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"FUEL EFFICIENT TWO WHEELERS USING MICRO-HYBRID TECHNOLOGY& SMART EMBEDDED SYSTEM"

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Development at Kinetic communication

***Abstract*—** Fuel pricing, CO2 emission and conservation of nature have become a hot topic on the international agenda. Due to CO2 emission and other factors global warming is increasing drastically and it is a topic of discussion among engineers, environment mentors and researchers globally. The past decade is driven largely by an effort to meet legislated carbon emissions reduction goals for vehicle fleets. The automakers have introduced technologies that enable internal combustion engines (ICEs) to turn off automatically when vehicles are stopped. These stop-start vehicles are also known as micro hybrids, idle stop vehicles, and a variety of names branded by automakers. These vehicles can offer significant reductions in fuel consumption and CO2 emissions, although the actual saving depends heavily on the drive cycle. Stop-start vehicles require more robust batteries and starter systems than are found in internal combustion engine vehicles and are priced at a small premium over ICEs but considerably less than hybrid vehicles. With the most aggressive environmental goals in the world, Europe has seen so far the greatest selection of vehicles with stop-start technology and, not surprisingly, the greatest volume of vehicles (cars) sold. North America has experienced a relatively slow penetration of the technology due to less stringent emissions reduction goals and an Environmental Protection Agency (EPA) testing cycle that underestimates the benefits of the technology. Worldwide, Pike Research expects more than 41 million of these vehicles (car) to be sold annually by 2020 – nearly a tenfold increase over 2012 sales.

***Keywords*— Micro-Hybrid Technology, fuel consumption, Throttle position sensor, Alternating Current CDI.**

I. INTRODUCTION

The micro-hybrid (start-stop) system is based on an intelligent combination of engine, breaks and battery management. This system automatically shuts down and restarts the internal-combustion engine to reduce the amount of time the engine spends idling in traffic jam, traffic signal or when people chat keeping the vehicle on (idle condition). When the traffic jam is over or traffic signal is released or the chatting of two drivers is finished as the driver raises the accelerator, the system automatically restarts the engine. The micro-hybrid systems are also known as start-stop systems and stop-go systems. This system is most advantageous for the vehicles which spend significant amount of time waiting at the traffic light or frequently come to stop in traffic jam. The electronics ensures the fuel saving, reducing CO2 emission and ultimately conserving nature without compromising convenience. The driver doesn't feel that he has stopped and again restarted the vehicle with any efforts. The stop and restart function is automated in the system. For the non-electric vehicle (called micro hybrid) fuel economy gained from this technology is typically in the range of 5 to 10 percent. We are proposing the micro-hybrid technology in two wheelers with affordable cost. This is because in the urban area the popularity of two- wheelers is increasing day by day.

II. OBJECTIVES

The objective of this system is to help to conserve fuel, nature, money and to generate revenue by converting this system in to the successful product. This whole system includes the smart algorithm, low cost efficient embedded processor and efficient hardware to reduce overall systems cost.

