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Intellectual Automobiles Using Embedded Systems

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Abstract:
The widespread use of electronic equipments and their integration into the vehicular system have become a necessity in the automobile industry. Automation of vehicles are being carried out with the help of Embedded Systems. In our project, we have proposed and completed four objectives in automotives. The automobiles basically includes wagon under wheels which helps in transportation, locomotion, etc., and reducing human efforts. Existing luxury vehicles have certain disadvantages considering the tyre pressure, accurate quantity of fuels, alternator in which the internal component damage will not be notified and finally a battery notification which will not come with a backup battery. Hence our project idea is to set separate detecting digital meters and controlling equipments for all above said problems inside automobiles itself. This will improve the reliability of the machines used and also avoids accidents, at the end consumer level.

1.Introduction

Recent progress in semiconductor technology, microcontroller architectures etc, provides a novel development in automotives. Every automobile has distinct monitoring equipments for measuring speed, distance covered, indicating systems etc. But the advancements in every field and every day to day life requires some more additional features which meets the requirements of even common people. Our main idea is to implement these systems at a lesser economic rate. The existing systems
have many disadvantages as stated in the abstract. Let us discuss in detail about each objective and the working our setup to overcome the disadvantages in current scenario.

2.Tyre Pressure Monitoring System

The existing tyre pressure monitoring system are available only at separate pressure checking stations and petrol bunks. Also some of the luxury vehicles have this monitoring system inside the car itself. But the cost of the system limits the manufacturers to avoid this system for low and medium budget cars. But this tyre pressure monitoring system becomes a necessary one for both foreign and Indian roads. This is because, a recent study carried out by an international tyre manufacturer suggested that the increasing number of incidents could be attributed to drivers' negligence in regularly checking their tyres.

3.Foreign News Updates

ABU DHABI // The number of people killed in accidents caused by burst tyres is on the increase, according to figures from the Abu Dhabi traffic police. There were 41 accidents caused by blown tyres during the first half of this year (2011), compared with 30 during the same period last year. Thirteen people died as a result of those accidents compared with 10 last year. The number of injuries nearly tripled in the same period, from six to 17.

4.Indian News Updates

An Air India plane carrying 111 people from Thiruvananthapuram to Male narrowly escaped an accident when one of its tyres burst on landing at the airport in the Maldivian capital. GMR, which operates the Ibrahim Nasir International Airport (INIA) here, said that flight AI263 sustained a tyre burst upon landing at 12:06 pm, May12,2012.

At least 52 people including two children have died after an overcrowded bus plunged 300ft into a gorge in northern India.

The driver lost control when a tyre burst at a sharp bend on a mountain road in the state of Himachal Pradesh, 335 miles north of New Delhi. Many passengers riding on the roof of the 42-seat bus were killed in the carnage. Among the victims, 18 were women.

Figure 1: Bus Accident at Himachal Pradesh due to tyre burst

Thus, Tyre Pressure Monitoring Systems (TPMS) should be implemented readily in all the automotives to ensure people’s life. The existing TPMS uses a pressure sensor which is connected to the nozzle of the tyre and fitted under the rim. The resultant output is sent to the monitor display at the dashboard. This includes high cost and disadvantages in it. The major disadvantages are the sensors connected with nozzle are highly sensitive and it may broke due to tension. Hence it should be properly maintained at regular intervals and also if any sudden vibration occurs then it will damage the nozzle pin and hence the sensor itself may be a cause for the leakage of pressure from tyre. This happens for even foreign roads then imagine our roads, surely the motion and vibration caused by the dumps in our roads may damage the nozzle fitted with sensor. Hence this system feels to be a drawback. And so we are introducing the new technique of sensing the pressure from a conductive foam and it feels to be cheap and effective from the existing system.

5.Working Of Modified TPMS

In our modified system, the pressure sensor is replaced with a conductive foam of suitable size (here we consider the size to be of 10x5 inches). This conductive foam is supplied with a 5V battery and fixed above the rim and below the tyre (if tubeless) or tube. The pressure applied inside the tyre varies the resistive value of the foam and hence the voltage varies. This corresponding voltage is taken and fed to the PIC IC (16F877A).

