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Model Based Design of Digital Fuel Indication System

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Abstract - *In this 21st century almost everything has become digital, if the fuel indicators in the vehicles is additionally made advanced we can determine the correct quantity of fuel available in the fuel tank. Hence, this system will be indicating the amount of fuel in the tank in milliliters. The indication of fuel will be in numerical digits (ex: - 100ml, 200ml and 1000ml). This system mainly focuses about the indication of fuel level in car, trucks or diesel occupied tanks .This project allows us to get rid of issues like fuel theft at fuel stations, fuel adulteration and keeps us from getting into circumstances where we may get into inconvenient situations due to unspecified level of fuel. Current systems contain the fuel indication mechanism for the automobiles which are computerized yet they don't show the correct amount of fuel which is available in the tank i.e. they demonstrate the measure of fuel in as bars and not in numbers or digits like liters or Milliliter. So this issue is considered for our work of building up the digital (numeric) fuel indication mechanism for automobiles which indicates correct measure of fuel in Milliliters (ml).*

Key Words: *ATMEGA328 controller, Ultrasonic sensor HC SR04, MQ135 Gas sensor, LCD, USB to Serial Converter*

1. INTRODUCTION

At present, even after paying a huge amount of money at many of the fuel pumps, we don't get the exact amount of fuel as shown by the filling machine and also there is lots of news regarding the fuel pump frauds which leads to corruption. In many cases it has been observed that there is dissimilarity between the amount of fuel displayed on the fuel filling machine and the fuel filled in the tank. Many of the times the fuel filled are less than the displayed value. This is because of the additional electronic arrangements made in the filling machine which leads to the benefit to fuel pump owner.

User having analog systems cannot find out the accurate and exact value of the remaining fuel in tank. Therefore, if the fuel indicator in the automobiles is made digital it will help to know the exact amount of fuel available in the fuel tank. The above mentioned fact is considered in our project and we found out a proper solution for indicating the exact availability of fuel in the tank digitally. Although contactless methods are more complicated than contact methods, there are lots of sensors available for the fuel level measurement. Here, we are indicating the amount of fuel in the tank in mililiters. This project deals with Development of Digital Fuel Meter for Vehicles. Proposed Digital Vehicle Meter is able to give reading in real time units like in Mililiter's. Multiple Ultrasonic Sensors are used to sense depth of fuel in tank. Arduino Controller (ATMEGA328) will be used as the heart of hardware system. Before hardware implementation we will design Simulink Model to simulate and validate output.

2. NEED OF PROJECT

This sysetm is needed because how much fuel left in the tank, is always a point of tension? So before digital world analog meter were invented to keep a check on the fuel. Those meters gives rough estimate of the fuel left in the tank and sometime this rough idea created trouble for the driver. Today everyone is in a race of making as much profit as possible therefore many petrol pumps does not injects the paid fuel. So this project also keeps a track of this theft. This project tells about parameters that indicate the volume of fuel in the tank available for driving the automobile with more precision compared to the existing system. Calculates and verifies that the paid amount of fuel was delivered to the vehicle or not; indicates, in case of any discrepancy and upgrades its status on the basis of real time.

3. BLOCK DIAGRAM

In this project the main blocks are micro controller unit, ultrasonic sensor, Gas sensor, LCD display, Power supply unit and PC for MATLAB. The power supply section is used for regulated energy distribution to all the components being interfaced. The ultrasonic sensors are mounted on top of fuel tank to measure the level of fuel present in tank and then the measured signal is sent to the microcontroller unit for further operations. While the tank is being filled with fuel (ie. diesel) the gas sensor detects the quality of fuel flowing through the fuel inlet pipe. The detected quality value is sent to Controller for conversion to digital from analog. All these calculated values are sent to LCD display unit for indication. The serial to USB converter is used to send all this information to PC for simulation of this system.

