AUTOMOTIVE TRANSPORTATION

IN THE KGP CAMPUS

We aim to develop an infrastructure of autonomously controlled and dynamically programmed Carriers shuttles in the campus,for which a student could request a ride on through a robust application.

The Basic Picture

We plan to install and develop a system of autonomous 6-10 person carrying electrical shuttles that covers the following features:-

- It is governed by a dynamically controlled path planning algorithm that determines the shortest possible path based upon the current and drop locations of all the people availing the facility at that time.
- Dock Setup:- Implementation of a robust charging dock where these shuttles can return to charge when-
    - They have been left idle for a defined amount of time.
    - Their battery is low.
    - They are out of order(some sort of malfunction)
- The shuttle only accepts requests when its battery can last the ride to the pickup location, drop location and back to the dock (also accounting for the increase in weight and hence a fixed amount of decrease in mileage.)
- When any object approaches the vehicle with a certain speed X,the vehicles calculates the best approach path after calculating all the scenarios where a collision is eminent.

- When any object classified as an obstruction enters within an elliptical area around the shuttle, the vehicle comes to a complete stop.
- This scenario also applies to places like crossroads,sharp turns, signals, etc. where visibility is compromised.
- The avalier can request a shuttle by indicating his pickup location anywhere in the campus through a mobile web-based application.
- We plan to implement a reputation-based reward-punishment system, wherein if an individual calls for shuttles but fails to prevail them, his credibility is compromised.So if the scenario calls for it, this individual will be valued less in terms of the level of service to be provided, as compared to say, someone with a higher reputation.
- Person and abnormality detection cameras inside and outside the vehicle that can detect any wrongdoing/mishappening/misuse of the in, out and around the shuttle and can sound an alarm/inform the authorities for the same.

IMPACT AND BOLDNESS

- The influence of technology on human life has been spectacular. The invasion of technology in most of the fields have been yielding excellent results and transportation is no exception. The point to be highlighted in this discussion is the advantages as well as disadvantages of autonomous vehicles.

ADVANTAGES:

1. Greater Road Safety- Automation can help reduce the number of crashes on our roads. The greatest promise maybe reducing the devastation of impaired driving,drugged driving,unbelted vehicle occupants,speeding and distraction.
2. Greater Independence- People with disabilities are capable of self sufficiency and

highly automated vehicles can help boost their lifestyle .These vehicles can also help the senior citizens in their daily travel.

3. 24/7 availability,can be called anytime, throughout the day and night.Helpful for handling any non-medical uncalled/unknown emergencies.

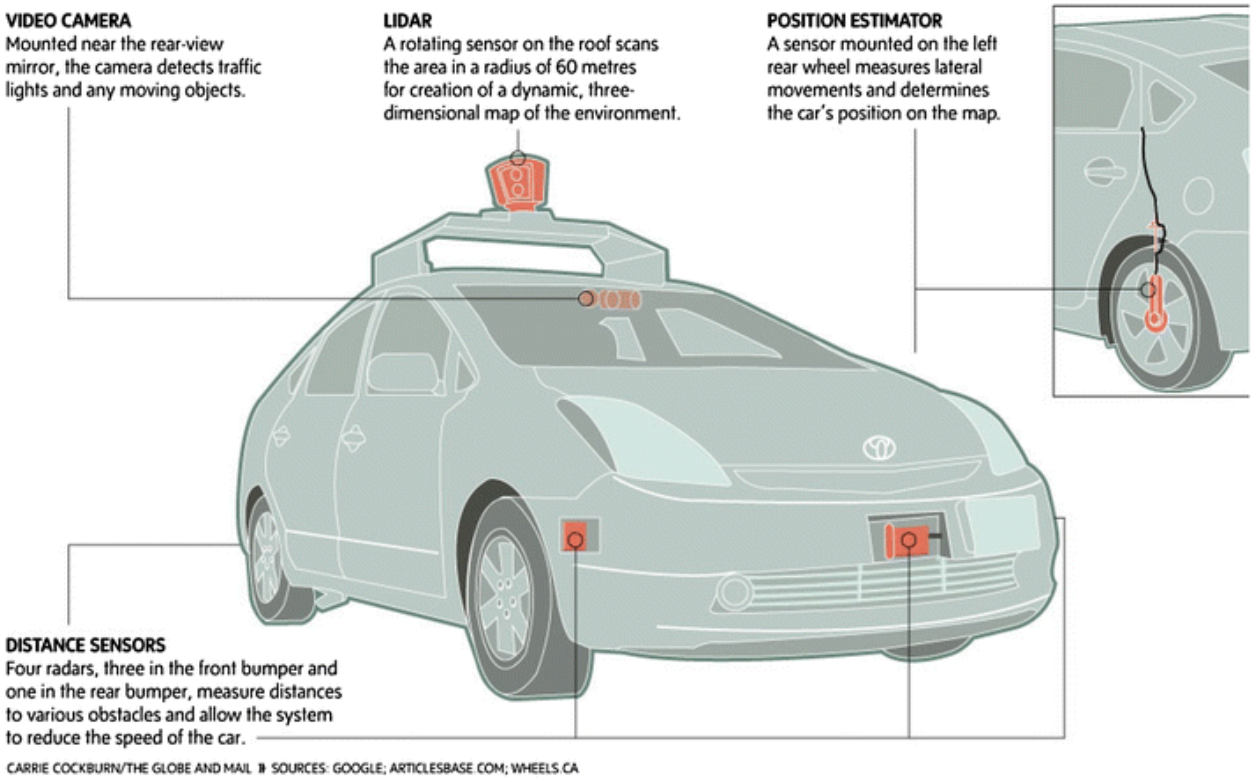
4. Reduced Congestion-HAV maintain a safe and consistent distance between vehicles helping to reduce stop and go waves that produce congestion.