The analog value is converted to digital form and it is manipulated in terms of psi. The average tyre pressure will be 35psi. This pressure is treated as the normal level and the tyre gets burst at an average value of 180 – 200 psi. Hence this level is considered to be the critical level. The values are displayed using a LCD display. If the value reaches the critical level (i.e 180psi) then the controller switches the relay and it trips the fuel ignition switch inside the automotives. Thus when tyre reaches the burst condition, the vehicle automatically gets stopped by cutting the fuel supply. Questions may arise that when a fuel supply is cut off suddenly in a fast moving vehicle, will it not be wobble more? But according to motor experts, when tyre gets burst then steps to be followed are : Do not slam on the brakes or move the steering wheel. Immediately release the accelerator and gradually apply the brakes to slow down and stop the vehicle while holding the steering wheel straight.

Hence it will be very safe for the drivers to travel in any condition of tyre pressure and it will be monitored at all times. Also proper signaling can be provided at each pressure levels and the drivers can be alerted.

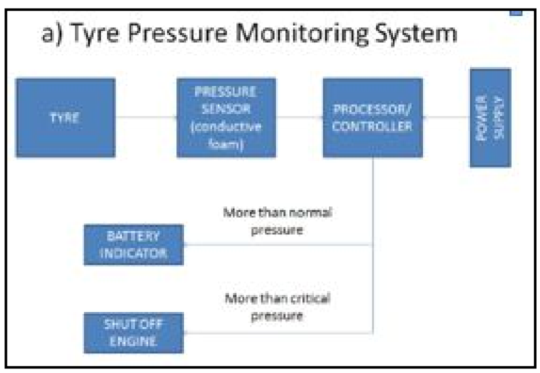

Figure 2: Block diagram

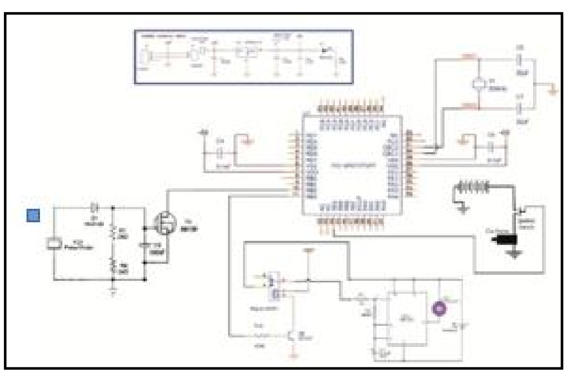

Figure 3: Tyre pressure automation circuit

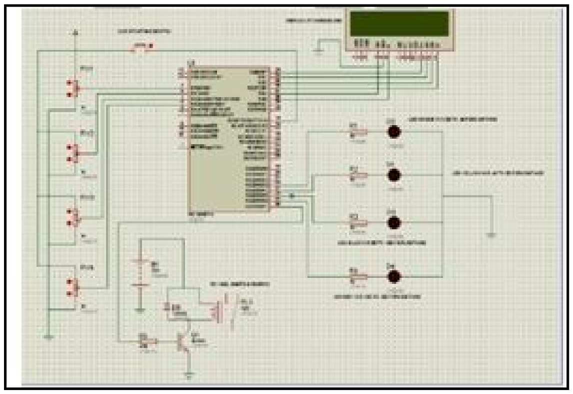

Figure 4: Simulation for tyre automation ckt

6.Backup Battery Switching

Batteries are used inside the automotives primarily to start up the engine and next to power the accessory equipments like music system, lighting etc. Consider a situation, a customer picks up his car at night time and goes on a travel. He stops in a certain remote location and was doing his works. The lighting systems are still on and the battery gets weaken slowly. The starting of car requires most charge in a battery (say about 50%). Hence, in that situation, if the car battery gets discharged about 50% then the car can't be started from that place. In this case if a secondary battery is placed to start the car, then it'll be really easy for the customer and not to rely on any help. After the car is started and during the running condition the alternator charges the battery. The primary cum secondary batteries can be charged at that instant. However, the extra battery increases the weight and it simultaneously decreases the speed of the vehicle. So the weight of the additional battery should be compensated with any other systems in the vehicle (say music systems, speaker systems etc).

