DESIGN AND CONSTRUCTION OF WIRELESS PC BASED FUEL LEVEL MONITORING SYSTEM

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ABSTRACT

Global System for Mobile communication (GSM) firms in Nigeria operates their base stations using generator sets. These base stations are located at nationwide. This research work aim at the design and construction of Wireless personal computer (PC) based fuel level monitoring system . The work focuses on the continuous monitoring of fuel level in four different tanks of a generator set at different locations of the base station via the combination of four high profile floater sensors and Radio frequency (RF) transceiver. The radio frequency transceiver was introduced to interpret the transmitted information to the end user at the receiving point using PC. Thereafter, the results of the different fuel levels obtained through wireless medium are graphical represented on the PC display for monitoring and prompt actions. The PC interface was made possible using C++ programming language.

Keywords: Monitoring system, fuel level, floater, transceiver and Radio frequency

1. Introduction

A growing trend is to monitor all aspect of electrical power and devices. In the vein of “you can’t manage what you don’t measure,” facility managers and engineers can use this monitoring application to reduce costs without sacrificing reliability and system uptime.

The word monitoring comes from watching over, accessing a certain subject. To monitor is to avoid a disregarded situation of the subject ABI, 2007. Many subjects have been monitored through ages, such as: traffic, intruders and constructions. . Sensors are artificial intelligence that could interprets any physical characteristic of a matter be it air, solid or gas. There are different varieties of sensors such as: Photo voltaic cells, Light depending resistors,

Infra red, Touch sensors, Ultrasonic sensors and Field sensors (Aakvaag *et. al*, 2007). But today a sensor called floater has been created to measure the rise and falling of fuel level. Microcontroller is the brain box imposed on this device to read and to execute a certain objective without the interference of man (Akan, O.B and Akyildiz, I.F, 2005), yet the distance factor was still a stumbling block to this progressive research work. To this end a Telecommunication device was initiated into the device to interpret the transmitted information to the last end of the receiving point using computer to access, which solve the problem of distance. Therefore this reduces stress, time factor and initiate effectiveness in the monitoring system.

The aim and objective of this paper is to design and implement PC based fuel level monitoring with a graphical user interface embedded with C++ programme in order to detect when to refill the fuel tank.

2. Background of study

The field of wireless communications is diverse and it may be difficult to get picture of the different technologies utilized in a certain field. In industry, the proposed and already employed technologies vary from short range personal area network to cellular network, and in some cases even global communication via satellite are applied.

This research shall first give a short review about the emerging and already employed Wireless technologies in process fuel monitor, executing proprietary solution provided by different manufacturers.

To study the applicability of the Microcontroller based Wireless Sensor Network in process monitoring application, an example as stated in the review is the application to fuel monitoring was implemented (Buckley *et. al*, 2006).

A survey investigated Wireless technologies used in industrial monitoring shows that the most exploited were Wi-Fi (34%), Radio Frequency Identification (RFID) (21%), Blue Tooth (14%) and Zig Bee (6%).had been strengthening its position. Namely RFID and Zig Bee were reported to have highest number of new uses (RFID + 17%), (Zig Bee + 16).

In process fuel monitoring, Wi-Fi networks can serve as the back bone for data concentration and networking, for example it can be use in conjunction with short range low power devices in a Wireless Field Network to control room or other data collection point (Culler, J., 2004).

Transceivers are based on Complementary Metal Oxide Semi-Conductors (CMOS) Technology. The amount of energy needed to communicate wirelessly increases rapidly with distance and obstructions further attenuate the signals. WSN radio energy consumption is about 20Mw and their range is typically measured in tens of meters (Cerpa *et. al*, 2001), (Bonivanto *et. al*, 2006).

2.1 Over view of sensor

A sensor (also called detector) is a converter that measures a physical quantity and converts it into an electrical signal which can be read by an observer using an instrument. The qualities of good sensor are: sensitivity to the measured property only, its insensitivity to any other property likely to be encountered in its application and do not influence the measured properties (Kretschmar *et. al* 2007), (Sensor type, 2012). Type of sensors developed over the years are: capacitance level, resistive chain level, pneumatic level, optical level, admittance-type level, vibrating point level, rotating paddle level, ultrasonic level, microwave, and floater sensor.

