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Sudan University of Science and Technology
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Automatic Control of Fuel Stations in Sudan

التحكم الآلي في محطات الوقود في السودان

A Research Submitted in Partial Fulfillment of the Requirements of M.Sc
In Electrical Engineering (Computer Engineering and Networks)

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الآية

قال تعالي:

(قُلْ إِنَّمَا أَنَا بَشَرٌ مِّثْلُكُمْ يُوحَى إِلَيَّ أَنَّمَا إِلَهُكُمْ إِلَهٌ وَاحِدٌ فَمَن كَانَ يَرْجُو لِقَاء رَبِّهِ فَلْيَعْمَلْ عَمَلا صَالِحًا وَلا يُشْرِكْ بِعِبَادَةِ رَبِّهِ أَحَدًا) 110

سوره الكهف(110)

DEDICATION

I want to dedicate this research to

The persons whom treat me with kind, patience, and love in all my life stages

My parent

To the lovely and sweet of my life

My sister and brother

To the people who add beautiful things in my life

My friends

To my teachers' and college in all my educational levels specially in this faculty

ACKNOWLEDGEMENT

Firstly, I thank ALLAH for giving me the strength to complete this work.

I would like to thanks and gratitude all those who helped me from near or far to accomplish this work and to overcome the difficulties I encountered, for great efforts to facilitate this study, especially my advisor and supervisor: Dr. Ala-Addeen Awouda for his valuable guidance, supervision and persistent encouragement. Due to the approach adopted by him in handling my thesis and the way he gave me freedom to think about different things, I was able to do the constructive thesis. By working under him I have gained priceless knowledge as to how to go about doing an effective research.

The greatest thanks to my family for gave me courage and strength whenever I needed it and their support.

ABSTRACT

The system currently used to manage the fuel stations in Sudan is a traditional system where manually paying the cost of the fuel and manually monitoring fuel level within the station tank, which makes the service slow, unreliable, need additional time, large number of workers and it is also expensive for the company that owned the stations. This research design an automated system to control the fuel sale and remote monitoring of the fuel level in the station tank which makes the work more accurate compared with manual work ,reduce workers inside the station , provide better service to customer , avoid all the human errors and also avoid the cheating activities . Remote monitoring technology can thus be applied to this process to provide timely information such as fuel level in station tank to enable timely decision making based on accurate data. An electronic system has been designed for fuel stations using Arduino microcontrollers and the wireless technology. In Fuel sale Graphical User Interfaces (GUI) are created to interact with customers using visual Basic which enables them to enter the data (ATM Number, Fuel Cost). If the customer's data is valid, customer's request transmitted by wireless X-Bee to a microcontroller to give the order to the fuel counter chosen by the customer to start the work for refueling his /hers vehicle. This reduce manpower, save time، provides reliable and faster services. In monitoring fuel level Arduino Uno gets the fuel levels which are measured from the ultrasonic sensor, and then sends this fuel levels via wireless XBee to Graphical User Interfaces to display real time Fuel Levels values. This makes fuel station management easier, faster, high accuracy, real-time monitoring and provides information about the current status of the station, which helps to take decisions in a suitable time.

المستخلص

النظام المستخدم حاليا لإدارة محطات الوقود في السودان يستخدم الطرق التقليدية حيث ان عملية دفع تكلفة الوقود وقياس كمية الوقود داخل خزان المحطه تتم يدويا ، الأمر الذي يجعل الخدمة بطيئة وغير موثوق بها وتحتاج الي وقت إضافي، وعدد كبير من العمال، وهي أيضا مكلفة للشركة المالكه لهذه المحطات.يهتم هذا البحث بتصميم نظام آلي للتحكم في عمليه بيع الوقود ومراقبه خزان الوقود عن بعد مما يجعل العمل اكثر دقه مقارنه مع العمل اليدوي وتقليل العمال داخل المحطه وتقديم خدمه افضل للعملاء وتجنب الأخطاء البشريه وأيضا تجنب أنشطة الغش. وتطبيق تكنولوجيا المراقبة عن بعد على هذه العملية لتوفير المعلومات في الوقت المناسب المتعلقة بمعلومات متنوعة مثل مستوى الوقود في خزان المحطه ليمكن من اتخاذ القرار في الوقت المناسب استنادا على بيانات دقيقة.صمم نظام إلكتروني لمحطات الوقود يستخدم متحكمات (اردينو) والتكنولوجيا اللاسلكية في عمليه بيع الوقود تم انشاء واجهات المستخدم الرسوميه (جي يو أي) باستخدام لغه الفيجوال بيسك للتفاعل مع العملاء وتسمح لهم بادخال بياناتهم (رقم بطاقه الصراف الالي،سعر الوقود) اذا كانت هذه البيانات صالحه فان طلب العميل يرسل عبر الموجات الاسلكيه الي المتحكمه الدقيقه لاعطاء امر لعداد الوقود المختار من قبل العميل لبدا العمل وتذويد مركبة العميل بالوقود مما يودي الي تقليل القوي العامله في محطه الوقود وحفظ الوقت وتقديم خدمه موثوقه وسريعه. وفي مراقبه مستوي الوقود تعتبر متحكه اردينو جزء اساسي للحصول علي قياسات مستوي الوقود من حساس الالتراسونك وارسال قيم مستويات الوقود بواسطه الموجات الاسلكيه لواجه المستخدم الرسوميه لعرض قيم مستويات الوقود في الوقت الحقيقي مما يجعل عمليه اداره محطه الوقود اسهل واسرع واكثر كفاءه وتقديم معلومات عن الوضع الحالي للمحطة من حيث كمية الوقود في خزان المحطه الذي يساعد على اتخاذ القرار في الوقت المناسب.