III. BLOCK DIAGRAM

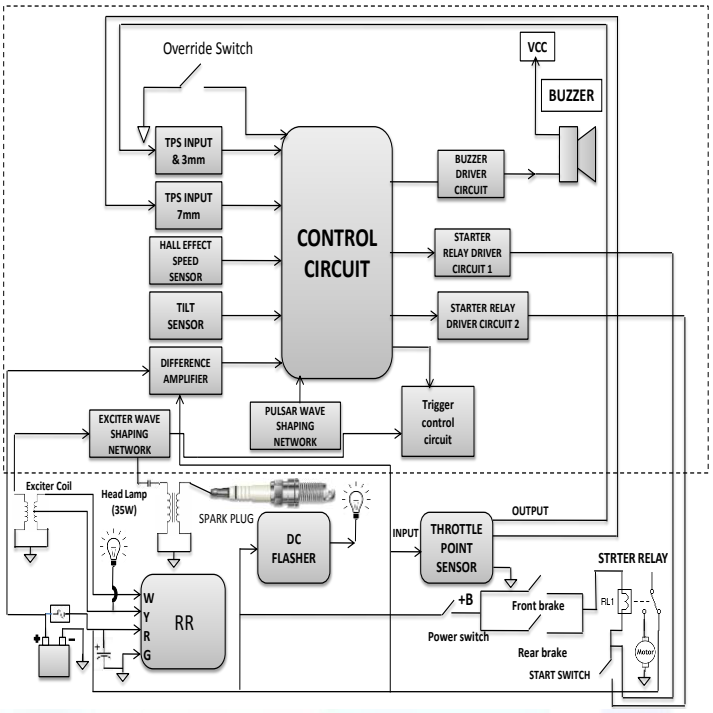


Fig. 1 Total Vehicle System Block

***Details of Each Block*:**

The above diagram is our proposed micro-hybrid unit. It includes one of the basic ignition systems and the micro-hybrid (start-stop system). The purpose of including ignition system and micro hybrid feature is to reduce the system cost as both are interrelated. The systems can design using smart algorithm and embedded processor.

RR (Regulated Rectifier): It is SCR based rectification and regulation potted unit by epoxy resin. Its input is AC voltage which is generated by magneto or alternator and its output is regulated 12V DC and 12VAC. 12V DC is for charging battery and 12V DC loads (systems), 12VAC is for lamps (like head lamps, tail lamps etc).

DC Flasher: It is potted control unit for turn signal. It is manual switch type control. It works as per the specification or guidelines given by ARAI (Automotive Research Association of India).

TPS (Throttle Position Sensor): It is waterproof sealed Throttle position sensor having two outputs; one is used for giving the signal to the control unit for starting the vehicle by accelerator and other is used to change the fuel economical graph i.e. speed vs. angles in degree (it is graph of speed vs. the position of the spark in the piston block system to get the maximum fuel efficiency, spark position is referred in terms of degree considering piston-block top at zero degree and piston-block bottom as 360 degree). The graph of speed vs. angle in degree may refer as map or profile.

Starter motor and starter relay: it is used for starting the vehicle and which is controlled by start switch and accelerator. The dotted unit is nothing but micro-hybrid unit (Start-Stop).

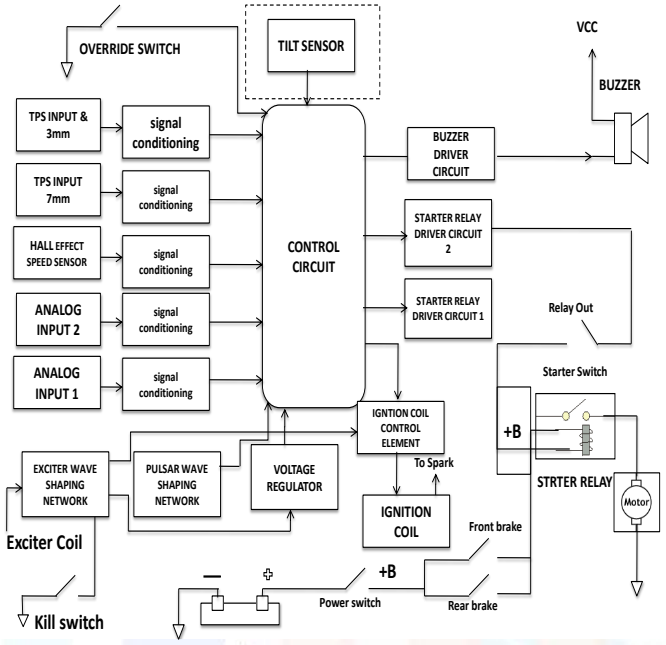


Fig. 2 Start-Stop Controller Block Diagram

IV. TOOLS FOR THE SYSTEM

We used two techniques for the system

1) **Optimization CDI curve i.e. optimum spark position in the piston at various RPM:**

Capacitor discharge ignition (CDI) or thyristor ignition is a type of automotive electronic ignition system which is widely used in outboard motors, motor cycles, lawn mowers, chainsaws, small engines and some cars. It was originally developed to overcome the long charging times associated with high inductance coil used in inductive discharge ignition (IDI) system, making the ignition system more suitable for high engine speed. The capacitive discharge ignition uses capacitor discharge current output to fire spark plugs.