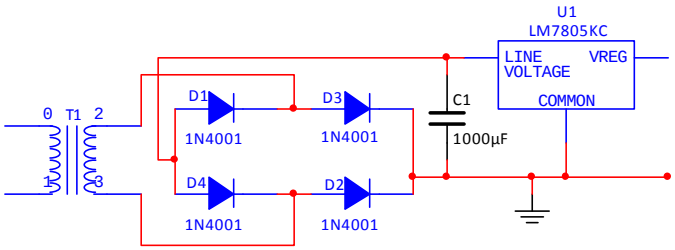
3. Materials and Methods

The wireless PC based fuel level PC monitoring system consists of different electronics components. These components are grouped into the following units: power, sensor, analog to digital converter (ADC), control and transmitter/receiver units.

3.1 Power unit

This is achieved via the use of a step-down transformer. This transformer steps down 220VAC to 12VAC.This is further converted to DC via the use of a bridge rectifier. The DC form this rectifier often contains some components of AC called ripples. This is then filtered via the use of a capacitor. The circuit of the power supply is shown below.

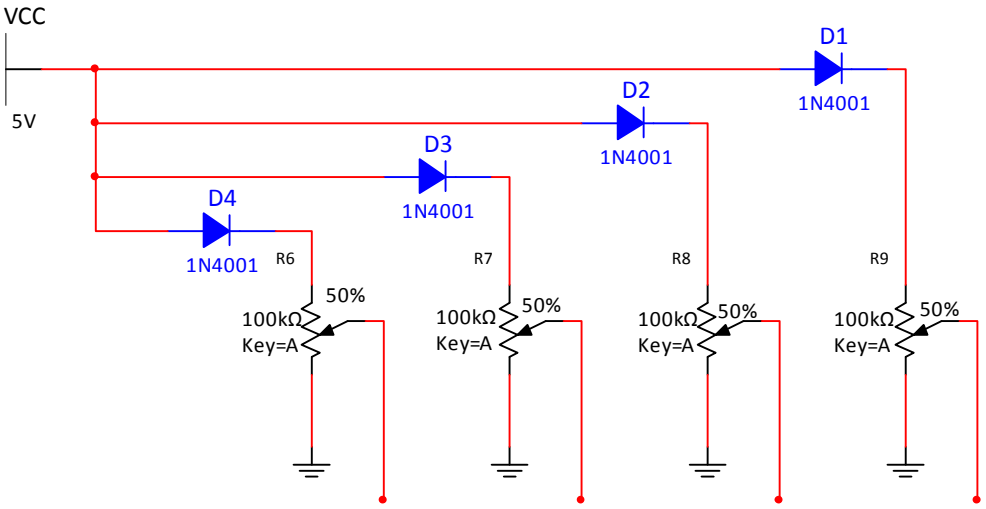
Figure 1.0: Power supply circuit



3.2 Sensor unit

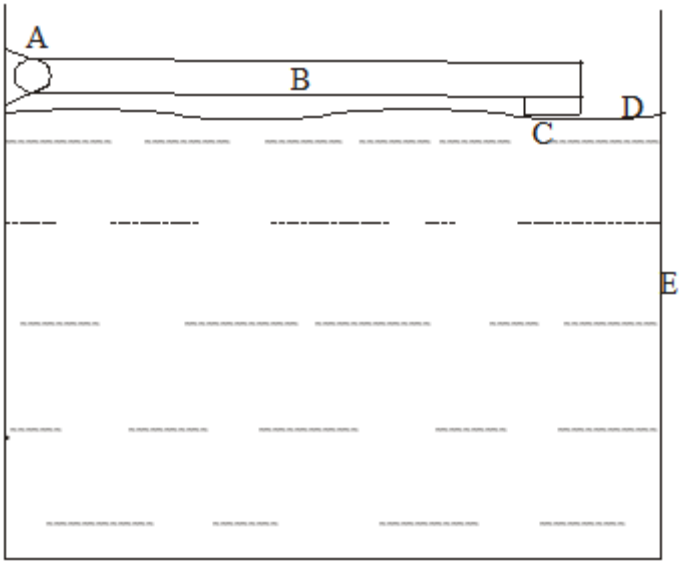
This is achieved with the use of potentiometers fastened to a lever and at the end of the lever a floater is attached. All together there are four of these potentiometers but so as not to achieve one single resistance during their parallel connection. A diode is used to separate each potentiometer as shown in the diagram below.