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LIST OF ABBREVIATIONS

AC	Alternating current
ADC	Analoge didital converter
BASCOM	BASic COMpiler
COM	Communication Port
CPU	Central Processing Unit
DC	Direct Current
GND	Ground
GUI	Graphical User Interface
IC	Integrated Circuit
IEEE	Institute Electrical and Electronics Engineer
I/O	input/output
LED	Light Emitting Diode
MCUs	microcontroller units
NFC	Near Field Communication
OOP	Object-Oriented Programming
PC	Personal Computer
PCB	Printed circuit board
PLC	Programmable Logic Controller
PCB	Printed circuit board
PWM	Pulse width modulation
RAM	Random Access Memory
RF	Radio Frequency
RFID	Radio Frequency Identification
USB	Universal Serial Bus
VB	Visual Basic
VSPE	Virtual Serial Port Emulator
WSN	Wireless Sensor Network

CHAPTER ONE

(INTRODUCTION)

CHAPTER ONE
INTRODUCTION

1.1Overview

The rapid development in wireless technology along the recent years has significantly contributed to improve our daily lives, creating wide fields of applications (environment, health, military, security, etc), and gradually becoming a sustainable alternative to traditional wired systems. All of this can be traced back to the development of microelectronics and integrated circuits, however, the appearance of several wireless communication standards such as Bluetooth Sigsbee,and Wi-Fi which provide a compromise reliability of the system for long term applications[1], as in case of monitoring tank and control of fuel sale inside the fuel station. Fuel and gas play a key role in the production of petrochemical goods and in power generation. They are a prerequisite for economic prosperity and enter into many areas of daily life so it has to be maintained. Vehicle fuel is considered one of the most important modern needs. As a result of the increasing number fuel stations and growing demand for fuel, therefore it is necessary to provide easier, faster and more accurate ways to manage fuel station by Owner Company and afford better services to customer. But traditional methods are slow And require additional number of workers which lead to loss of time and and lack of accuracy.

Fuel stations in Sudan depend on workers in refueling the customers' vehicle and paying the cost of the fuel manually. This procedure is time consuming and wasting the human resources. On other hand the owner company lack of direct

monitoring fuel level inside stations, which fuel levels are measured inside station, measured manually, which requires large number of workers and at the same time consuming time. These problems push us to think in designing a Project help the company to real-time monitoring of fuel level in fuel station , at the same time preserve the human resources, also providing services that preserve costumer's time for their satisfaction.

This thesis proposed project is an automatic system work through electronic circuits, GUI interfaces and wireless tecnology, designed to facilitate the sales process and make it more reliable and faster than manual labor and avoid Human errors. It is preserve customers' time and their trust in the process. .The system also can monitor the fuel level inside the station provides accurate realtime information about fuel level to the owner company's. In our era, it became necessary, getting for real-time information that helps in the speed of decision-making based on accurate and reliable data This method saves money, time, and human recourses for the company. This proposal also make fuel stations management process is easy and flexible. Fuel stations system work full interdependence of all fuel station procedures through the sale of fuel or supplying the station with fuel (fuel level) therefore the system provides comprehensive management through direct linkage with the available devices inside the station with Petroleum Company to provide the company of Information about the fuel station (fuel tank level). This information can be then stored in computerized systems and reports generated with data to inform management practices. Fuel management is provided through the use of network to provide detailed fueling data. This enables to provide timely information to enable timely decision making based on accurate data.

1.2 Problem statement

Traditional ways of fuel sales is slow process which leads to loss of time and congestion inside the station. It lacks of sufficient accuracy and confidentiality and the owner company has no close control monitoring for fuel station. Fuel levels are measured inside station, and are often measured manually, which requires large number of workers and it is time consuming.

Traditional fuel level measurements interfere with decision making ability because it doesn't provide accurate and real time information of station tank status.

1.3 Proposed solution

By using fuel station systems with efficient and modern techniques; Design an automatic system to control the Sales process electronically in fuel station by using wireless technology and GUI interface to deal with customer. An electronic monitoring the fuel tank inside fuel station to determine how much fuel level in the station , then send this information (fuel level) to owner Company.

1.4 Aims and Objectives

The aims of this thesis to design automatic system of fuel stations in Sudan to help the petroleum company in providing better customer service, more accurate, reliable and confidential .it also provide close monitoring about the current status of the fuel level in station.

The objectives are:

- To make the work at fuel station more Accurate compared to manual work.
- To provide the highest protection and security levels, allowing the fuel pump nozzle automatically identifies the refueling that the driver selected in advance Options.
- To reduce the human resources.
- To avoid all the human errors and also avoid the cheating activities.
- To provide real time information relating to fuel level status to enable timely decision making based on accurate data.
- To achieve Speed reports about fuel level are very large and fast and Strong screens.
- To accelerating the refueling process, which no longer have to wait on individuals for payment process.
- To improving the management.

1.5 Methodology

The methodology used in the sale of vehicle fuel, through the creation of GUI interfaces to deal with customers (enter customer's data) using visual basic program language then the customer request is sent by wireless to the Arduino Microcontroller to give order for certain counter chosen by customer to start work for supply customer 's vehicle by fuel.