7.Working Of Battery Switching

The primary and secondary battery levels are monitored by the controller and it displays the result at every instant. The analog values are converted into digital form by A/D converter in PIC. If the primary battery gets discharged and reaches the critical level then it satisfies the first condition in the program for battery switching. Then if the car starting switch is on then it satisfies the second condition too and the relay trips through the controller.

```
if(p_battery<=50)
        {
```

```
if(car_start==1) relay=1;
  else relay=0;
          }
```

Now the secondary battery gets connected to the system and the car gets started. During run-time the alternator charges the battery and if the secondary battery gets fully charged then it trips back to primary battery and it starts to charge from alternator.

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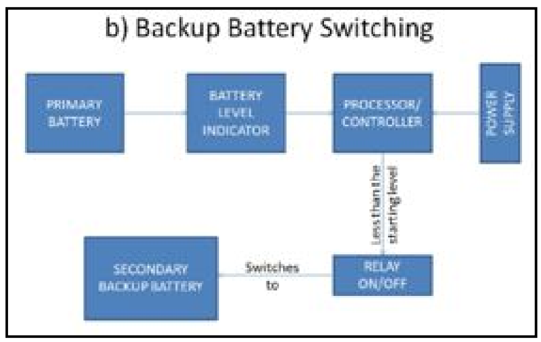

Figure 5: Block diagram

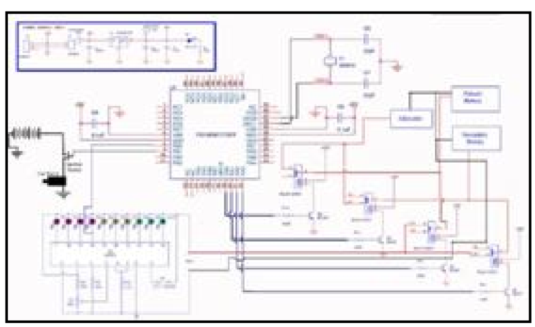

Figure 6: Battery Switching Circuit diagram

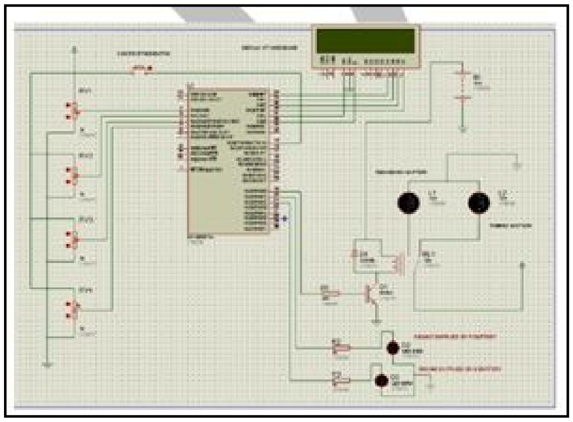

Figure 7: Simulation of Battery switching

8.Alternator Brush Monitoring System

The vehicle gets charged only with the help of alternator. In olden days, there is no special equipment or warning systems have been employed to criticize about it. But nowadays the brush level can be sensed when it is fully worn out. But if the brushes abrasion is sensed at the critical level itself (say at 75% of brush) then it'll be comfortable for the customers to replace the brush without any other component damage. But the existing systems could not state the critical level of the brush and thus we proposed this idea of extruding a conducting wire at the top of the fixed portion of the brush and another wire extruding from the spring attached to the carbon brush. Thus when the wires comes into contact then the circuit gets closed and the buzzer or led warning system is alerted.