5.Environmental Gains- Since they are electric,These vehicles will help to reduce fuel-use and carbon emissions.

SOUND ENGINEERING ANALYSIS

- THE SHUTTLE HARDWARE
    - A 3 dimensional lidar
    - Multiple cameras for indoor and outdoor monitoring
- THE PATH PLANNER
- THE DRIVER SOFTWARE
- In the autonomous shuttle, one of the major tasks of a machine learning algorithm is continuous rendering of surrounding environment and forecasting the changes that are possible to these surroundings. These tasks are classified into 4 sub-tasks:
    - The detection of an Object
    - The Identification of an Object or recognition object classification
    - The Object Localization and Prediction of Movement
    - The machine learning algorithms are loosely divided into 4 classes: decision matrix algorithms, cluster algorithms, pattern recognition algorithms and regression algorithms.
- **Computer vs Humans: ethics:** If we look at crash optimization, ideally we should program a car to crash into whatever can best survive the collision. Now whilst this sounds good in theory, when you look at it a bit more in depth, it can get confusing. Take for instance a cyclist, if you prioritize whatever could best survive a crash, a program's algorithm would be able to account for the much higher odds someone has of surviving a collision with a helmet on than without one. Now you have a car that, in certain situations, would deliberately target cyclists with helmets on rather than those without, due to its statistical and logical decision-making process. This would effectively punish cyclists for being responsible and thinking about his or her safety.

TECHNOLOGY



BMW says it will start selling a wireless charging pad for its 530e iPerformance hybrid later this year. This connects to a regular power outlet in your garage and feeds the car with electricity when it is parked in the right position (as directed by instructions on the infotainment display). BMW says 3.5 hours is enough to charge the car's 9.5kWh battery.

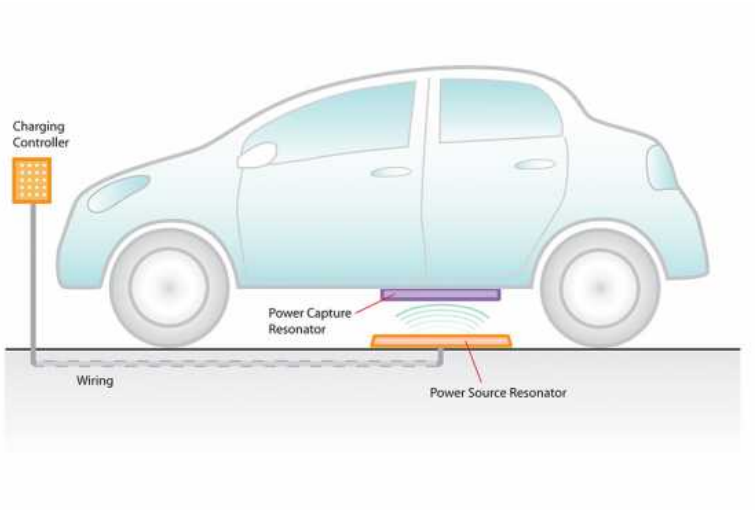
The aforementioned US company Plugless sells wireless chargers for the Tesla Model S, BMW i3, Nissan Leaf and first-generation Chevrolet Volt.

