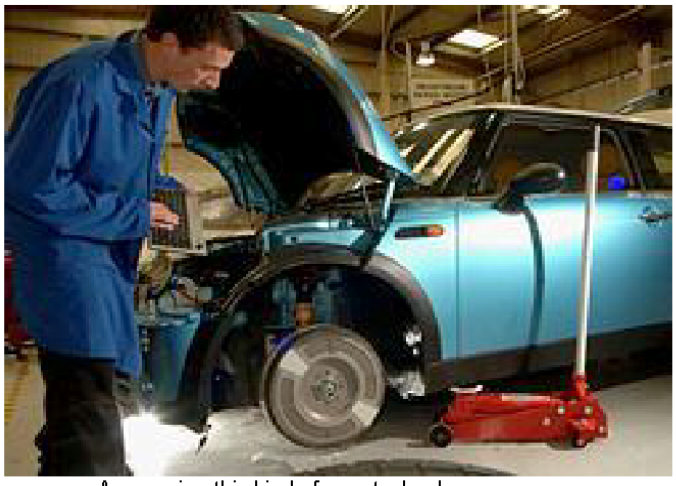
SMART CAR WHEELS

(Reinvention of wheels using AI)

Abstract-

This paper gives the information about how an artificial intelligence is used to build the world's first thinking car wheel. The steering wheels use microcomputers which perform 4,000 calculations per second and communicate with each other. Then the wheels use AI to learn as the car is being driven, making calculations and adjustments according to travelling speed and road conditions. It is the first time artificial intelligence has replaced fundamental mechanics within a motor vehicle and will mean tighter control, a smoother ride and a safer drive, yet the driver remains in control of the car. Artificial Intelligence controls the suspension, steering and breaking systems, teaching it to adapt to bends in the road, potholes and other potential hazards, and compensating by adjusting the car's reactions. The information is retained in the computer's memory and used the next time the car encounters similar road conditions. The car is learning as it drives and adapting its performance accordingly. As the system can adapt to the road conditions and other potential hazards, this means we'll have both safer and faster cars.



A car using this kind of smart wheels

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1. Introduction

India imports almost 65% of the petroleum required for the country and the energy security is threatening for the country. Most of the foreign currency is being used for importing petroleum products. Software development in the country, by using the information technology, has

attained a good self sufficiency in generating foreign exchange and helped the country from risks of devaluation.

Can this knowledge base be utilized to solve the energy security issue? we are proposing intelligent wheels to solve the problem. These smart wheels will be used by the MINI QED, a standard MINI car from BMW converted into an electric vehicle by PML Flightlink. PML Flightlink has successfully converted a Mini into an electric vehicle (EV) with four direct-drive wheels, each with an electronic hub motor of 160 break-horse-power. This combined 640 bhp allows for an acceleration of 0-60mph in 4.5 seconds and a top speed of 150 mph (240 kph). A small 250cc petrol engine charges the car's battery while the car is being driven. In this mode it will run for up to 900 miles before needing to re-fuel, while in pure EV mode it will run for 200 miles.The features and specifications of the MINI QED car and its applications etc are discussed in this paper.

MINI QED

2. Working

The wheels use microcomputers to perform 4000 calculations per second and 'communicate' to each other. The wheels use AI to think and learn as the car is being driven, making calculations and adjustments according to traveling speed and road conditions. Artificial Intelligence controls the suspension, steering and breaking systems, teaching it to adapt to bends in the road, potholes and other potential hazards, and compensating by adjusting the car's reactions. The information is retained in the computer's memory and used the next time the car encounters similar road conditions.

wheels will be fixed with an electric motor or drive for each wheel. The electricity passed to the wheels is controlled from the module based on the soft ware available in the car.

Global positioning system available in the system will note the latitude and longitude data as travel is going on. In the panel if the route map is available car will be tracking its position in the latitude and longitude in the satellite communication. Route can be saved in the computer console and will be remembering the latitude and longitude and as particular location is approaching. It can know the particular adjustments in the speeds of the motors and accordingly the speed will vary and will be able to negotiate the curve. Similarly the road conditions and other things will be negotiated

3. Key Features

1) Traction control and anti skid built into each wheel
The system is fitted with anti skid software. This acts during acceleration and braking. The system monitors rate of change of wheel velocity. This is done at a resolution of over 30,000 parts per wheel rev. Therefore ,we can prevent wheels from skidding.

2) High unsprung weight
The unsprung weight has increased by less than 2 kg over the original standard Mini. This has been achieved in the first part by removal of the disc, brake caliper etc..., Secondly we have designed a very light motor and electronics system. As a comparison the power electronics (included inside the wheel) is around 20 times lighter than the lightest currently available alternative!

The fully laden weight of the standard Mini is 1300kg. The vehicle weight after modifications is less than 1500kg.

3) Blistering acceleration and high top speed
The original Mini with 4 passengers and some luggage is specified as 1300kg. The modified Mini QED weighs in at 1500kg with the same payload. Higher the acceleration the rate of change of speed will be higher and from the zero speed to top speed can be achieved based on the acceleration generated by the automobile. This expressed in number of seconds top speed is achieved.