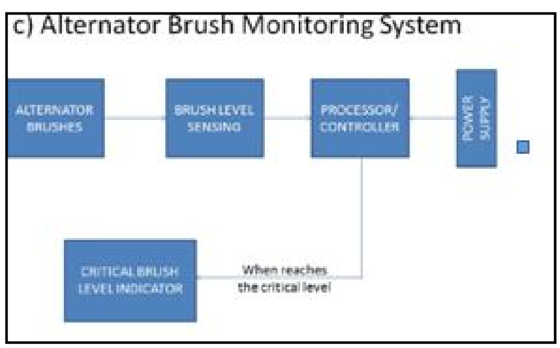

Figure 8: Block diagram

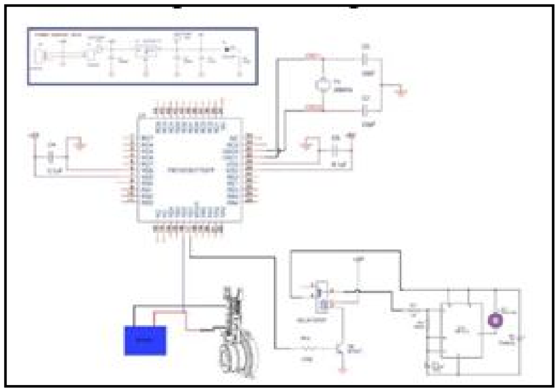

Figure 9: Brush Monitoring Circuit diagram

9.Fuel Quantity Monitoring System

Fuel quantity monitoring systems are available in the present scenario but the gauges are very much inaccurate and it develops dissatisfaction for the customers when they pump in fuel every time. These devices are notoriously inaccurate, showing empty when there are gallons left in the tank and showing full for the first 50 miles. In this section, let’s see why the fuel gauges behave the way they do.

There are two main parts to a fuel gauge: the sender, which measures the level of fuel in the tank, and the gauge, which displays that level to the driver.

Sending Unit : The sending unit is located in the fuel tank of the car. It consists of a float, usually made of foam, connected to a thin, metal rod. The end of the rod is mounted to a variable resistor. A resistor is an electrical device that resists the flow of electricity. The more resistance there is, the less current will flow. In a fuel tank, the variable resistor consists of a strip of resistive material connected on one side to the ground. A wiper connected to the gauge slides along this strip of material, conducting the current from the gauge to the resistor. If the wiper is close to the grounded side of the strip, there is less resistive material in the path of the current, so the resistance is small. If the wiper is at the other end of the strip, there is more resistive material in the current's path, so the resistance is large.

When the float is near the top of the tank, the wiper on the variable resistor rests close to the grounded (negative) side, which means that the resistance is small and a relatively large amount of current passes through the sending unit back to the fuel gauge. As the level in the tank drops, the float sinks, the wiper moves, the resistance increases and the amount of current sent back to the gauge decreases.

This mechanism is one reason for the inaccuracy of fuel gauges. You may have noticed how your gauge tends to stay on full for quite a while after filling up. When your tank is full, the float is at its maximum raised position -- its upward movement is limited either by the rod it's connected to or by the top of the tank. This means that the float is submerged, and it won't start to sink until the fuel level drops to almost the bottom of the float. The needle on the gauge won't start to move until the float starts to sink.

Something similar can happen when the float nears the bottom of the tank. Often, the range of motion does not extend to the very bottom, so the float can reach the bottom of its travel while there is still fuel in the tank. This is why, on most cars, the needle goes below empty and eventually stops moving while there is still gas left in the tank.

Another possible cause of inaccuracy is the shape of the fuel tanks. Fuel tanks on cars today are made from plastic, molded to fit into very tight spaces on the cars. Often, the tank may be shaped to fit around pieces of the car body or frame. This means that when the float reaches the halfway point on the tank, there may be more or less than half of the fuel left in the tank, depending on its shape.

The Gauge : The gauge is also a simple device. The current from the sender passes through a resistor that either wraps around or is located near a bimetallic strip. The bimetallic strip is hooked up to the needle of the gauge through a linkage.