Universal Programmable CDI Tool Box: Universal Programmable CDI Tool Box is efficient tool which used for Mapping Firing Angle Profile for Vehicle .Which is user friendly & having facility to vary RPM & Angle also.

BASIC PRINCIPLE OF PROGRAMMABLE CDI:-

- User has to enter dimple upper limit(in terms of degree) in software from

TDC (Top Dead Centre). The pick-up coil senses the dimple edge at higher limit (in terms of degree) and calculates the required angle and corresponding time with respect to the upper limit of dimple which is sensed by pick-up coil.

Fig. 3 Programmable CDI

In the diagram above, the pick-up coil senses the dimple edge and calculates the angle which is required.

- The user can enter RPM (Revolutions per Minute) and angle in software (total profile) and according to that profile software will calculate the required angle at each RPM and transfers it to the hardware. Hardware will work according to that profile which is entered earlier. User can change angle and RPM online.
- The dimple limit which has to be sensed by pick-up coil is entered by software. From this we can change the angle which we require. We can change angle or RPM in GUI (Graphical User Interface). User should have to enter angle in the range otherwise it takes higher limit default.

2) **Micro hybrid Technology (START-STOP CONTROL):**

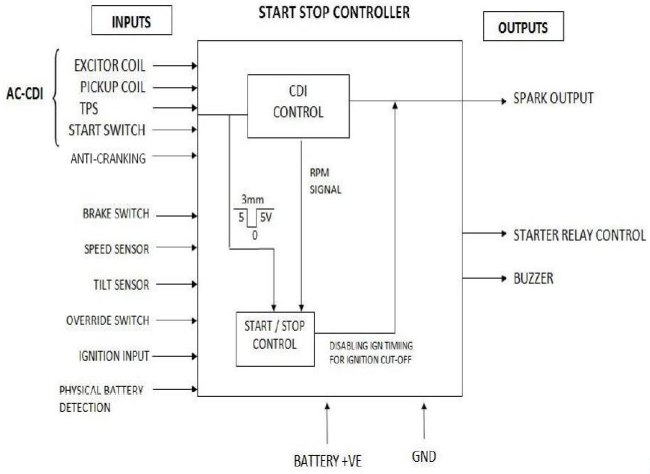


Fig. 4 Micro hybrid Technology

The above diagram is our proposed micro- hybrid unit. It includes one of the basic ignition systems and the micro-hybrid (start-stop system). The purpose of including ignition system and microhybrid feature is to reduce the system cost as both are interrelated.

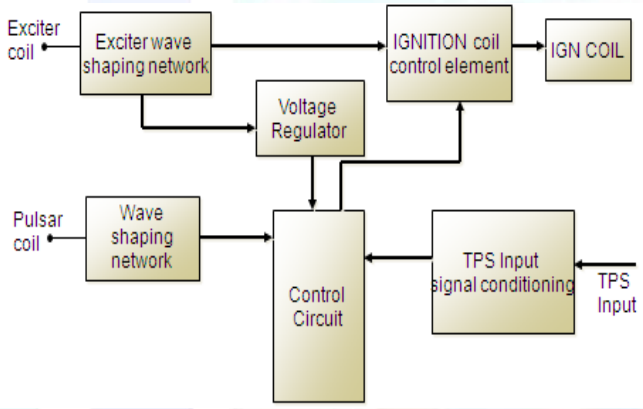


Fig. 5 Ignition System blocks (AC-CDI) which used in the above Start –Stop system.