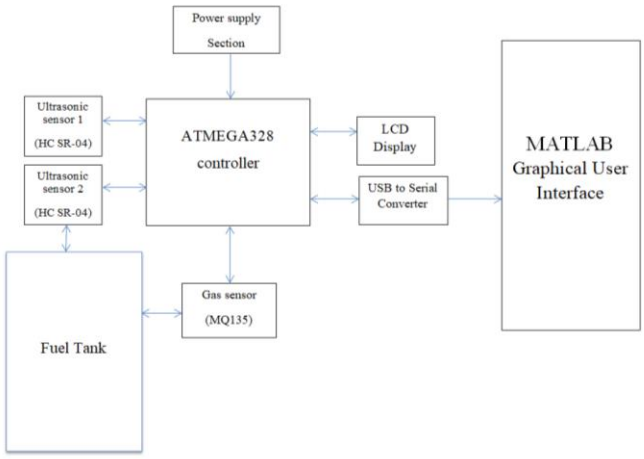

Fig -1: Block Diagram of proposed system

4. CIRCUIT DIAGRAM

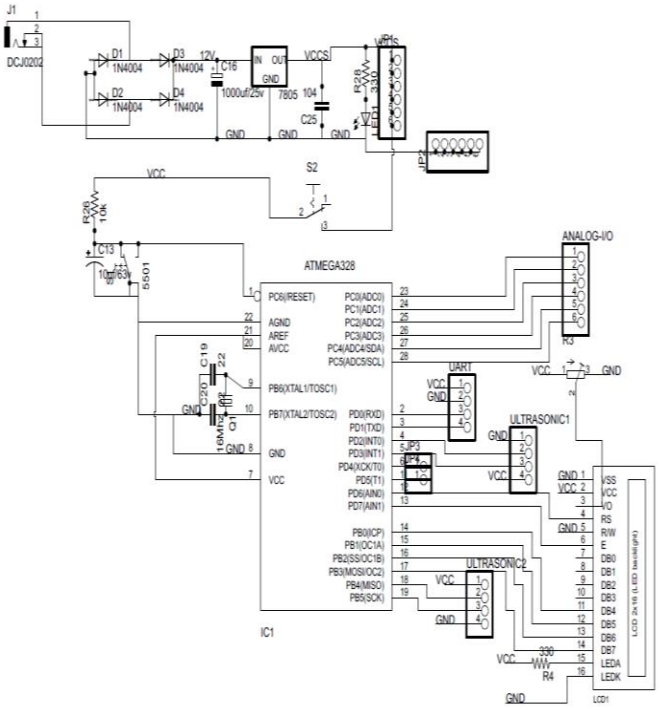

Fig -2: Circuit diagram of proposed system

The whole system is controlled by using Arduino controller ATMEGA328. The 5v, 1A supply is used to drive the Arduino controller and Ultrasonic sensors.

The Ultrasonic sensors HC-SR04 uses 40 kHz high frequency sound signal for the depth detection of level to measure amount of fuel in fuel tank. This analog signal is given to controller's ADC pin.

5. HARDWARE DESCRIPTION

5.1 ATMEGAC28 controller:-

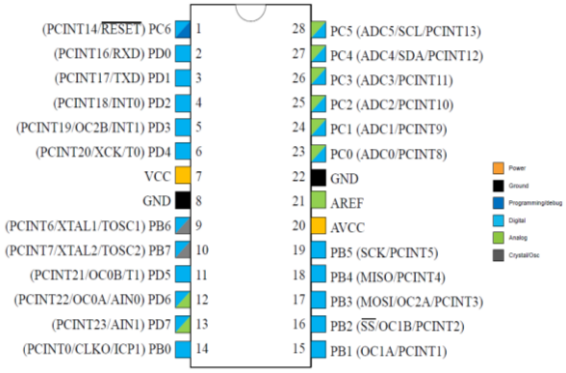

Fig -3: ATMEGAC28 controller Pin Diagram

The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs , 1 byte-oriented 2-wire Serial Interface (I2C), a 6- channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes.

5.2 Ultrasonic Sensor Module HC - SR04:-

In a similar way to radar and sonar, ultrasonic transducers are used in systems which evaluate targets by interpreting the reflected signals. For example, by measuring the time between sending a signal and receiving an echo the distance of an object can be calculated. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions.