These steps show the way in which it will be the sale of vehicle fuel at fuel stations. By use (Arduino Microcontroller; wireless network, GUI interface).

- Consumer enters his card identification(ATM card) and select the price at which he wants to fill
- After checking if it has met the conditions (authorized).
- Automatically selecting a certain counter from the counters which only gives the required quantity of fuel without having to respond to the rest of the counters
- Or shows that there is error and does not respond any of the counters

Wireless sensing system for sensing and monitoring the fuel level data. The methodology of the monitoring fuel level in fuel tank by connect A sensor for measuring the fuel level through wireless and monitor The quantity of fuel inside the station in the graphical user interface (GUI) exist within Petroleum Company. Firstly the data point in the ultrasonic sensor connects with the Arduino Uno digital port. Secondly Arduino Uno sends the input data from digital port via XBee to another XBee that is connect with a computer. Visual Basic use to write a program to display the data (fuel level), finally receive this data (fuel level) in computer. The computer consists of graphical user interface (GUI) to display values of fuel level at the company interface.

1.6 Thesis outlines

This thesis includes five chapters as follows: Chapter one gives introduction of this thesis. Presents the Problem statement and objective it also presents the Methodology, Chapter two about background and literature review, Chapter three showed system design of the proposed system and explains the system structure and how the system work, Chapter four presents the results and discussion, Chapter five consists is conclusion and recommendation.

CHAPTER TWO

(LITERATURE REVIEW)

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In the system currently used to manage the fuel stations in Sudan is traditional ways system where the process of paying the cost of the fuel manually and mentoring of the quantities of fuel within the tank of the stations, which makes the service provided to customers slow and unreliable and need additional time, a large number of workers and It is also expensive for the company that owned the stations. From here we have proposed an automated system to reduce the number of workers, faster performance, accurate, save time and provide real time information relating to fuel level status to enable timely decision making.

In this chapter, we describe the key concepts of components used in this research, describe the classifications in general. And we provide an overview of the latest trends of research going in the field of fuel stations. The related studies demonstrate the techniques and methods used to improve and increase the efficiency of work at fuel stations.

2.1.1 Related studies

Marion, K. O [2] in his paper proposed the system includes wireless communication electronics for communicating with a remote communication unit, a dispenser and customer interface for conducting a transaction and accepting payment, and a control system. The control system is adapted to determine a value correlating to payment made by a customer, effect storage of the value in association with the remote communication unit, communicate with the remote

communications unit subsequent to effecting storage of the value and deduct the value of an amount of a transaction associated with the communications unit to effect payment.

Nedjeljko Lekic, Zoran Mijanovic and other [3] in their paper presented the identification system for automation of company petrol stations. The system is based on NFC technology with Mifare 1K contactless cards as identifiers. The system facilitates control and optimizes fuel consumption of company vehicles. It is designed to facilitate recording and control of the process as well as allow filling without the presence of the operator. The system is realized and mounted at the petrol station of the Ministry of the Interior.

Edward, O. O. and other [4] in their paper proposed design the fuel monitoring and electronics control of dispenser for fuel station. It consist of two sections; hardware implementation for control section and software implementation section. Some fuel stations which used the flow rate sensors cannot get satisfactions both customers and dealers. The reason is that the fuel volume can increase or decrease due to the temperature changes depending on the places and times. The system can solve the disadvantages of it. The system controls for the compensation in volume flow rate with controller. In order to solve this problem, PIC16F877A is used as a controller to control the time taken for each data representation customer requests from the keypad and LCD (liquid crystal display) is also used as display unit in this system. And then computer is also used as a control station by using VB.Net. The status of the fuel levels is also monitored from the computer. MikroC is used for software implementation of the system In order to control time taken.

Yee, N. K. S. and K. T. Theingi and other [5] in their paper discussed a Web Based Monitoring System that enables effective monitoring of fuel pump output and sales volume from distributed fuel stations under the domain of a single company /organization. The traditional method of operation by these organizations in Nigeria is un-automated and accounting for dispensed product is usually approximated and manual as there is little or no technology implemented to presently provide information relating to the state of affairs in the station both to on-ground staff and to supervisory staff that are not physically present in the station. This results in unaccountable losses in product and revenue as well as slow decision making. Remote monitoring technology as a vast research field with numerous application areas incorporating various data collation techniques and sensor networks can be applied to provide information relating to fuel pump status in distributed fuel stations reliably. Thus the proposed system relies upon a microcontroller, keypad and pump to demonstrate the traditional fuel dispenser. A web-enabled PC with an accompanying graphic user interface (GUI) designed using virtual basic which is connected to the microcontroller via the serial port which is to provide the web implementation.

J. A. Goundar, A. A. Chand, N. Tabua, R. Prasad, P. Chand, U. Metha, K. A. Mamun and other [6] in their paper discussed Liquid levels are measured in a variety of industrial applications, and are often measured manually, which can be labor-intensive as well as time-consuming. Rapid advances in electronic technologies have made a variety of inexpensive sensing, monitoring, and control capabilities available. A mechatronic design solution is produced to solve a practical problem faced by Generation Strategic Business Area at Cawaira power-station, a substation of Fiji Electricity Authority (FEA). A monitoring system is developed, designed and evaluated for automatic measurement and controlling of

fuel levels in the fuel supply tanks at this sub-station. The design was demonstrated using a hardware model. The system is composed of a pressure sensor, a microcontroller, solenoid valves and a liquid pump. The pressure sensor measures the pressure inside the air column submerged in the tank, which is then calibrated to display level. The system is designed to read real-time data to measure the fuel level inside the tank as well as programmed with critical event alarms which trigger upon the occurrence of an event such as low fuel inside the tank, reaching maximum safety limit and leakage in the fuel pipe line. The system is being tested using the fabricated model and the system measurement results are verified to those measured manually. This system is inexpensive, easy to build, install, and maintain. In addition to monitoring liquid level, the system could be adapted to a variety of other measurements.