Description of Block Diagram:

Exciter wave shaping network:-Ignition System blocks (AC-CDI) which used in the above Start –Stop system.It has rectifier inside which is capable to charge capacitor (ignition control element) with 300V and applied to IGNITION coil through SCR control element.

Voltage Regulator: Voltage regulator is capable of withstanding high input voltage which is came from exciter and generates voltage for microcontroller circuit.

Pulsar wave shaping network: This network is used to shape the pulses which came from pulsar coil i.e. it converts to the digital pulses and this is given to control circuit which will be use for calculating RPM and reference for ignition delay.

TPS Input signal conditioning circuit:-TPS input is used to change ignition timing profile from POT to WOT vice versa for fuel economy. If there is problem or no TPS I/P then this circuit has to work in basic profile.

Control circuits: - It takes the digital pulses O/P from pulsar wave shaping circuit calculates RPM, generates ignition delay according to the fuel economy profile. After elapsing generated delay, it trigger SCR to discharge the capacitor through primary coil of HT. HT generate 20Kv to 40Kv in its secondary coil for spark plug and combustion in engine.

Throttle Position sensor having 2 outputs:

1) Above 7 mm it o/p is 5V otherwise it is 0V: used to change ignition profile for fuel economy.

2) Above 3 mm it o/p is 5V otherwise it is 0V: used to give the signal to the controller to start vehicle when accelerator is accelerate.

Working:

This works as per the smart algorithm presented in the flow chart. It checks all smart parameters which are designed considering all the conditions of vehicle which are as follows.

1) It ensures that battery is charged then the system will work by using smart time logic.
2) It checks whether battery is present or not.
3) It checks engine RPM are idling condition.
4) It checks wheels of vehicle in standstill condition.
5) It checks that the start cycle is completed successfully.
6) It checks for the system is enable or/ disable by user through override switch

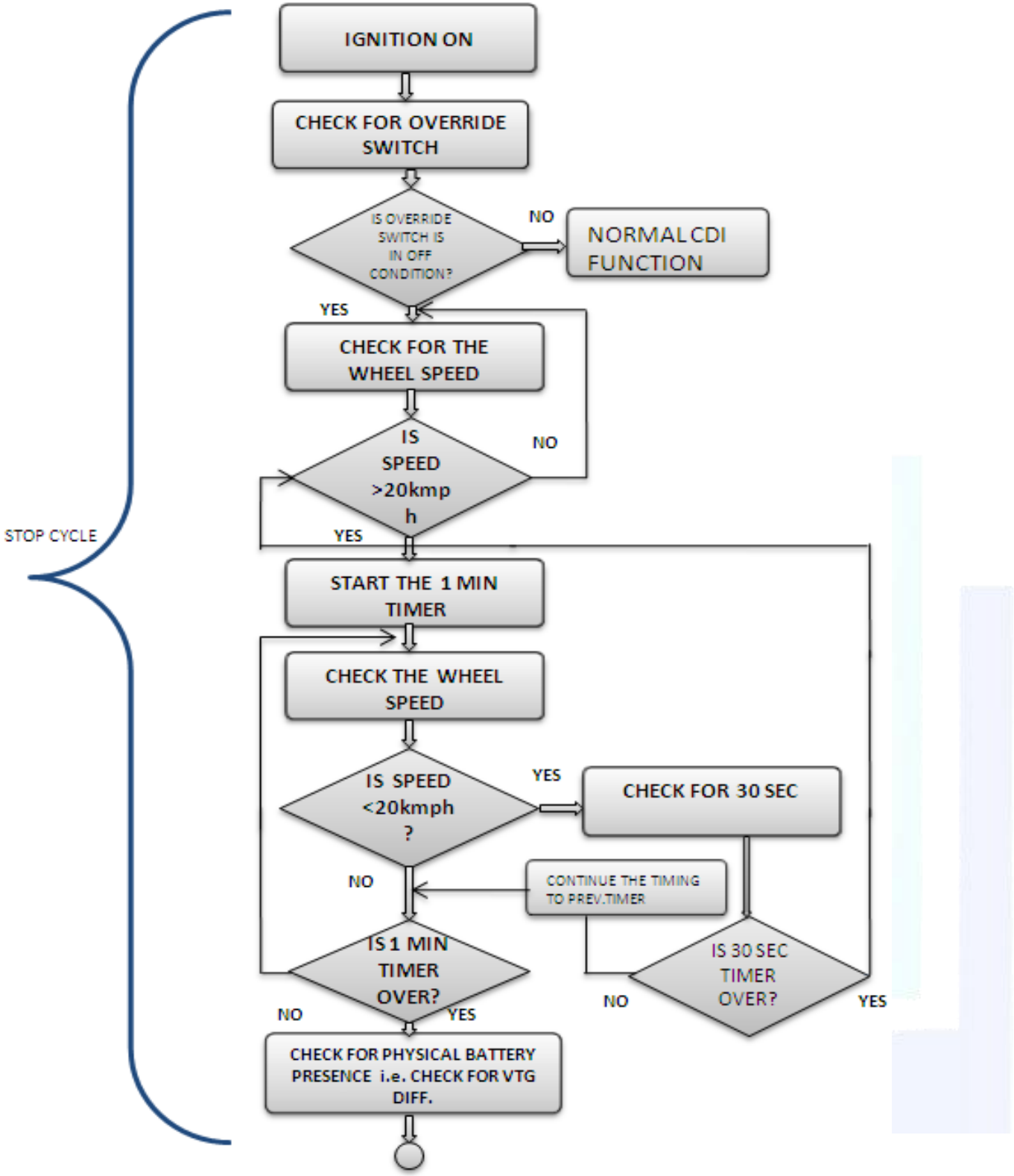
If the above conditions meets then it stop vehicle automatically by alarming buzzer before 5 second, the driver can disable the system by pressing override switch within 5 second if the drive does not like to stop this time.