Figure 2.0: Parallel arrangement of floater sensor



The principle of operation of this sensor is simple. When attached to the tank the floater will reduce the lever angel towards horizontal when the tank is filled as shown below.

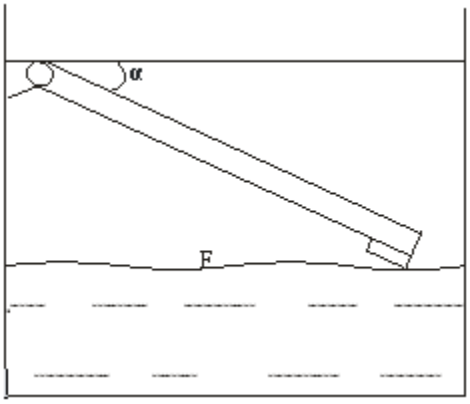
Figure 3.0: Fuel tank at full level



A - Potentiometer (sensor), B - Lever, C - Floater, D - Fuel level and E – Tank.

When the fluid level reduces the angle between the horizontal and the lever increases to (angle α) as shown below

Figure 4.0: Varied fuel level



α = angle and F=Varied Fuel Level.

this result to a variation of voltage at the common of the potentiometer. This voltage is what is used to categorize the level of fuel in the tank.

3.3 ADC unit

The signals from the sensor are analyzed since it changes as physical angle changes. Therefore this output signal is feed into an ADC to give its digital equivalent in 8bits.The basic way of controlling the ADC to achieve the conversion can be found in the data sheet of ADC 0808 which is the ADC used. The reason why it is preferred is because of these 8 inputs. So this gives us the opportunity to measure the level in 4 different tanks as proposed earlier before now.

3.4 Control unit

This unit is achieved via the use of the microcontroller called 89552.The basic connection of the chip is describe below Pin 40 is the positive pin to power the controller while pin 20 is grounded.

Pin 18 and 19 is where the crystal oscillator is connected while pin 9 is pulled up with a 1µf capacitor to Vcc. It should be noted also that pin 31 must be connected to Vcc since the instruction is gotten from within the controller.

