



SMART FUEL METER DESIGN AND IMPLEMENTATION

L MONISHA

Electronics and Communication
SRM Institute of Science and Technology
Kattankulathur, India
monilgu@gmail.com

S NISHANTH KANNA

Electronics and Communication
SRM Institute of Science and Technology
Kattankulathur, India
nishanth.kanna96@gmail.com

S SHUBHRA

Electronics and Communication
SRM Institute of Science and Technology
Kattankulathur, India
shubhrasaklecha@gmail.com

A RAMYA

Assistant Professor (O.G)
Electronics and Communication
SRM Institute of Science and Technology
Kattankulathur, India
ramyaarumugamm@gmail.com

ABSTRACT

In countries like India with a lot of vehicles, the consumption of fuel from fuel stations is large. Most of the times, consumers are not satisfied with quantity or quality of fuel, because the consumers get less quantity and are cheated. Smart fuel meter is a microcontroller board which will calibrate the amount of fuel flowing into the fuel tank with the help of a fuel flow sensor. The amount of fuel is measured very accurately and can be viewed in the display provided to the driver of the vehicle. The information regarding the amount of fuel flow is also transferred to the owner's mobile phone through SMS. Flow meters are devices that measure the amount of liquid, gas, or vapour that passes through them. Some flow meters measure flow as the amount of fluid passing through the flow meter for a particular time period (such as 60 litres per minute). Other flow meters measure the total amount of fluid that has passed through the flow meter (such as 100 litres). Smart fuel meters shall be portable / fixed type. It is a battery operated device and is based on a microcontroller. When our fuel meter is implemented in a vehicle it gives complete satisfaction to its users.

Keywords: Flow meter ; GSM ; GPRS ; USART ; AVR ; RS232 ;

I. INTRODUCTION

Petrol bunk scams are very common in recent time. Almost 81 percentage of the petrol bunks today manipulate pumps such that it displays the amount as entered, but in reality, the quantity of fuel filled in the customer's tank is much lesser than the displayed value. Such malpractices result in huge profits for the petrol bunks and the customers are being cheated. It is found out that a proper solution for indicating the accurate availability of fuel in the tank is a digital meter. Some issues with respect to the existing level measurement techniques are identified and so a better alternate digital sensing technology has been suggested, described and justified.

We are able to understand the basic and traditional techniques in use for measurement of fuel in tanks. It explains the use of digital meters[1] rather than analog meters which will help to increase the accuracy of measurements. We get in depth knowledge about fuel measurement using a reed switch[2] and communicating the data using telematics technology that uses telecommunication and informatics. We are explained in detail how a simple Faraday's law of induction[3] can be used to measure a flowing fluid. This gives us an insight into efficient and low cost methods practically in use to measure water flow in South Africa. It aids us to understand the operations of a GSM module[4] and gives information about sending AT commands to control sending of information from the board to mobile phones using Short Message Services. We are able to analyse and understand the low-cost method of fabricating a printed circuit board (PCB). This gives a step by step guide

to fabricate a PCB[5], from printing circuit, heat transferring onto copper clad. One of the important papers which explains in detail about a functional schematic[6] will place these partson the drawing in such a way as to delineate the circuits we build.

In this project we focus on creating a digital display of the exact amount of fuel contained in the vehicle tank and also help to cross check the quantity of fuel filled at the petrol bunk. Finally once the fuel is filled at a bunk the device also sends an SMS to the vehicle owner indicating the amount, quantity, and date, time etc.

II. PROPOSED SYSTEM

BLOCK DIAGRAM

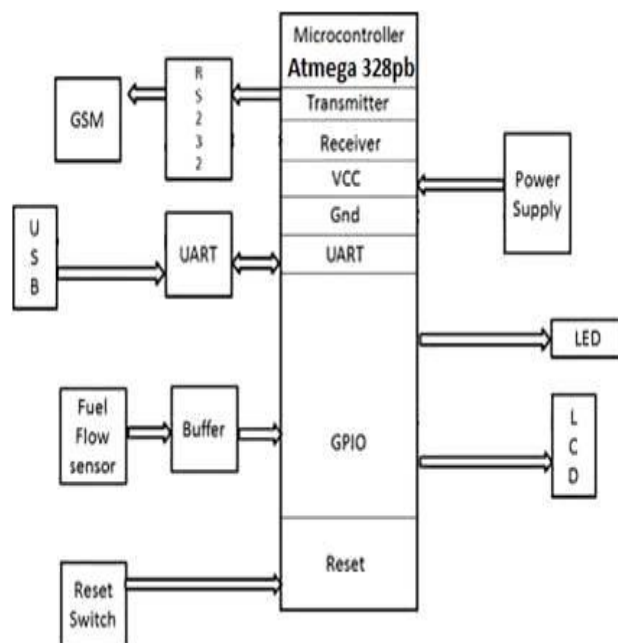


Figure 1: Block diagram of the various interfaces

III. REQUIREMENTS

A. HARDWARE

1. Power Supply Module

This unit is divided into two variants. One will be portable which operates on battery power and other will be fixed one which directly draw direct DC power from vehicle. In addition USB based charging will be provided if required.

i) Portable

Standard 230V AC to DC adapter, to provide 9-12V DC to Unit. It will be used to charge battery of module and to power the fuel sensor, GSM modules. Suitable DC-DC converters (Low Dropout Regulators) and battery changing circuits will be provided in the board.

