I3S TECHNOLOGY

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***Abstract*- I3S is a green technology that automatically shuts the engine when idling and turns it on when needed, thus giving more mileage in congested cities. The experience of being trapped in a traffic jam is hard enough psychologically for most people. For instance, a stop at a red light at an intersection will cause the engine to cut off. When the bike is idle, no gas will burn inside the engine. Once the light turns green and the driver accelerates, the engine should switch back on seamlessly, as though it hadn't been turned off at all. Stop-start systems can cut combined city-highway fuel consumption and greenhouse gas emissions by 3-10 percent. By eliminating engine idling, stop-start systems also reduce toxic and smog-causing tailpipe emissions. One way to combat the issue of frequently stopping, starting and standing still is a technology that can seamlessly switch your engine on and off depending on how your vehicle is operating the key role in this system is of battery. The main purpose of battery is as a part of the idle-stop system that shuts off the gasoline engine when a bike is at rest, coasting or slowing down.**

***Index Terms*- coasting, idle-stop, tailpipe**

I. INTRODUCTION

The Idle Stop-Start System is a low cost method for increasing fuel economy and decreasing emissions. The system turns off the internal combustion engine when the vehicle stops at a stop light or during stop and go traffic where the vehicle would normally idle for a minimum of three to five seconds. The engine is then automatically restarted when the driver is ready to proceed. An electronic control unit determines an appropriate time to turn off the engine based on data from various sensors. An auto start/stop system can reduce greenhouse-gas emissions by 5% to 7%. The national mandate set forth by the Environmental Protection Agency (EPA) to increase fuel efficiency and reduce greenhouse gas (GHG) emissions by 5% each year for all new model mid-size cars, medium-duty cars, and light-duty trucks is pushing automobile makers to convert their fleets to hybrid-electric and micro-hybrid vehicles. Implementing automated start/stop (SS) technology in a passenger vehicle is a cost effective way to improve fuel economy (FE) and reduce emissions without affecting consumer acceptance. In urban areas, where much of the vehicle driving time is spent idling at stop lights or in traffic, the engine can be shut down when the vehicle is stopped to save fuel. The engine is quickly and quietly restarted as the driver demands torque for acceleration.

This operating strategy is often utilized in full hybrid-electric vehicles that have powerful electric systems, but is becoming more popular in micro-hybrid vehicles that use traditional starter/battery configurations. It is challenging to maintain drivability and achieve efficient start-ups using a micro-hybrid configuration. This research investigated the feasibility of using a micro-hybrid configuration to achieve efficient start transients for SS technology. The consumption of energy by the starter/battery was analyzed by creating a model of the engine SS dynamics. The model was calibrated and validated through experimental testing on a vehicle and engine that had been provided. The model was used to simulate start transients for different component packages. As the preliminary simulation results which suggest that traditional starter/battery combinations may be appropriate and a fuel savings of over 5% expected in regulatory urban driving cycles. The model and selected component package will be used for development and control of a SS system in a test vehicle.

II. OVERVIEW ON I3S

I3S means idle stop-start system. Idle start-stop systems replace a car's starter motor and alternator with an electric starter-generator. In automobiles, a start-stop system or stop-start system automatically shuts down and restarts the internal combustion engine to reduce the amount of time the engine spends idling, thereby reducing fuel consumption and emissions. With the stop/start system activated the

engine is automatically turned off and goes to standby mode when the vehicle is brought to a stop at traffic lights, stop signs and in traffic jams.

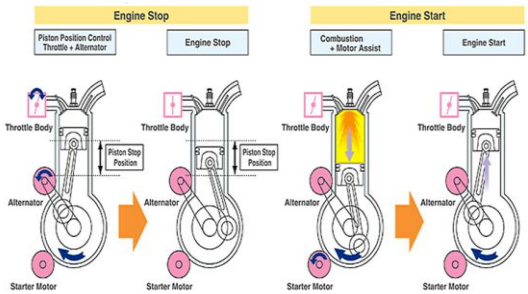
It can quickly start and stop a gasoline engine when the vehicle is at idle, e.g. at traffic lights and in 'stop-and-go' traffic.