Types	Pin symbol	Description
HC-SR04	VCC	5v power supply
	Trig	Trigger pin
	Echo	Receive pin
	GND	Power ground

Table -1: Pin description of HC-SR04

Electrical parameters	HC-SR04 Ultrasonic Module
Operating voltage	DC-5v
Operating current	15mA
Operating frequency	40kHz
Farthest range	4m
Nearest range	2cm

Measuring angle	15 degree
Input triggger signal	10us TTL pulse
Dimensions	40*20*15mm

Table -2: Electrical parameters of HC-SR04

5.3 LCD Display:-

The LCD display is used to display the messages during the action. Here a 16x2 display is used; each character is made of 5X7 dot matrix. Displays have built in backlight (blue or green diodes)

5.4 Gas sensor MQ135:-

Fig -4: MQ135 Gas Sensor

Symbol	Parameter name	Technical condition	Remarks
Vc	Circuit voltage	5V±0.1	AC OR DC
Vh	Heating voltage	5V±0.1	AC OR DC
Rl	Load resistance	can adjust	
Rh	Heater resistance	33Ω±5%	Room Tem
Ph	Heating consumption	less than 800mw	
Tao	Using Tem	-10-45	
Rs	Sensing Resistance	30KΩ-200KΩ (100ppm NH3)	Detecting concentration scope_ 10ppm-300ppm NH3 10ppm-1000ppm Benzene 10ppm-300ppm Alcohol
α	Concentration Slope rate	≤0.65	
Detection condition	Temp: 20_±2_ Vc:5V±0.1 Humidity: 65%±5% Vh: 5V±0.1		

Table -3: Features of gas sensor

6. SYSTEM IMPLEMENTATION

[1] Connect the power adaptor to the home supply socket of 230v, 1A.

[2] Turn on system by pressing switch to check fuel quantity and quality.

At the initial stage the system will show 0 ml as the quantity if no fuel available and if there is no filling of fuel to sense the quality it will show "No data" when switched to quality knob as shown in figure below.

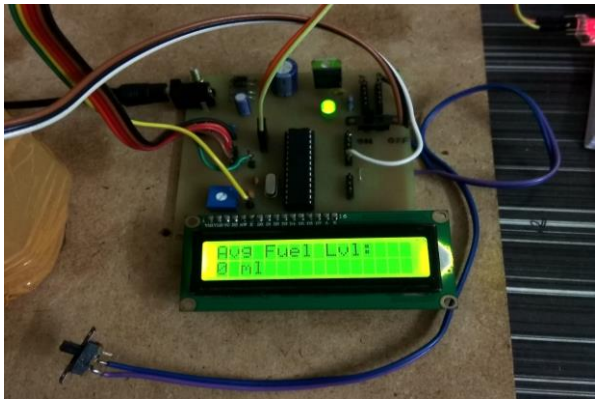

Fig -5: Initial stage of system without any fuel

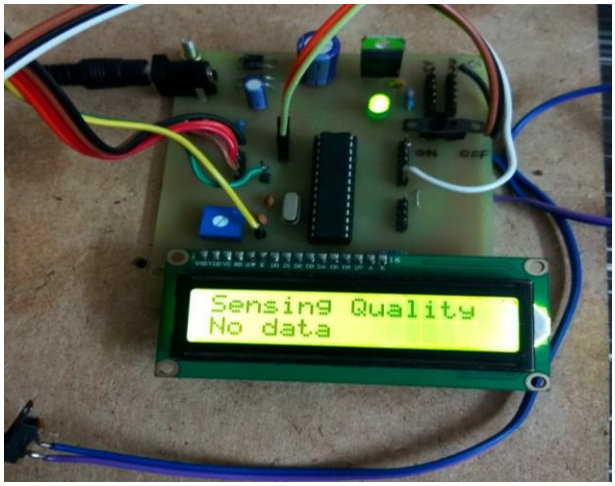

Fig -6: Initial stage of fuel quality without fuel

[3]Once the system turns ON, start filling fuel in tank through funnel on inlet of tank.

[4]After the fuel fills up in fuel tank the LCD display will show the exact amount of fuel being filled in tank using the data provided by ultrasonic sensors.

Fig -7: Fuel level displayed on LCD after filing 100 ml fuel

Fig -8: Fuel quality displayed on LCD after sensing fuel at inlet while fillimg

[5] Connect the serial to USB converter pin to PC for checking the simulation of system in MATLAB GUI.

[6] Open MATLAB R2013a and run the MATLAB code, after the run GUI window will pop up.

[7] Put the COM Port number in GUI window and establish the connection to start simulation of system.