Battery Features and Benefits:

- Made of ten 1800mAh cylindrical 55950 cells with poly switch for full protection.
- Light weight and higher energy density than any rechargeable battery
- Built-in IC chip will prevent battery pack from over charge and over discharge and prolongs battery
- Li-Ion Capacity: 3.7V 1600mAh

ii). Fixed

Suitable DC-DC converters (Low Dropout Regulators) will be provided in the board and it will be suitably converted to power the fuel sensor, GSM modules. Works in the voltage range of 100-240Vac with an output about 1-12V

- Glass fuses of proper rating shall be provided to protect the equipment
- The power supply module shall have self resetting type protection from under voltage of DC input, over voltage of DC input, over load of DC output short circuit of DC output.
- Voltage regulation shall be less than 1 percent of output rated voltage

2. Processor Module (ATmega328PB)

In this project we have used ATmega328PB ,a 8 bit ATmel AVR Controller. This module is being designed to facilitate:

- ADC/Timer-Counter for Flow sensor interface, data acquisition
- UART Interface for GSM/GPS Module
- UART interface to transmit the fuel quantity data
- GPIO Interface for LED indications and LCD interface
- SPI for Flash memory
- Inbuilt RAM, FLASH and Clock
- Functional software and calibration options

3. GSM Module (SIM900)

This module is used to establish communication between the processor and the GSM, GPRS system. This is a GSM/GPRS compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs. Externally, it looks like a big package (0.94 inches x 0.94 inches x 0.12 inches) with L-shaped contacts on four sides so that they can be soldered both on the side and at the bottom. Internally, the module is managed by an AMR926EJ-S processor, which controls phone communication, data communication (through an integrated TCP/IP stack), and (through an UART and a TTL serial interface) the communication with the circuit interfaced with the cell phone itself. The processor is also in charge of a SIM card (3 or 1.8 V) which has to be attached to the module's outer wall. In addition, the GSM900 device integrates an analog interface, an A/D converter, an RTC, an SPI bus, and a PWM module. The TTL serial interface is not only for communicating all the relative data, the SMS already received and those that come in during TCP/IP sessions in GPRS, but also for receiving the circuit commands (in our case, coming from the PIC governing the remote control) that can be either AT standard or AT-enhanced SIMCom type. The module is supplied with continuous energy (between 3.4 and 4.5 V) and absorbs a maximum of 0.8 A during transmission.



Figure 2: GSM Module

4. Flow Sensor

OF-Z flow sensor is suitable for measuring oil (heavy oil, light oil, heating oil). It is a flow sensor with elliptic gears that measures micro flow with accuracy.

Features Specifications:

- Connection: G1/2" / 13mm
- Flow range: 1-60L/min
- Working voltage: DC3V-12V
- Accuracy: 0.5 percent
- Output signal pulse signal: 2.5mL/P
- Max operation pressure: 0.5Mpa with fluid temperature of +20 Degree
- Ambient operating temperature: -10 to 70 degree celsius (freezing must be avoided)
- Wiring: Red—Power+ ; Black—Power- ; Blue—Pulse



Figure 3: Flow Sensor

5. Display System

A Liquid-Crystal Display (LCD), is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a back light or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content.

B. SOFTWARE

1. Atmel Studio 7

Studio 7 is the integrated development platform (IDP) for developing and debugging all AVR and SAM microcontroller applications. The Atmel Studio 7 IDP gives you a seamless and easy-to-use environment to write, build and debug your applications written in C/C++ or assembly code. It also connects seamlessly to the debuggers, programmers and development kits that support AVR and SAM devices. In this project we use Atmel studio 7 to configure each of the component that is interfaced with the controller. Specific codes are dumped into the controller for appropriate functioning of all components

2. OrCAD Capture

OrCAD Capture is one of the most widely used schematic design solutions for the creation and documentation of electrical circuits. Coupled with the optional OrCAD CIS (component information system) product for component data management, along with highly integrated flows supporting the engineering process, OrCAD capture is one of the most powerful design environments for taking today's product creation from concept to production. It helps to streamline the creation of more complex schematic designs with hierarchical, reuse, and variant design capabilities. We use this application to accelerate design process and lower project costs with an integrated component information system (OrCAD CIS). It is being used to analyse designs to meet project goals and achieve first-pass success with signal integrity analog/mixed signal, and constraint development flows. This OrCAD makes use of our multiple CAD netlist interfaces to extend OrCAD Capture into multi-vendor flows to standardize on a common front-end solution. All our schematic diagrams are designed and the netlists generated using OrCAD which has enhanced usability and boosts productivity.