3.5 Transmitter/Receiver unit

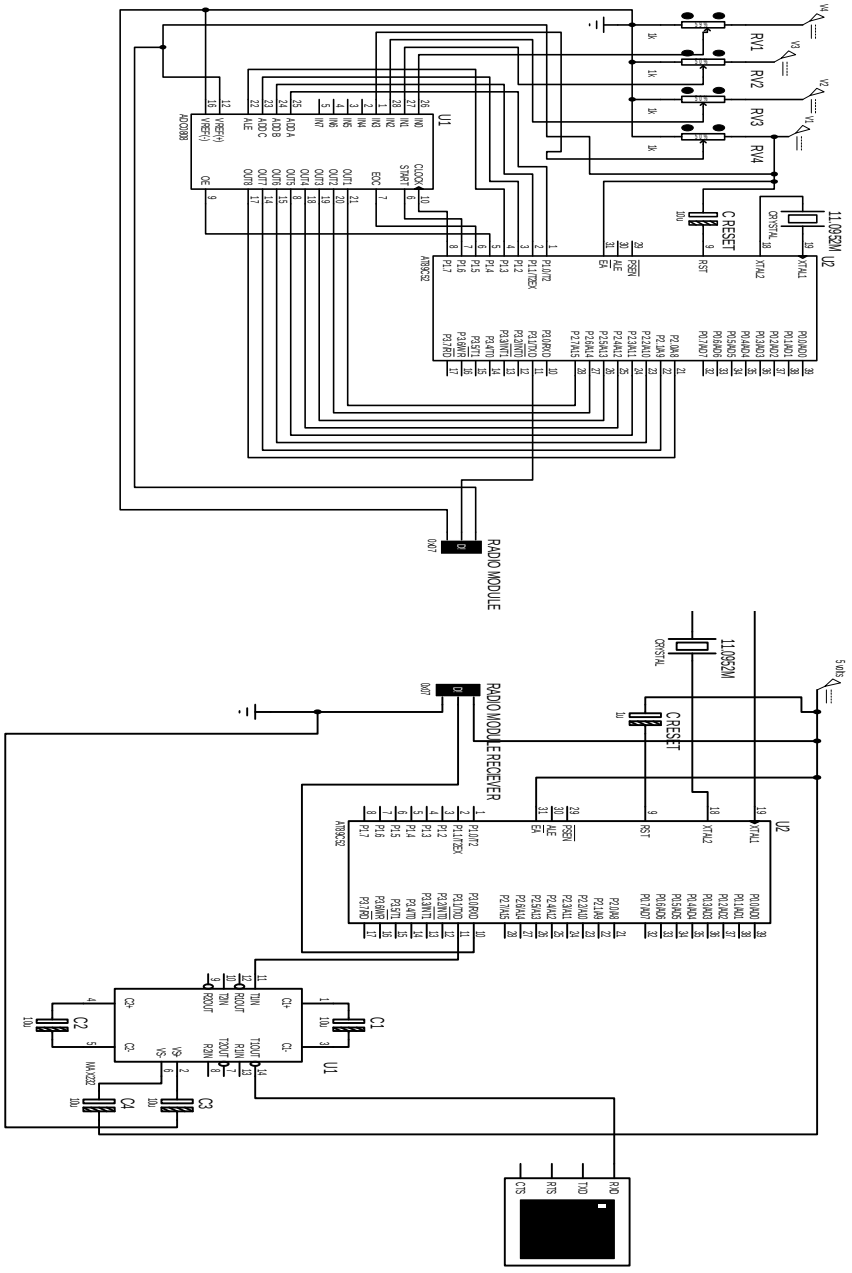
The transmission/reception of the data received from the controller is achieved via the use of Radio frequency (RF) module. Here the RF module transmits the data to the receiver at a very high frequency which cover a reasonable distance between the transmitter and the receiver.

3.6 The system mode of operation

The floating object that is fixed through the lever to the tuner of the potentiometer serves as the sensor unit which remains float in each tank. As the level of fuel drops from its initial position, the angle of the sensor unit together with the output voltage of the potentiometer also changes which lead to the variation of voltage. This variation of voltage is the analog signals that are fed to the four input pins of the analog to digital converter (ADC). As the analog signals gets to the ADC unit, the address latch enable (ALE) of the ADC activate the addresses to be able to pick those analog signals for conversion and at this point the controller clock the ADC to start conversion and the ADC convert those analog signals and feedback the controller when the conversion is completed. When the whole process is completed, the digital equivalent of those analog signals is then sent to the controller in 8bit which process the data and sent through its serial port to the transmitter that transmit the data to the receiver. At the receiving end, the receiver received the transmitted data and passes it to a remote controller at the receiving end which further processes it and finally sent it to the PC for monitoring purpose via Max 232.(Note the whole processes takes place continuously

in micro sec). A simulation software package was written in C to simulate the implementation of the tank level and interface the system with the PC as shown in figure 6.0