These start at $1,260 (around £880/AU$1,625) for the Volt and increase to over $3,000 (roughly £2,100/AU$3,865) for the Tesla, which charges at 7.2kW and delivers approximately 24 miles of range to the battery per hour. Tesla's own home charger works at 51 miles per hour.

The Plugless system includes two parts; the charger which sits on the floor, and a power receiver which attaches to the car - something which requires professional

installation, but which can be removed when you come to sell the car but want to keep the charger.

Wireless Charging Spot :



Quick charging with high power WEVC, supporting wireless power transfers at 3.7 kW, 7.4 kW, 11 kW and 22 kW with a single primary base pad and wireless power transfer efficiency of 90%+.
Currently, there are a limited number of companies offering the wireless charging technology, but there are a few. Since 2012 Qualcomm Halo has been developing their charging system that's currently used by the Formula E electric race series. They can transfer up to 22kW of power, which is in line with what rapid public chargers are offering.
BMW plans to sell a wireless charging pad for the 530e iPerformance hybrid. It will take 3.5 hours to fully charge the car and works by connecting your home's power outlet.
BATTERY TYPE / CAPACITY (ah) of bmw
9.2 kWh lithium-ion / 90

Implementations in the past

1) COLUMBUS

The latest addition to that list is Columbus, Ohio, where self-driving shuttles are being deployed on city streets. The electric, low-speed vehicles — operated by the Michigan-based start-up May Mobility — will begin testing and mapping local streets before accepting passengers in December, the company said. Eventually,

there could be as many as 10 shuttles operating in downtown Columbus. the site encompasses 5.75 acres (**2.33 ha**; 0.0233 km^2) of land in the western part of downtown.

2) Google WAYMO

Waymo is a self-driving technology development company. Waymo is currently running a trial of an autonomous ride-hailing business in Phoenix, Arizona. The company has announced that the service will be available for public use by the end of 2018.

3) TESLA

In October 2014 Tesla Motors announced its first version of AutoPilot. Model S cars equipped with this system are capable of lane control with autonomous steering, braking and speed limit adjustment based on signals image recognition. The system also provide autonomous parking and is able to receive software updates to improve skills over time.[89] As of March 2015, Tesla has been testing the autopilot system on the highway between San Francisco and Seattle with a driver but letting the car to drive the car almost unassisted.

BUDGETING AND FINANCE

Estimated no. of pedestrians at the peak moment during a normal day- 250 for
→ Leisure (Jogging, walking, etc.)
→ Traversing short distances
→ Traversing large distances

Approximate no. of people likely to use the shuttle service at the peak moment (mainly those traversing large distances)- 50

Assuming the maximum shuttle capacity to be of 10 people, no. of driverless shuttles required- 5
Approximate no. of shuttles broken down in case of any malfunctioning (or in case of any emergency) plus those getting electrically charged at the charging pads-3

Total no. of shuttles required approximately-8

No. of charging/parking stations required=3 (At Tikka, Gymkhana and RP-RK stretch). Additionally, there would be a permanent parking station at Nalanda that provides the space for all shuttle cars to get parked at once.
A small control station that monitors the overall system of shuttle carriers.

Approximate amount of electricity used by each shuttle in a day=20kWh
Total amount of electric energy used by all the shuttles in a day (approximately)= 120kWh

Cost of Driverless SHUTTLE

While current estimates for the cost of a self-driving hardware and software package range from $70,000 to $150,000, “the cost of that autonomous driving stack by 2025 will come down to about $5,000 because of technology developments and (higher) volume,” Clark, Chief Executive Officer, Aptic inc. said in an interview.

So going by the cost of each shuttle car i.e. ($10,000) in the near future, money spent on 8 shuttle cars= 10,000*8=$80,000= Rs.56,00,000.

Approximate expenses for construction and development of parking and charging stations including a mini control centre =Rs. 4,50,000

Extra unexpected and unwanted expenses during the time of installation=Rs.1,50,000

TOTAL COST FOR DEVELOPMENT OF THE SHUTTLE CARRIER SYSTEM= Rs.62,00,000 approx

Cost of one unit electricity supplied to the campus= Rs. 6.5

Amount spent on charging of cars= Rs.6.5 per unit * 120 units= Rs. 780

Extra amount spent daily on cleaning and repairing(if needed) of the shuttles= Rs.250 approximately.

TOTAL OPERATION COST PER DAY= Rs.1000 approximately.

FINANCE

PLANNING AND EXECUTION

We optimised the perfect route for the shuttle to be executed within the IIT campus. And we also planned to implant charging stations at required locations and at regular intervals.