The key features of OrCAD are:

- It helps us to compare designs with different design viewers.
- It provides advanced annotations to assign reference range of components.
- It enables component part search from the database of components using Component Information System (CIS).
- It can directly import data using the Digi-key partlink.
- It also enhances user interface by providing intelligent PDF output.

IV. METHODOLOGY

- This project involves creating a microcontroller board with fuel measuring application. The foremost step is to create a schematic of each of the modules in the project. OrCAD Capture is used to design the schematic diagrams. It is one of the most powerful design environments for taking today's product creation from concept to production.

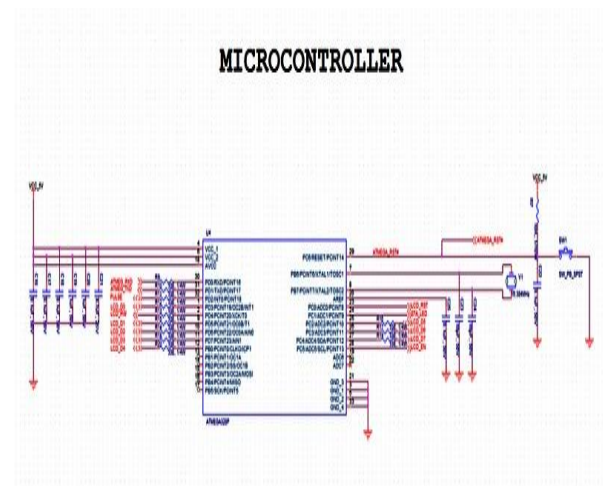


Figure 4: Schematic design

- PCB printing begins with designers output of schematic files in an advanced laserjet printer, that uses incredibly precise printing technology to provide a highly detailed film of the PCB design. The basic form of PCB comprises a laminate board called substrate material. Laminate serves as an ideal body for receiving the copper that structures the PCB. Another machine performs an automatic optical inspection of the panels to confirm a total absence of defects. The conducting areas and connections are now properly established and solder mask is cured in an oven.

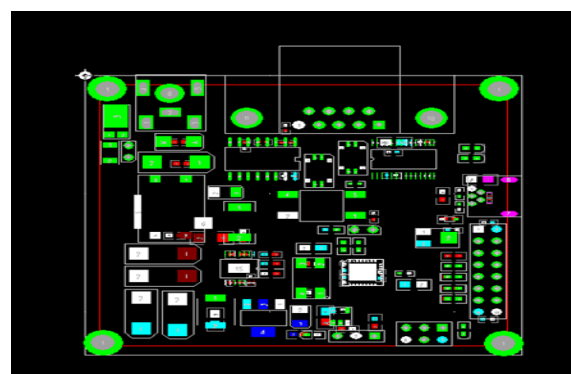


Figure 5: PCB design

- The board we built will work as a smart fuel meter that measures the amount of fuel available that flows into the fuel tank. The processor module interfaces FlowSensor, LCD, Power Supply, RS232 UART and GSM Module. The board operates on battery power and can also draw direct DC power from vehicle.

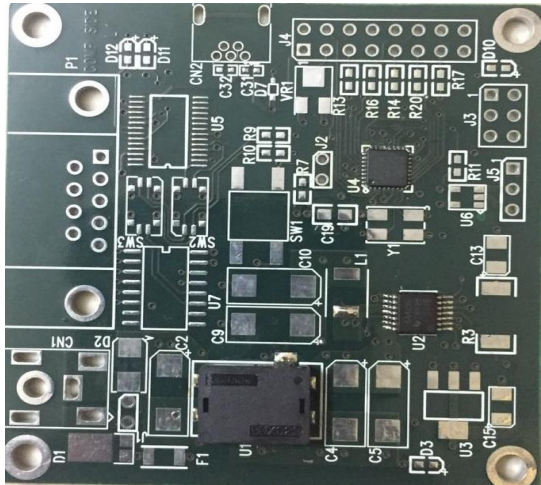


Figure 6 : Fabricated PCB

- In this we use the OF-05ZAT flow sensor that is suitable for measuring oil (heavy oil, light oil, heating oil). It is a flow sensor with elliptic gears that measures microflow with accuracy. Once the sensor senses the amount of fuel in the tank displays the information in a 16x2 LCD display.