4) Regenerative braking recovers almost all energy
The motors develop 750Nm each. This torque is relatively flat and drops off to around 600Nm at top speed! So the power is only 120kw at top speed. However, it is the torque which matters since power at lower speeds is low, but for good acceleration (and braking!) torque is what is important. The Super capacitors are sized to hold the full energy of the vehicle kinetic energy at 70mph. This is around 700kj. So as the vehicle speed increases we maintain "space" in the capacitors to absorb the regenerated energy from braking to stop from this speed. Note that the regenerative braking captures about 85% of the available kinetic energy from the vehicle motion.

5)Safety concerns
The braking system is fully dual circuit and each wheel is independently connected to the brake system. Each wheel has several levels of redundancy so any single failure will never prevent the vehicle from operating safely.

6)Sensors
Steering sensor ,yaw, vehicle attitude and gyroscopic sensors are main sensors used in the mini.

7) Heavy batteries
The batteries and super capacitors weigh in the same as the engine and gearbox which was removed. The location of this mass is also precisely the same as the original car, so handling is unaffected. The batteries and super caps weigh around 190kg. PML assembled the cells in groups of 8 cells per pack with a total of 10 packs being used

Battery pack fitted to Mini QED

Sub pack assemblies consisting of of 8 cells

8) Touch screen display

With all this advanced technology the driver needs to have clear and complete information presented to him. The in-car display module provides the latest touch screen technology with intuitive display and scroll options. Showing available mileage subdivided by battery and fuel along with boost status, the display gives comprehensive information. Of course the display shows speed and warning functions, but further it is GPRS enabled allowing:

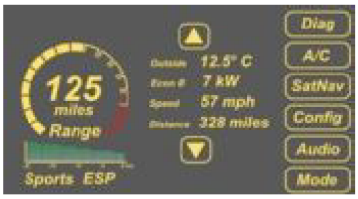
- Remote diagnosis of any fault to allow the "AA" man to come prepared
- Auto tracking of speed limits (optional)
- Auto management of generator to prevent inner city operation via "ECO mode"
- History storage and system configuration interface

screen views will be optional

Alternate colours and fonts will be optional

9) Immediate selection of driving mode

- Eco
- Normal
- Sport



If no warnings or menu items are shown screen re-sizes to show only important information

Each of the 3 driving modes is selectable by a single touch of the in-car display. Imagine starting your journey in the city in Eco mode then selecting Normal mode as you reach the suburbs, and finally Sport mode as you hit the open road.

Main screen is divided into equal areas
for clear display of parameters

Provides full driver information service: (refer the fig above)

- Speed
- Range
- Performance
- Status
- Energy flow map

Reports warnings of:

- Low battery
- Extreme temperatures
- Other out of limit warnings

Future option to link to GPRS allows:

- Journey / energy reserve matching
- Prediction of journey radius available
- Automatic speed limit control (optional)
- Driving license optimised speed constraints
- Remote diagnosis of any system fault conditions
- Auto reporting of breakdowns

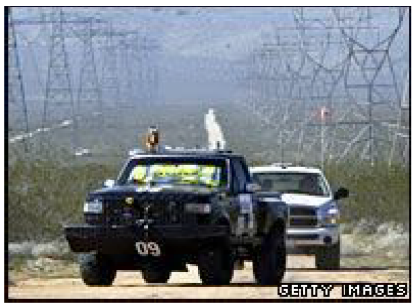
- Auto location for attending engineer

4. Specifications

Item	Original target specification
Emissions	Zero
Autonomy	1500 km
Top speed	200 kph minimum
Acceleration	0-100 kph in 6 secs
Braking	No mechanical brakes
Fuel	Zero carbon
BHP	250 bhp minimum
	Current specification
Emissions	Zero for 4 hours
Autonomy	1500 km
Top speed	240 kph
Acceleration	0-100 kph in 4.5 secs
Braking	No mechanical brakes
Fuel	Carbon neutral option
BHP	> 640 bhp

5. Applications

1.) The Sydney-Berkeley driving team are entrants in the 2007 Darpa Challenge, to be held in October. Sponsored by the United States Government, which wants to develop driverless military supply vehicles for war zones, The most important rule with" No humans allowed". Cars will have to navigate by themselves, avoid other cars, circumvent traffic jams, stop at junctions, follow road markings and give way when they're supposed to. In such situations we can use these kind of vehicles.



An earlier Darpa rally in the desert

2.) Visually impaired person sitting in a car with Global Positioning system can start and drive the vehicle with the aid of the Artificial intelligence.

3.) You might buy a car that has a special button called an 'auto-chauffeur' button, push it and it drives you home and wakes you up in your garage. And maybe we have the self-park button that says 'drop me off at the office then go and find yourself a parking spot'. You could have a mobile phone button that calls the car back when you need it.

6. Conclusion

1. More research should take place in this field to utilize the scarce natural resources and also to take our country into No.1 position.

2. Almost every loss of life in accidents is due to human error. Statistics tells us the truth that these cars are more reliable than human driving.

3. If the system doesn't work properly, the driver remains in control of the car.
4. The next generation of vehicles have the potential to be fully autonomous with global positioning.
5. computer-controlled cars could organise themselves more efficiently, talking to each other to minimise the space they take up on the road without getting too close. That could cut traffic jams and road rage.

References

http://blogs.zdnet.com
http://www.pmlflightlink.com/