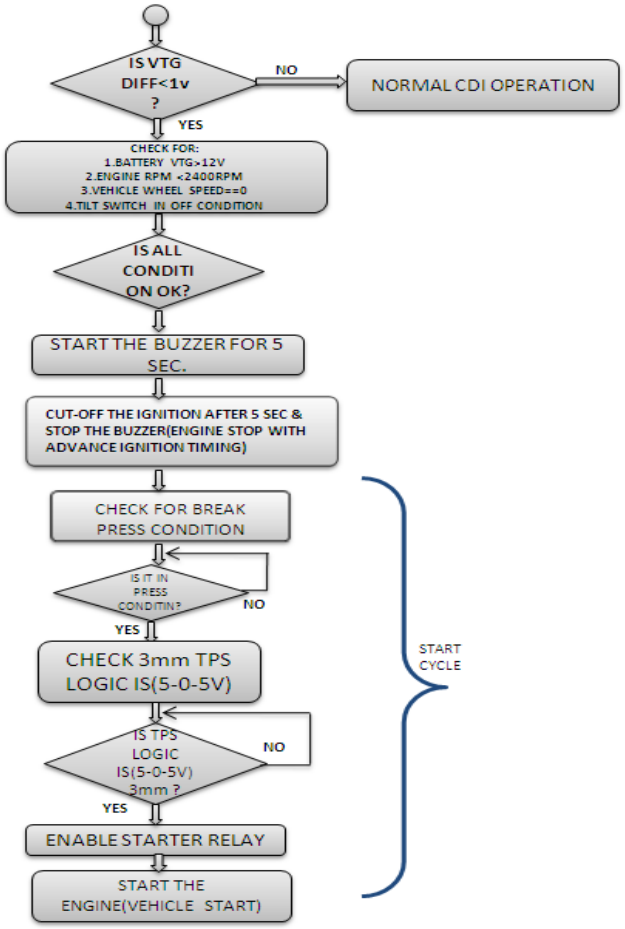
There are many techniques to stop the ignition some of them are as follows

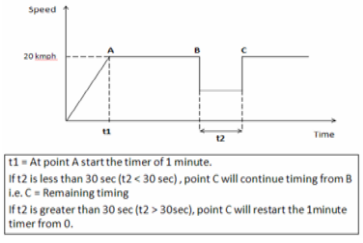
1) By disabling SCR gate drive
2) By firing at exhaust stroke.
3) By enabling kill switch. Etc.