R. Gnanavel,P. M. Deepak,B. Praveen Kumaar, Jason Bakthakumar and other [7] in their paper proposed the scenario, for replacing the human efforts into automated digitalized mechanism has become a vast growing factor. Human race has become far more independent than they were in the past. Every field has reached their goal of user friendly, in which the actions of a person are controlled by software. However, this is not applied in most of the petrol bunks. Normally in petrol bunks there is a Human to Human interaction. Our project is to overcome this phenomenon by bringing the interaction between Human and Software. By following this mechanism, we can avoid all the errors that a human does and also avoid the cheating activities that a culprit laborer performs in his work. Our project idea is to make the entire process performed by human laborer in a Filling Station into automated digitalized mechanism to avoid small errors and cheats that can be performed by the laborer to their owners. Our system consists of RFID READER to be placed in the Filling Station and all the vehicles must be provided with RFID

TAGS. When the RFID READER senses the RFID TAG that holds the customer id, it sends the id to the centralized server, verifies the ID and opens the gate, the database in the centralized server consist of all banking details of the customer that can be fetched automatically after the confirmation of the user for the cost of the fuel. At present using RFID technology in automating the filling station including the transaction process have created the idea that it is not secure, so we use advanced cryptographic techniques like Secure Socket Layer (SSL) cryptography. AES - Advanced Encryption Standard Symmetric Cryptography to make sure that the process is secured and efficient. All the customer's ID details and total amount of fuel dispensed from the filling station will also be stored in a separate database for the filling station owner's view and also sent to user's registered mobile number using GSM technology.

2.2 Background

This section will introduce basic information about microcontroller, wireless communication, ultrasonic Sensor, and visual basic language.

2.3 Microcontroller

Microcontroller (μC or uC) is a compressed micro computer manufactured to control the functions of embedded systems in office machines, robots, home appliances, motor vehicles, and a number of other gadgets. A microcontroller is comprises components like- memory, peripherals and most importantly a processor. Microcontrollers are basically employed in devices that need a degree of control to be applied by the user of the device.

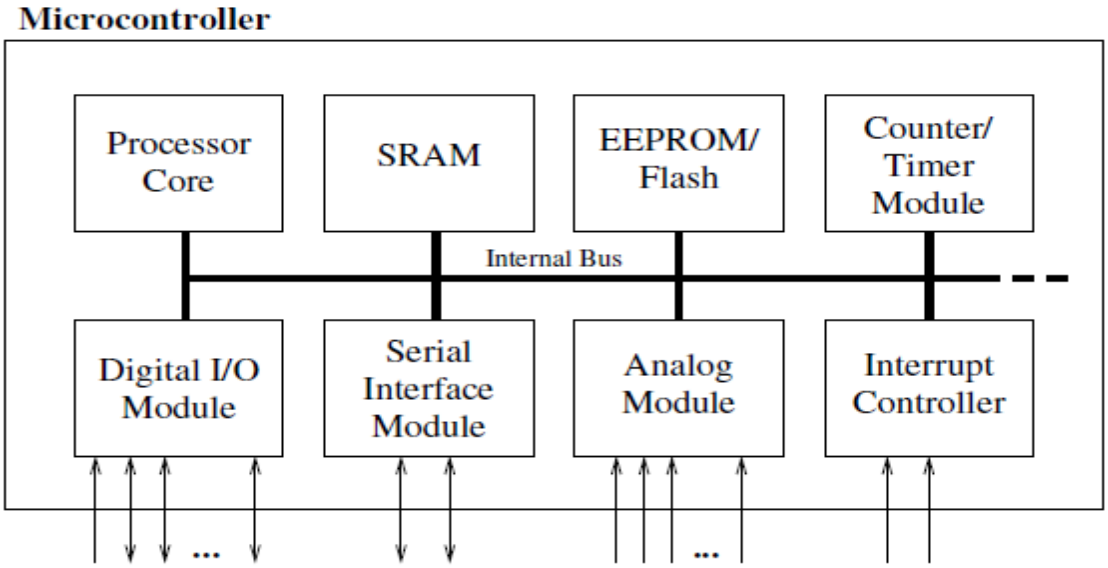

Figure 2.1: Basic layout of a microcontroller.

2.3.1 Arduino Microcontroller

Arduino is an open-source microcontroller used in electronic prototyping. These days many people try to use the Arduino because it makes things easier due to the simplified version of C++ and the already made Arduino microcontroller that can program, erase and reprogram at any given time.

There are many shields built for Arduino. Shields are boards that can be plugged on top of the Arduino PCB extending its capabilities. The different shields follow the same philosophy as the original toolkit: they are easy to mount, and cheap to produce. One of popular Arduino shield is Ethernet shield. It is used to connect Arduino board with another Ethernet based device through LAN cable. Many applications have been made using Ethernet shield. It can be used as a web server for heart rate monitoring so people can monitor physical status of the patient remotely from the web. Also, it can be used as connector between PLC, ultrasonic sensor and line following sensor to develop automatically guided vehicle

controlled by PLC, which can be easily used for supplement transport inside factory, or even for human transport.