- The information about the fuel level is communicated to the owner's mobile phone, for that we use a GSM Module. The GSM module SIM900 is a GSM/GPRS compatible Quad-band cell phone, which can not only be used to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs.

V. RESULTS AND DISCUSSION



Figure 7 : LCD Display

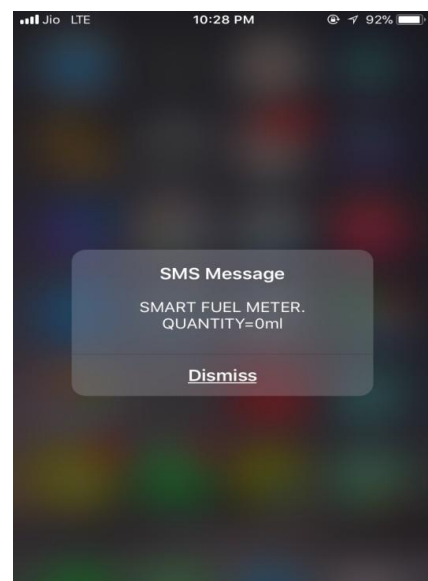


Figure 8 : SMS Screenshot in Mobile

Application

- Measure fuel flow in real time and display
- Portable & Battery operated
- Compact and Light Weight
- Low cost
- Suitable for 2 wheelers/ 4 wheelers
- Operates on DC/USB Power
- Very accurate
- Flow range between 3-50 litre per minute
- Weather Proof & Flame Proof

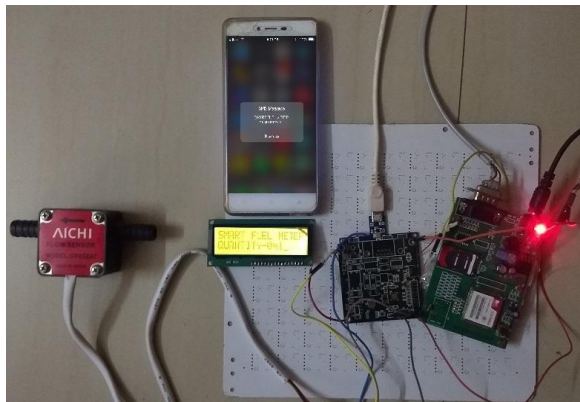


Figure 9 : Project Set-up

VI. CONCLUSION

This smart fuel meter will serve as an intelligent device to measure the amount of fuel flowing in and display the information to the driver in the customised LCD screen. It will also enable the owner to know the same information through his mobile phone. The board is ready with the schematics and will be fabricated with the appropriate components. The suitable code will be dumped into the microcontroller for its specific functioning. For future enhancements:

- This quantity measuring device can be extended to analyse the quality of fuel flowing into the tank .
- All the different constituents in the petrol can be examined using this smart fuel meter.
- The purity of fuel which is flowing in, can be determined.
- The speedometer and the odometer data can be synchronised to be displayed in our LCD screen

References:

- [1] : Dhivya Sri Gal and Rajeswari Mariappan, Kumaraguru College of Technology, "ADVANCED FUEL LEVEL TRACKING SYSTEM", Electrical, Computer and Communication Technologies (ICECCT), (ISSN: 4799-6085) 2015 IEEE International Conference , August 2015.
- [2] : G. Kiran Kumar and Venkata Siva Rao of CSE dept from MLR Institute of Technology, "DIGITAL FUEL METER", International Journal Magazine of Engineering, Technology, Management and Research , (ISSN: 2348-4845) Vol.3 No.4, October 2016.
- [3] : S Botha , Dept of electrical and electronics, University of Pretoria, South Africa , "DESIGN OF A WATER FLOW AND USAGE METER", Industrial Electronics Society, IECON 2016-42nd Annual Conference of the IEEE, (ISSN: 5090-3474), April 2016.
- [4] : Xuemei Li and Qiuchen Yuan, VLSI System Laboratory Beijing University, China, "IMPLEMENTATION OF GSM SMS REMOTE CONTROL SYSTEM", Information Science and Engineering, (ISSN: 4244-7618), IEEE Conference, January 2011.
- [5] : Jerry Branson and John Naber, Senior Member, IEEE, "A SIMPLISTIC PRINTED CIRCUIT BOARD FABRICATION PROCESS FOR COURSE PROJECTS", IEEE Transactions on Education, (ISSN: 0018-A , S9359), August 2000.
- [6] : Stuart H Larick, Member of I.R.E , "FUNCTIONAL SCHEMATIC DIAGRAMS", Proceedings of the IEEE, (ISSN: 0096-8390), December 1986.