III. HISTORY

Devices of this type have been developed by Toyota in 1964 tested since the mid-1970s, when the Toyota Corporation fitted a Crown sedan with an electronic device that would automatically switch off the engine after sitting stationary for 1.5 seconds. Testing showed about a 10% improvement in fuel economy in Tokyo traffic. And firstly in hero motorbike in 2013.

Some of the earliest production vehicles to use this technology were the Fiat Regata "ES"[5] and Volkswagen Polo "Formel E" models of the 1980s. The Volkswagen Group also adopted it in the Golf*Ecomatic* in 1994 and in the Volkswagen Lupo "3L" and the Audi A2 "3L" in 1999. Though these early implementations were considered rather disconcerting by many drivers, and high pricing failed to yield these cars much commercial success, both the Volkswagen Lupo and the Audi A2 (in their "3 litre" leverage) still hold the world record for most fuel efficient production car to date.

IV. ENGINE START-STOP



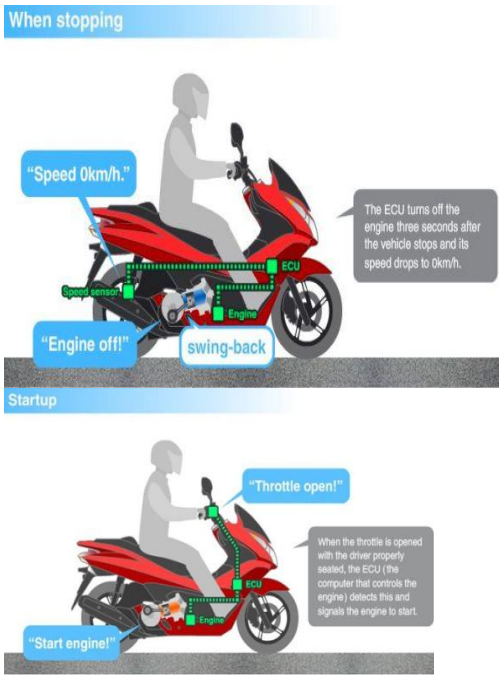
Idling stop systems generally use the starter motor to restart the engine. The i-stop system, however, uses a "combustion start method" to restart the engine. It injects fuel directly into a cylinder of the stopped engine and ignites it to force the piston down. Because the combustion start method requires the pistons to be halted in the optimum position when the engine is stopped, this system requires technology capable of accurately detecting and controlling piston positions.

The starter motor is operated to assist engine restarting, but using mainly combustion power for restarting requires less time and reduces power consumption.

V. WORKING OF I3S

5.1 IN TWO WHEELER:

The key role in this system is of battery. The main purpose of battery, is as a part of the idle-stop system that shuts off the gasoline engine when a bike is at rest, coasting or slowing down. For instance, a stop at a red light at an intersection will cause the engine to cut off. When the bike is idle, no gas will burn inside the engine. Once the light turns green and the driver accelerates, the engine should switch back on seamlessly, as though it hadn't been turned off at all. There are essentially three main parts involved in an idle-stop system: the gasoline engine, an electric starter/generator and a battery. The transfer of energy works in that order, both forwards and backwards — it just depends on what state the bike is in. When the engine is on and you're just about to brake, stop-start systems use regenerative braking, where rotational energy from the wheels turns the electric generator and creates electricity. The generator sends electricity to the battery where it can be stored for later use. When the driver applies the brakes, however, the generator shuts off the gasoline engine. Accelerating the bike, starts the engine once again by taking the stored energy from the battery and running it through an electric starter.



Hero Motor corp has introduced the new i3S technology (Idle Stop and Start System) for two-wheelers which will make its debut in the all-new Splendor iSmart. i3S is a green technology that automatically shuts the engine when idling and turns it on when needed, thus giving more mileage in congested cities. The evolution of Hero-developed i3S technology signifies the technological excellence achieved by the company within a short span of time and HMCL has already filed for patent for this innovation.

5.2 IN FOUR WHEELER:

A start-stop system used in automobiles automatically shuts down and restarts the internal combustion engine to reduce the amount of time the engine spends idling, thereby improving fuel economy and reducing emissions. In a typical situation the driver releases the accelerator pedal, activates the brake paddle and the vehicle comes to a halt. The driver takes the car out of the gear i.e. in neutral position.