The Arduino environment can be extended through the use of libraries, just like most programming platforms. Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. A number of libraries come installed with the IDE. [8]

2.3.2 Arduino Board

Arduino is an open source micro-controller system based on simple input output board. Arduino is typically used for creating prototype as well as to develop standalone interactive objects. Arduino was developed with requirements as easy to learn and use, flexible, reliable. They are widely used in a wireless sensor network as a portable device. Arduino comes in different variations like Arduino Uno, Arduino R1, Arduino R2, and the Arduino Duemilanove etc. There are number of sensors and actuators that work with Arduino. Popular sensors like temperature, air pollution, light, GPS modules and sound and actuators like LEDs, speakers and digital/analog outputs are common actuators [9]

2.3.3 Arduino Mega 2560

Arduino Mega2560 is a microcontroller board based on the ATmega2560. Arduino Mega2560 has 54 digital pins Input / Output, of which 15 pins can be used as PWM outputs, 16 pins as Analog Inputs, and 4 pins as UART (Serial Port Hardware), 16 MHz crystal oscillator, a USB connection, Jack Power, Header ICSP, and a reset button. This is all that is needed to support the microcontroller. Simply by connecting it to a computer via USB or power cable is connected to AC-DC adapter or battery to start to activate it. Arduino Mega 2560 is compatible with most shields designed for the Arduino Duemilanove or Arduino Diecimila.

Arduino Mega 2560 is the latest version that replaces the version of the Arduino Mega. [10]

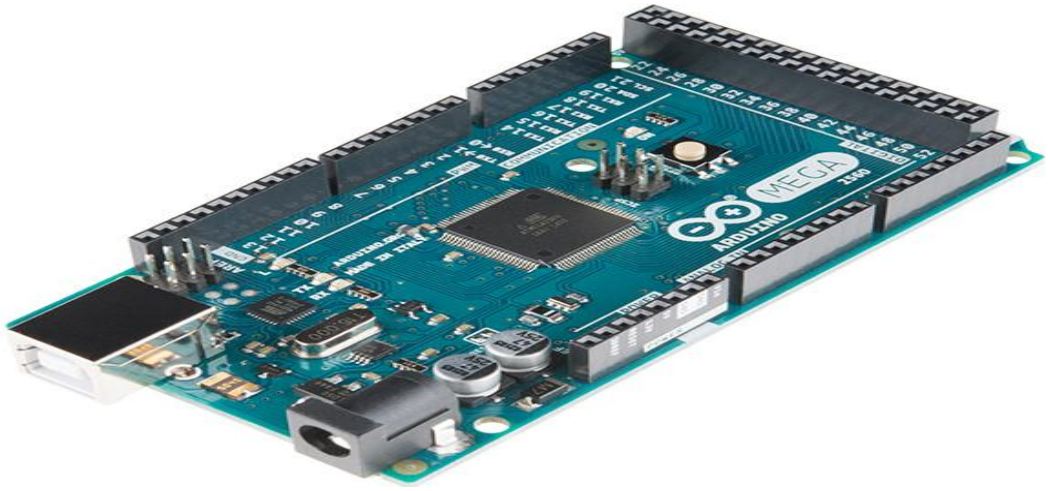

Figure 2.2: Arduino Mega Microcontroller.

2.3.4 Arduino Uno

The Arduino Uno is a microcontroller board grounded on the ATmega328.It comprises of 14 digital input/output pins (out of which 6can be utilized as PWM outputs), 6analog inputs, a 16MHz ceramic resonator, a facilitation for USB connectivity, a power jack, an ICSP header, and a reset button. Its designs comprises of assistances that supports the microcontroller in every possible way. In order to get to work with it one has to simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery. It is accessible in two different versions namely Arduino Uno and Genuino Uno. The Uno is unique from all its former boards in the way that it does not make use of the FTDI USB-to-serial driver chip.

The word "Uno" refers to one in Italian and it is named so to mark the forthcoming release of Arduino 1.0. The Uno and version 1.0 are the reference versions of Arduino in the forward journey. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

Arduino IDE is open-source software which makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. Interrupts are used in programming to make system more effective and respond to changes accordingly. [11]

Figure 2.3: Arduino UNO Microcontroller.

2.4 Sensors

Sensor is an electronic component, module, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics, whether as simple as a light or as complex as a computer. Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base, besides innumerable

applications With advances in micro machinery and easy-to-use microcontroller platforms, the uses of sensors have expanded beyond the traditional fields of temperature, pressure or flow measurement. Applications include manufacturing and machinery, airplanes and aerospace, cars, medicine, robotics and many other aspects of our day-to-day life.

2.4.1 Ultrasonic Sensor

Ultrasonic sensor is electronic device that change the electrical energy into mechanical energy in the form of ultrasonic sound waves. Ultrasonic sensors are most commonly used due to its simplicity and low cost. The sensor consists of a series of ultrasonic transmitter and receiver. The accuracy of the measured distance is dependent on the separation between the ultrasonic transmitter and receiver.

Example of ultrasonic usage is distance measurement of an object in the path of a person, equipment, or a vehicle, stationary or moving is used in a large number of applications such as robotic movement control, vehicle control, blind man's walking stick, medical applications, binary gas mixture fraction, etc.