Figure 5.0: Complete Circuit Diagram

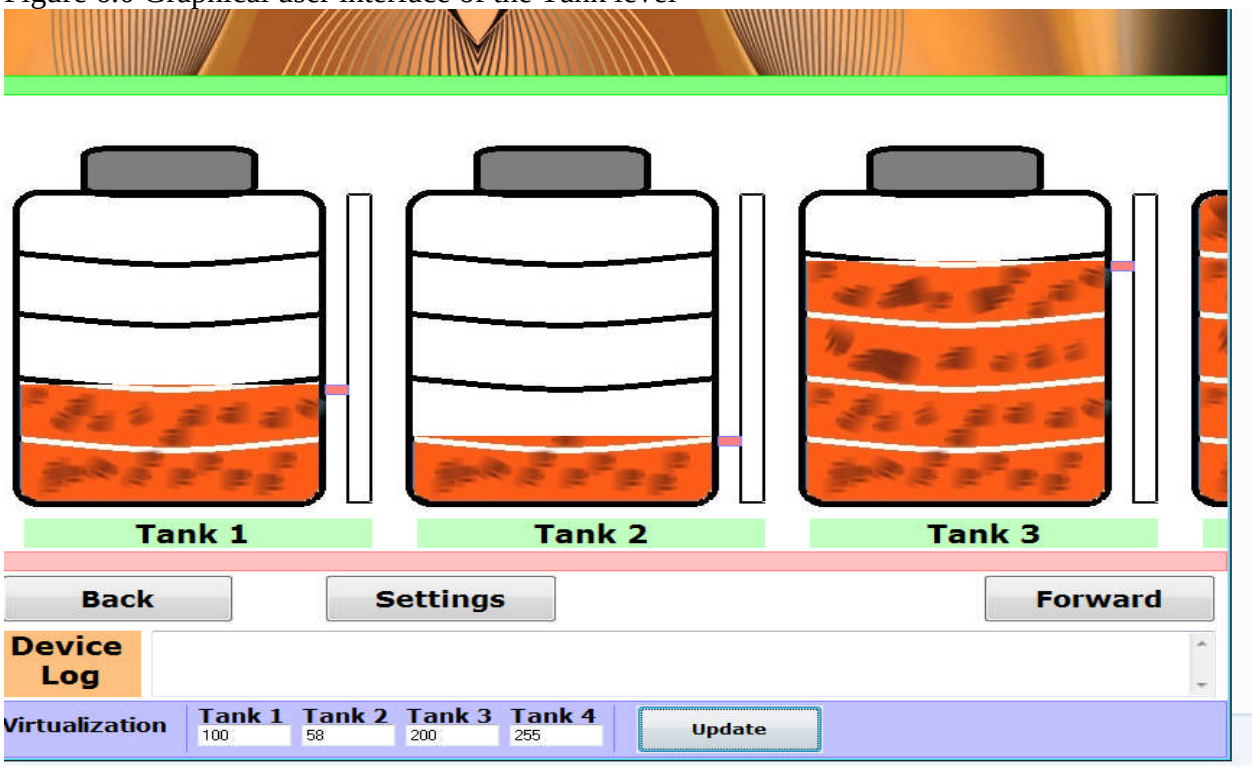


4. Results and discussion

Table 1.0: Test results showing the angle, voltage of sensor and ADC output relationship

S/N	Angle Reading (Degree)	Corresponding Voltage Output of the fuel level sensor (DC) (V)	ADC Output
1	90	2.5	127.5
2	80	2.22	113.22
3	70	1.94	98.94
4	60	1.67	85.17
5	50	1.39	70.89
6	40	1.11	56.61
7	30	0.83	42.33
8	20	0.56	28.56
9	10	0.28	14.28
10	0	0	0

Figure 6.0 Graphical user interface of the Tank level



Discussion

The 5v input voltage to the system is the nominal rated voltage that will continuously power the system without damage to any components that constitute the system.

Table 1.0 shows various fuel levels against angle of the floater sensor. When there is rise in the fuel level due to refilling the thank or falling in the fuel level due to generator consumption, the corresponding value or position will be display on the PC for monitoring purpose. As shown in the table 1.0 at full level the floater sensor makes angles 90^o with reference to the tank and the corresponding DC voltage output of the fuel level sensor sent to the ADC. Furthermore as the generator consume the fuel, the angle of the level sensor start decreasing from 90^o to 80^o and from 80^o to 70^o and so on till it get to angle 0^o where the tank is empty. But for this project when the fuel level is below the acceptable level, the PC display indicate with a change of color signifying urgent need to refill the tank to avoid power failure. The same is applicable to all the tanks that are involved in this project.

5. Conclusion

The project design and construction of wireless PC based fuel level PC monitoring system has been implemented according to the design, tested and confirm satisfactory as it has met the anticipated aim and objective. The maximum voltage required to optimally operate the system is 5volt.

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