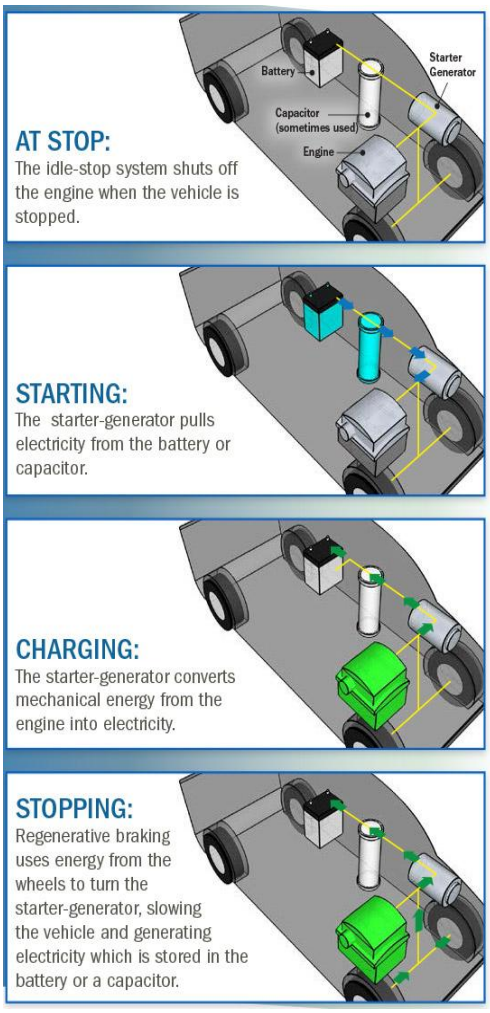


Figure5.2.1Start stop in car

The Engine ECU checks the following:

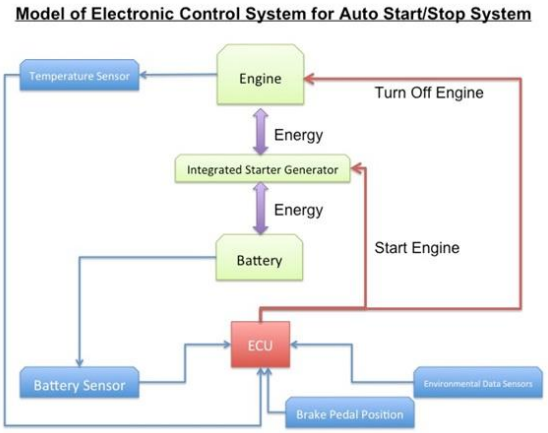
- Engine is in idling condition and no gear is engaged.
- The wheel speed sensor is showing a zero speed.
- Electronic battery sensor is showing adequate battery charge for next start operation.

When all these conditions are satisfied the engine will wait for some manufacturer specific denounce time and then switches off automatically. The starter pinion is engages in the ring gear 1 preparing for the next start. This can causes the engine to be started

quickly. (Ring gear is a medium carbon steel ring with teeth, it transfer torque from the starter motor pinion to the flywheel to rotate the engine to begin the cycle.) As soon as the clutch is actuated the starter receives the signal to restart the engine. The engine is started quickly and quietly and is

immediately ready for operation again . The conditions in which the system will go to stop mode may differ with various customers.

Stop-start systems combine smart electronic controls with a more robust battery, alternator and starter system, as compared to conventional vehicles. The smart electronics system monitors and controls the many onboard systems to ensure the stop-start system works effectively and safely under all driving conditions. The battery, alternator, and starter system is designed to withstand the increased starting and electrical demands and perform seamlessly. Manufacturers often integrate the starter and alternator into a single unit. Some manufactures also integrate regenerative braking, resulting in even greater fuel savings .



The Engine will start automatically, if all the below conditions are met:

- Engine Speed is zero.
- Vehicle Speed is zero.
- Gear Box is in Neutral.
- Bonnet remains Closed.
- Stop Start feature is selected through selection switch.
- Vehicle stopped automatically / stalled due to Auto Stop.
- Clutch Pedal is pressed fully.