This tool is used to measure the ultrasonic waves. Ultrasonic waves are mechanical waves which have the characteristic longitudinal and typically have a frequency above 20 kHz. Ultrasonic waves can propagate through the solid, liquid or gas. Ultrasonic waves are waves of energy propagation and mechanical momentum that propagate through the third element as the interaction with the molecule and the nature of the medium inertia path. [12]

Figure 2.4: Ultrasonic sensor chip.

2.4.2 Ultrasonic Sensor Principle of Work

Ultrasonic sensors are devices that use electro-mechanical energy transformation to measure distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves which travel as a sequence of compressions and rarefactions along the direction of wave propagation through the medium. It consists of 2 parts. One creates the beam waves and transmits it and other part receives the reflected wave. The ultrasonic sensor module is composed of an ultrasonic transmitter, a receiver and a sensor controller. The ultrasonic transmitter sends a signal by vibrating a piezoelectric element. When echo of ultrasound waves vibrates the element of the receiver, the sensor module sends the response signal. Time-of-flight (ToF), which is the difference in time between trans-mission and reception, is used to measure the distance from the ultrasonic sensor. [13]

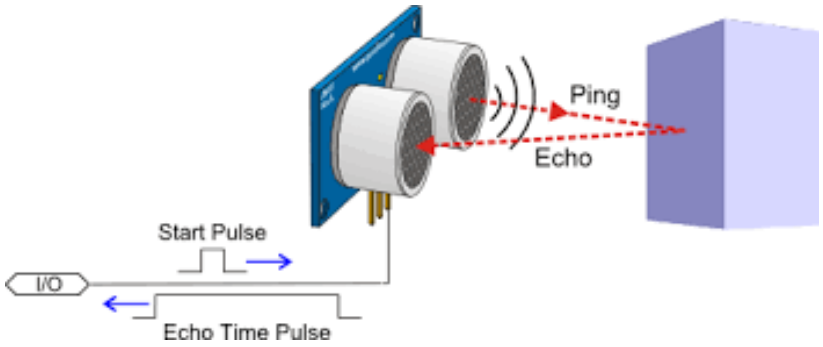

Figure 2.5: Ultrasonic sensor work Diagram.

In both the ultrasonic sensor can take input as duration in microseconds by a little code written as follow Microseconds = pulse In (7, HIGH); means that sensor calculate the duration in microseconds between the transmitting and receiving time of ultrasonic waves and then it will converted into centimeters by a formula: [14]

$$Centimeter = \left(\frac{Microsecond}{29}\right)/2 \tag{2.1}$$

2.5 Electric Motor

An Electric motor is a machine, which converts electric energy into mechanical energy. The reverse of this is the conversion of mechanical energy into electrical energy and is done by an electric generator. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field. Electric motors are used to produce linear or rotary force (torque), and should be distinguished from devices such as magnetic solenoids and loudspeakers that convert electricity into motion but do not generate usable mechanical powers, which are respectively referred to as actuators and transducers. They are tow type of Motors classification

Based on Power Supply Alternating Current (AC) Motors and Direct Current (DC) Motor.

2.5.1 DC Motor

A DC (Direct Current) motor is based on a fact that similar poles (magnetic poles) repel and dissimilar poles attract each other. An electromagnetic field is generated in a coil of wire when a current passes through it and is focused at the centre of the coil. When the current changes its direction or intensity or switching action on and off) in the coil, the magnetic field can be changed be reversed by 180 degrees or can simply generate switching magnetic field.

In a Dc motor a stator has a stationary magnets and armature has windings wring around the insulated stacked around iron pole commonly known as stack teeth with ends finishing at the commutator. Armature consists of bearings which are mounted at the middle of the motor and connections of commutator. The winding is winded around armature and is known as armature winding which uses conductor (single or parallel) wires which are wrapped around stack teeth. EMF's (Electromagnetic fields) strength depends on several factors such as current in the coil, size of the coil and the material ringed around the coil. Direction of EMF depends upon number of turns and sequence of turns in a coil. By removing and injecting the coil inside and A greater control over the DC motor can be established by designing the Dc motor in such a way so that the magnetic fields generated by the stator fields using electromagnets. [15]

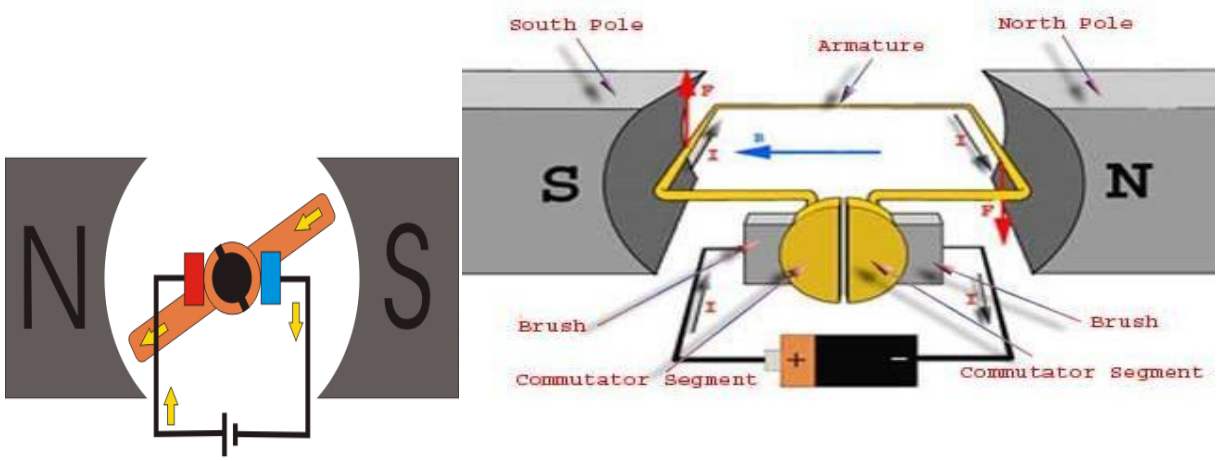

Figure 2.6: D.C motor components.