We have used the first technique.

V. FLOWCHART


IGNITION ON
CHECK FOR OVERRIDE SWITCH
IS OVERRIDE SWITCH IS IN OFF CONDITION?
NO
NORMAL CDI FUNCTION
YES
CHECK FOR THE WHEEL SPEED
IS SPEED >20kmp h
NO
YES
STOP CYCLE
START THE 1 MIN TIMER
CHECK THE WHEEL SPEED
IS SPEED <20kmph ?
YES
CHECK FOR 30 SEC
NO
CONTINUE THE TIMING TO PREV.TIMER
IS 1 MIN TIMER OVER?
IS 30 SEC TIMER OVER?
NO
YES
NO
YES
CHECK FOR PHYSICAL BATTERY PRESENCE i.e. CHECK FOR VTG DIFF.



Sr. No	Parameter	Input / Output signal	Specification
1	Battery	Input	Should be greater than 12V(Battery used in 9AH VRLA)
2	Engine RPM	Input	<2400 rpm
3	Wheel speed	Input	Wheel speed should be zero Sensor Type: Hub Mounted Wheel Speed Sensor Pulse input: 8 pulses/rev Time(min): 10msec Duty cycle(min):100msec Pull up vpltage:5V Operating Current:10-15mA
4	Physical battery detection	Input	One extra wire will be taken from the battery +ve.If the voltage difference between the separate wire for battery detection and regular supply wire is greater than 1V then vehicle should not stop means normal vehicle operation.
5	Over ride switch	Input	ON-OFF type switch, operating voltage:12V OFF Mode :Start-Stop mode :vehicle by start s/w OR Accelerator ON Mode: Normal vehicle mode: vehicle staring by only start s/w and not by Accelerator.
6	Starter switch	Input	Push type normal switch, operating voltage:12V
7	TPS	Input	Working Criteria :Initially 0-3mm:5-0-5 volt 3mm-8mm:0Volt Above 8mm:5Volt Operating voltage:9-18Volt Operating temp: 30 c -80 c Max.o/p current:8-10mA
8	Break switch	Input	Push pull type switch, operating voltage:12V
9	Tilt sensor	Input	Consider this input in the logic it is not currently used but as a running change. Gradient Angle :> 7, operating voltage: 12V, single axis, Bi-directional.
10	Buzzer	Output	Same as Rodeo-Rz vehicle Type: continuous On type, input voltage: 12V. Max.current:20mAmp Diaphram :peizo ceramic
11	Starter Relay	Output	Type: solenoid type load capacity:100A Operating voltage:12volt Coil current: 3.4 Amp.
12	TIME Based STOP Logic	Input	 t1 = At point A start the timer of 1 minute. If t2 is less than 30 sec (t2 < 30 sec) , point C will continue timing from B i.e. C = Remaining timing If t2 is greater than 30 sec (t2 > 30sec), point C will restart the 1minute timer from 0.

VI. CONCLUSIONS

This system raises the alarm to the society to cut CO_2 emission, save fuel and preserve the nature as well as solution to the mentioned issues. This smart electronics system ensures that the driver saves fuel, cuts CO_2 emission and conserves the nature without compromising to convenience. This system automatically stops and restarts the vehicle whenever engine spends time in idling at traffic jam or at traffic signal. The driver does not require efforts to start and stop the vehicle and need not compromise to
Convenience .This is very cost effective system useful in two wheelers to save fuel, CO_2 emission, nature and global warming.

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