first-and-last mile' problem, and be comfortable with the idea that such driverless cars can co-exist with pedestrian traffic."

MIT Lead Investigator, Prof Emilio Frazzoli said: "It is very impressive to see the pace in which Singapore is exploring how self-driving vehicles can be used for urban mobility. At the moment, few countries are taking the bold step to consider self-driving vehicles into its eco-system."

With the advancement of autonomous technology, driverless vehicles may soon be a reality in enhancing the lives of Singaporeans. This trial hopes to be a precursor to a new paradigm shift in how we understand transportation, and more specifically, how a disruptive mode of transportation can be a direct positive impact to the people in Singapore.

Moving forward, the research team aims to further improve how the vehicle's path interacts with pedestrian predicted intentions, how the vehicle is able to convey its own intentions to pedestrians, and how multiple vehicles can be used more efficiently. The research is funded by the National Research Foundation, Prime Minister's Office, Singapore under its Campus for Research Excellence And Technological Enterprise (CREATE) programme.

About SMART Research

To allow a fleet of autonomous vehicles to provide Mobility-on-Demand (MoD) which will complement the existing transportation system, so as to reduce the overall commuting time by solving the "first and last mile" problem. This solution will thus reduce the traveling time from the starting location (e.g. commuter's house) to the start of the transportation network (e.g. MRT station) and reduce the traveling time from the end of the transportation network to the final destination (e.g. commuter's workplace).

Our research integrates existing technologies with fresh methodologies to allow driverless vehicles to intelligently provide MoD, with the goal of making this future transportation paradigm a reality. A fleet of driverless golf buggies is used to demonstrate the MoD system.

The SMART autonomous vehicle is a collaborative project between the Singapore-MIT Alliance for Research and Technology (SMART) and the National University of Singapore (NUS); and the golf buggy has

been running driverlessly on the NUS campus since 2011.

Purpose of Deployment at the Gardens

This project involves the deployment of two driverless autonomous golf buggies at the Jurong Gardens in Singapore. Through an online booking system these golf buggies will provide visitors to the gardens with MoD. The purpose of this project is to:

1. Showcase a new concept of transportation
2. Showcase how autonomous vehicles can co-exist with pedestrians
3. Increase public awareness and gain public acceptance of this technology.

Mobility-on-Demand (MoD)

1. Fleet of lightweight Electric Vehicles
2. Strategically distributed charging stations throughout city
3. Providing mobility anytime, and anywhere

Advantages of MoD

1. Does not require fixed infrastructure
2. Fewer vehicles meeting the needs of many
3. Solution to peak hour periods
4. Personalized mobility whenever and wherever you need it
5. Vehicles are better utilized

Autonomous Vehicles

1. Safety - Traffic accidents are the leading cause of death in the 20-30 year old range. Most accidents occur due to human errors. Automation provides the vehicle with:
2. Quicker reaction time
3. Shorter braking time
4. Wider field of view
5. Not distracted
6. Not affected by fatigue
7. Non-aggressive behavior
8. Bad behaviors can be easily corrected

Accessibility - Provide mobility to people who cannot, should not, or prefer not to drive (elderly, youth and disabled).

Productivity - "Commodity" driving is a chore that absorbs a large fraction of people's time, which could be better used.

Efficiency/Throughput - Automated vehicles can cooperate to minimize the effects of congestion. Routes can also be planned to minimise energy wastage, i.e., unecssary braking/acceleration.

Environment - Automated driving can reduce emissions by 20-50%, and efficiently interface with smart power grids.

Better User Experience

- Routes can be planned to make the ride smoother
- Users can be doing other things and not worry about road conditions
- Possible location aware services

Golf Cart Specifications

1. Names: DJ (Driverless Jockey), BX (Buggy Xtreme)
2. 2.395m (Length) x 1.2m (Width) x 1.8m (Height)
3. Weight: ~500kg
4. Current max. autonomous speed in the gardens: 10 km/h
5. Vehicle localization using laser sensors, and not dependent on GPS
6. Vehicle works well in poor lighting as well as indoors
7. Obstacle detection using laser sensors
8. Real-time path planner
9. Dynamic safety zone

Enhanced Specifications (New)

1. Steering wheel removed for increased safety
2. Online booking system
3. In-vehicle touchscreen for alternate selection of destination
4. Vehicle-to-vehicle communication
5. Fleet management system

Provided by ResearchSEA