2.6 Motor Driver IC L293D

A motor driver Integrated circuit (L293D) chip is designed to control and regulate motors .It is a dual H-bridge motor driver Integrated Circuit. They are generally used in mechanics and robotics. It acts as an interface between motor and Arduino microprocessor in the circuit. L293D, L293NE are most commonly used motor driver Integrated circuits from L293 series. L293D is designed to control up to maximum of two direct current motors simultaneously when they are integrated with Arduino Uno. It helps to regulate the flow of current before it finally reaches the motor. It becomes a necessity and need to use IC L293D due to different requirement of current and voltages by microprocessors (low) and 5V DC motor (high) as it acts as a moderator and balances the flow of current. It protects the circuit from overload current and provides protection against overload temperature.

Current should not be directly supplied to the motor because it can damage the motor or even the microcontroller. It has an output capability and provides

bidirectional current of 600 mA per channel. The maximum or peak current which can flow through per channel as output is 1.2 Amp. It has Enable facility and internal clamp diodes. Input voltage is up to 1.5V-36V which is also high noise immunity (logical “0”).

Various and un-similar PWM signals are received because a motor driver IC interfaces with the microcontroller. A motor driver IC is also responsible for achieving required outputs for the speed variation of the DC motor.

Figure 2.7: the IC chip of DC motor driver L293D.

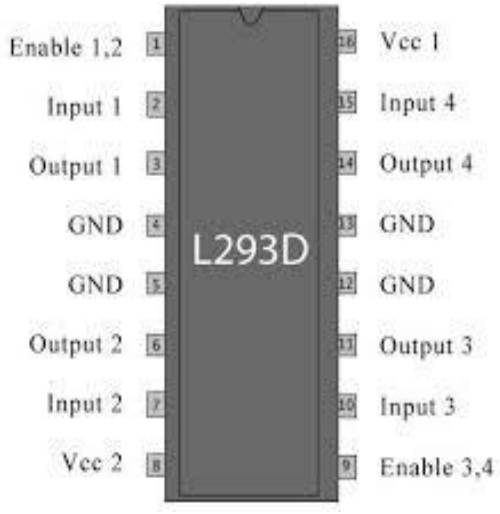

Figure 2.8: pin details of L293D.

It is composed with two H-bridges which are basic circuits. It is a simple circuit for regulating a rated motor with low current. L293D comprises of 16 pins which include 4 (ground, input and output) pins and 2 (Enable and Voltage) pins Because of it the DC motors can operate in both reverse and forward motion. To rotate it in forward and reverse directions logic function ‘01’ and ‘00’are used respectively. 1 and 9 are two enable pins for two motors respectively and they should be of high value to start operating. The drivers are enabled in pairs. Bipolar stepping motors, loads in high positive power supply applications, relays and solenoids which are fabricated to run various inductive loads. [15]

2.7 Serial Port Communication

A serial port is a computer interface that transmits data one bit at a time. In common use, the term “serial port” refers to ports that use a particular asynchronous protocol. These ports include the RS-232 ports on PCs and many serial ports in embedded systems. Most serial ports are bidirectional: they can both send and receive data. Transmitting one bit at a time might seem inefficient but has advantages, including the ability to use inexpensive cables and small connectors.

In PCs, applications access most serial ports as COM ports. Applications that use Microsoft’s .NET Framework class library can use the Serial Port class to access COM ports. Some USB devices function as virtual COM ports, which applications can access in the same way as physical serial ports. Some Ethernet and Wi-Fi devices function as serial servers that enable applications to access serial ports over a network. Microcontrollers in embedded systems can use serial ports to communicate with other embedded systems and PCs. Language compilers for microcontrollers often provide libraries with functions that simplify serial-port

programming. Serial ports are ideal for many communications between embedded systems or between embedded systems and PCs. Serial ports can also be a good choice when you need very long cables or a basic network among PCs, embedded systems, or a combination. Some systems include a serial port that is hidden from users but available to technicians for debugging and diagnostics. [16]

2.8 Virtual Serial Port Emulator

VSPE is intended to help software engineers and developers to create/debug/test applications that use serial ports. It is able to create various virtual devices to transmit/receive data. Unlike regular serial ports, virtual devices have special capabilities.

2.9 Communication Media

Different media are employed for transmitting data from one computer terminal to the central computer or to other computer systems inside some kind of network.

There are two forms of communication media:

- Analog: Includes conventional radio, telephonic and television transmissions
- Digital: Computer-mediated communication, computer networking and telegraphy

The communication media acts as a channel for linking various computing devices so that they may interact with each other. Contemporary communication media facilitate communication and data exchange among a large number of individuals across long distances via email, teleconferencing, internet forums and many other form of communication. They are several types of communication media. As shown in figure 2.9 below.