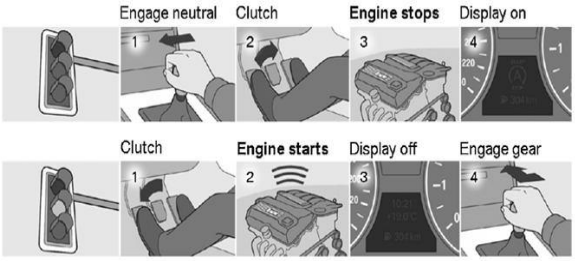


Figure5.1: stop-start working in car

	City	City saving
Without idle stop – start	10.26	11.5%
With idle stop –start	9.08	

VI. NEED OF I3S TECHNOLOGY

Table: fuel consumption in city with or without i3s technology

In comparison to different hybrid concepts i.e. fully hybrid pure electric vehicle which carry

significant costs for returns of improvement in fuel economy, start-stop technology costs relatively much less. It is estimated that start-stop vehicles costs few hundred of Euros additional to conventional vehicles yielding significant improvement in fuel economy (approximately between 5-10%). Start-stop technology is not only promising but also costs a fraction of what its competitor technologies do. To sum up, with ever increasing customer demand for eco-friendly cars, depleting oil reserves, stringent emission regulation, no doubt that SS technology will be a standard or even mandatory technology for vehicles in future.

VII. ADVANTAGES OF I3S TECHNOLOGY

- Fuel consumption is reduced by up to 5% to 10% in city driving.
- CO2 emissions are reduced by up to 5% to 10% in city driving; almost the same as the gain from fuel Economy.
- The engine restarts within 350 milliseconds and in complete silence.
- Eliminate engines noise and vibrations when the vehicle is at a temporary Standstill, which represents 35% of city driving time.

- Implementation cost is not very High (generally in range $300-$400)
- The engine stops and restarts automatically.

VIII. DISADVANTAGES OF I3S TECHNOLOGY

- Fuel saving is not as good as Fully Hybrid.
- some vehicle functions may not run when engine is off (Air conditioner etc.)
- Even though the Implementation is cheap, the vehicle manufacturer will charged huge amount for vehicles with Start-Stop systems.
- In four wheeler this technology required special type of battery and starter.

IX. APPLICATION

- Use in hero splendor ismart bike.
- Mahindra & Mahindra has introduced the stop start based Micro Hybrid system to Indian
- Automotive market known as “Fuel Smart” and is implemented in its SUV’s Mahindra Scorpio_2008, Mahindra Bolero_2010 and Mahindra XUV5OO_2013.
- Tata Motors has introduced this system on their LCV Tata Ace_2010.
- Fiat introduced this system in the end of 2008 in Fiat 500.
- The Honda Civic-Hybrid has been using Start-Stop system since 2006.
- Volkswagen began using Start-Stop system with Polo, Golf & Passat_2007.
- BMW uses Start-Stop technology across many of its cars & MINI line for 2008.

X. CONCLUSION

More than 50% of the newly registered vehicles will have start-stop as standard technology after 2013. Even though the technology is widely utilized for small / mid segment cars in Europe it also has high potential for compact and luxury car segments. It can be expected, that especially Micro-Hybrid technology will gain increasing relevance in the coming years as technological challenges are solved (high voltage electrical system, for e.g. 48V). The Start-stop is a key technology to be used in conjunction with other fuel saving technologies to attain the stringent carbon norms of 2020.

REFERENCE

[1] Peugeot_stop_start_technology_media_kit/2010
[2] Tech_Tuesdays_india_wordpress_automotive_technology_bl og/2010
[3] TSB_2008_100_NMF_00504_Scorpio_M2DI_with_Stop_St art_Mechanism.
[4] TSB_2010_100_NMF_00748_Bolero_PU_Micro_Hybrid_St art_Stop_mechanism.
[5] FEV LDV EU Tec
[6] Fifth Gear-Start/Stop Technology on Renault Megane, YouTube, Mar. 17, 2013.
[7] 2014 Chevrolet Malibu Start-Stop System..., Stephen Edelstein, Green Car Reports, Oct. 10, 2013.
[8] Fuel-Saving 'Stop-Start' Technology to Become Norm, Paul A. Eisenstein, CNBC.com, Dec. 31, 2013.
[9] 7 Cars That Save on Gas in a Way You Won't Believe, Brad Tuttle, Time.com, July 27, 2014.