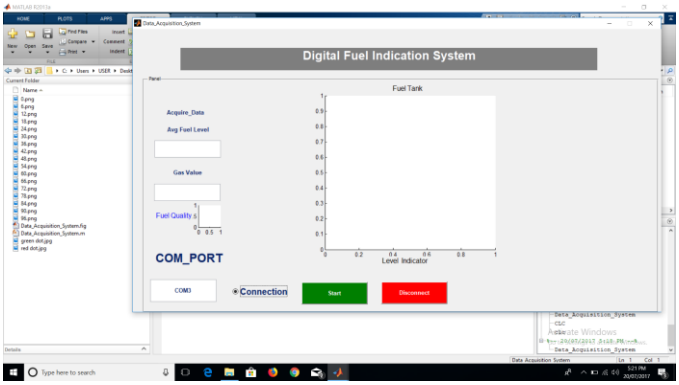

Fig -9: GUI window of system after executing code

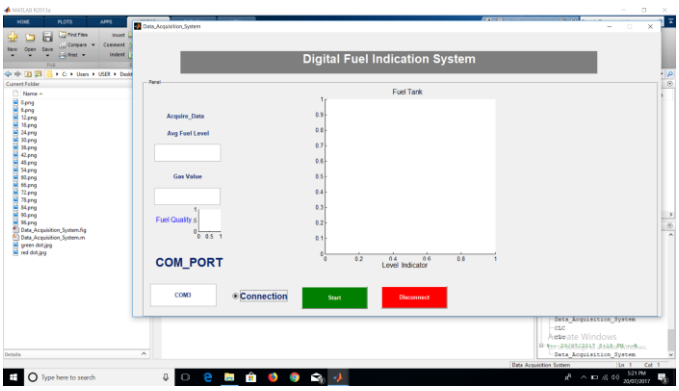

Fig -10: Establishing connection between hardware and software by serial COM port to start simulation

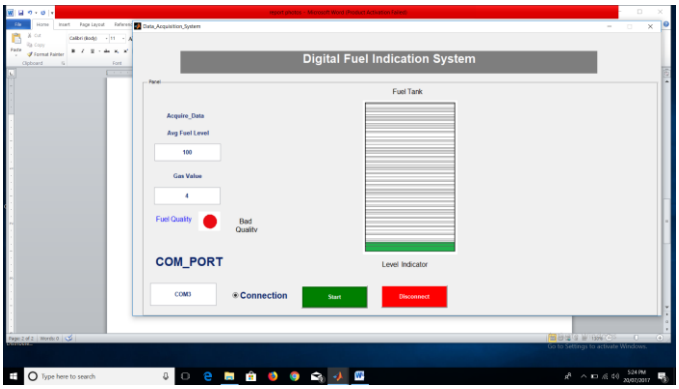

Fig -11: Real time simulation showing bad quality and fuel level while filling in tank.

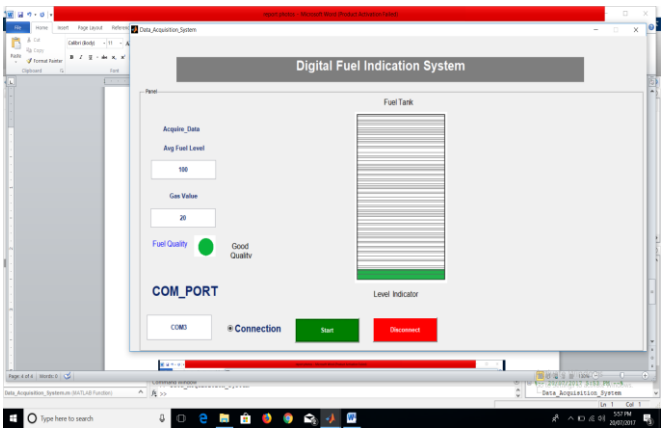

Fig -12: Real time simulation of fuel level and its quality with exact resolution of 100 ml when good quality fuel is filled

3. CONCLUSIONS

In our project Two Ultrasonic sensors detects the exact quantity of fuel available in fuel tank along with this the gas sensor will detect the quality of fuel being filled in tank. Thus these two important factors of quality and quantity from customer's point of view are determined.

Hence this project with accurate measurements will help us avoid the major issues of fuel fraud being carried out at fuel stations and it will also help us get the idea about the fuel adulteration.

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