Some newer cars have a microprocessor that reads the variable resistor in the tank and communicates that reading to another microprocessor in the dashboard. Carmakers can tinker with the gauge movement a little - - they can compensate for the shape of the tank by comparing the float position to a calibration curve. This curve correlates the position of the float with the volume of fuel left in the tank. This allows the gauge to read more accurately, especially in cars with complicated gas-tank shapes.

Systems like this can also trigger a fuel light that signals when fuel is getting low. Most of these lights come on while there are still a couple of gallons of gas left in the tank, giving you plenty of time to stop for fuel.

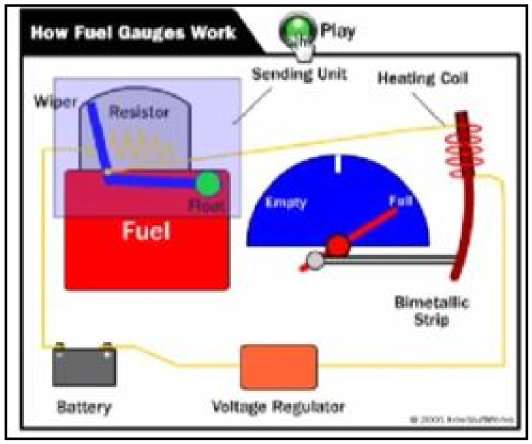

Figure 10: Existing Fuel Gauge

The microprocessor can also provide some damping to the needle movement. When you go around a turn, or up a hill, the fuel can slosh to one side of the tank and quickly change the float position. If the needle were to respond quickly to all of these changes, it would be bouncing all over the place. Instead, software calculates a moving average of the last several readings of the float position. This means that changes in needle position occur more slowly. You may have noticed this when filling up your car -- you'll finish filling the tank long before the needle reaches full.

While fuel gauges are far from exact, they err on the conservative side.

To minimize these demerits we process a technique of fitting a controller and taking up the resistance value and manipulating the appropriate resistance value to fuel level and displaying the accurate fuel level at the dashboard directly. Hence this reduces the dissatisfaction at the customers and it reliefs many circuits inside the vehicle for fuel measurement.

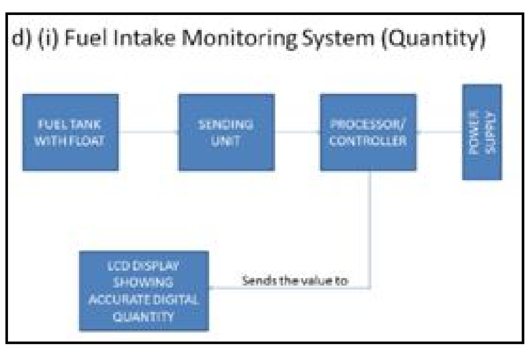

Figure 11: Block diagram

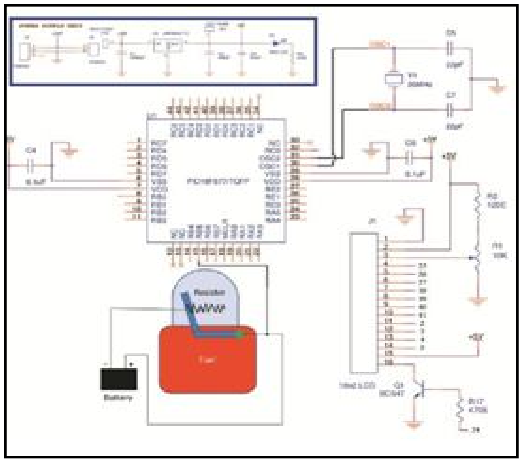

Figure 12: Fuel Quantity Monitoring Circuit diagram

10.Results

Our project mainly clears many demerits in the existing system and also ensure some more features like

- Safety for consumers and prevents from accidents due to tyre bursts.
- Increases the lifetime of the machines.
- Backup battery helps in starting of the vehicles during primary battery dried conditions.
- Helps in increased satisfaction and reliability for the consumers in the quantity level section.

11.Conclusion

Thus this paper ensures many merits on the monitoring and controlling systems of the automotives. Also it has many applications and wide range of fields (i.e low and medium manufacturers). Highly economic too.

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