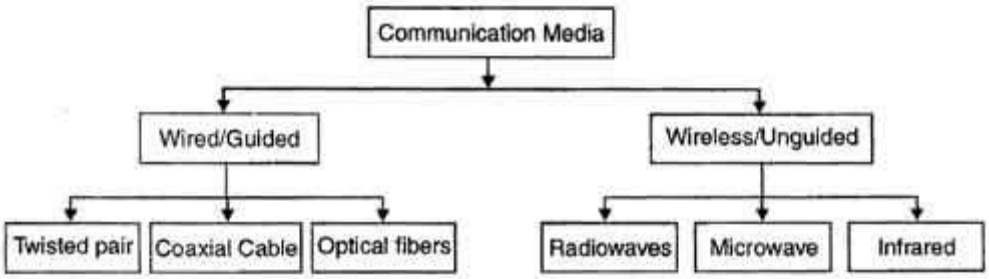

Figure 2.9: types of communication media.

2.9.1 Wireless

Wireless technologies are continuously expanding their transmission data rate, coverage, quality of service. With the success of Bluetooth and Wi-Fi, the usage of wireless data sharing is ever increasing. Wi-Fi has its origins in 1991 wherein NCR Corporation and AT&T Corporation invented IEEE 802.11 and in 1999, Wi-Fi alliance was formed to hold the Wi-Fi Trademark. Similarly, Bluetooth was created by Telecom vendor Ericsson in 1994 as a wireless alternative to RS-232 cables.

IEEE 802.11 WLAN (wireless local area net-work) or Wi-Fi has invariably been the most widely accepted wireless technology. Wi-Fi was basically de-signed to provide in building broadband coverage in campuses. Wi-Fi networks are used to access internet wirelessly through access points. Wi-Fi works in the ISM (industrial scientific medical) Band and provides better performance than most 3G systems.

IEEE 802.15.1 Bluetooth was designed as a re-placement for short distance wired communication. To-day, Bluetooth is basically used for sharing data between two or more closely placed devices. Data rate provided – 720Kbps, Range – 10

WI-FI (Wireless Fidelity)

There are three major amendments to the 802.11 standard and other different modes of operations, different transfer speeds and their range. There are many amendments to the IEEE 802.11 but the widely used three standards are as follows: 802.11a, 802.11b, and 802.11g.

IEEE 802.11a:

It was implemented in 2001 and functions at 5 GHZ delivers a maximum data rate of 54 Mbps with up to 28 frequency channels with 23 available. It is immune to interference from devices operating in 2.4 GHZ

IEEE 802.11b:

The IEEE 802.11b standard operates in the 2.4 GHZ band and provides a maximum data rate of 11 Mbps .It is equipped with data rate shift technology wherein the data rate can shift from 11 Mbps to 11 Mbps to 5.5 Mbps to 1 Mbps.

IEEE 802.11g:

Successfully launched in 2003, it is compatible with 802.11g and delivers the 54 Mbps data rate and works in 2.4 GHZ range. [17]

2.9.2 ZigBee Technology

ZigBee is low power consumption, low cost and low data rate wireless communication standard designed to be deployed in home automation and remote control applications. ZigBee protocol offers three main roles; coordinator, router and end-device. Only one coordinator is required for each ZigBee network, since it starts a network formation. ZigBee router is an optional network component where it participates in multi-hop routing of messages. Finally, ZigBee end-devices

utilized for low power operation and it’s not allowed to participate in routing of messages. In our real experiments, router nodes play the role of reference nodes, whereas the coordinator plays the role of target node. [18]

ZigBee technology is a short-range wireless communications technology, and its PHY layer and MAC layer protocol is belong to the IEEE802.15.4 protocol standard. ZigBee's work bands were 868 MHz, 915 MHz, and 2.4 GHz, including 868MHz channel, ten 915MHz channels, sixteen 2.4 GHz Channel, using CSMA-CA channel access method. ZigBee technology is an effective communication to avoid conflict, Network layer protocol formulated by the ZigBee Alliance .ZigBee devices can be constructed star-shaped network or peer-to-peer network, and can be connect with 16- bit address or 64-bit address. It has greater network capacity. Its application layer can be developed and utilized in accordance with the needs of users. [19]

2.9.3 XBee

In WSN every node is wirelessly communicate with each other. Xbee is basically used for this purpose. Many people do believe that ZigBee and Xbee are same. But that is not true. XBee is a Zigbee compliant hardware. ZigBee is a standard communications protocol for low-power, low-throughput, low cost wireless mesh networking applications, which is built on top of IEEE 802.15.4. XBee is a brand of radio that supports a variety of communication protocols, including Zig-Bee, 802.15.4, and Wi-Fi. There are two basic varieties of XBee radio physical hardware.

1. XBee Series 1 Hardware

These radios use a microchip made by free scale to provide simple, standards-based point-to-point communications, as well as a proprietary implementation of mesh networking.

2. XBee Series 2 Hardware

The Series 2 uses a microchip from Ember Networks that enables several different flavors of standards based ZigBee mesh networking. [9]

XBee Transceiver Module

XBee from Digi International is a family of compatible radio modules based on the IEEE 802.15.4 standard designed for point-to-point and star communications. The XBee module is presented in several versions that own similar pin outs but are different in the power output, antenna style, operating frequency and networking abilities. The XBee transceivers afford very reliable, cost effective, and simple communication between the microcontrollers and are supported by sleep mode for extended battery life. The 1 mW XBee adopted in this work operates at 2.4 GH and has at least a range of 30 meters. [20]

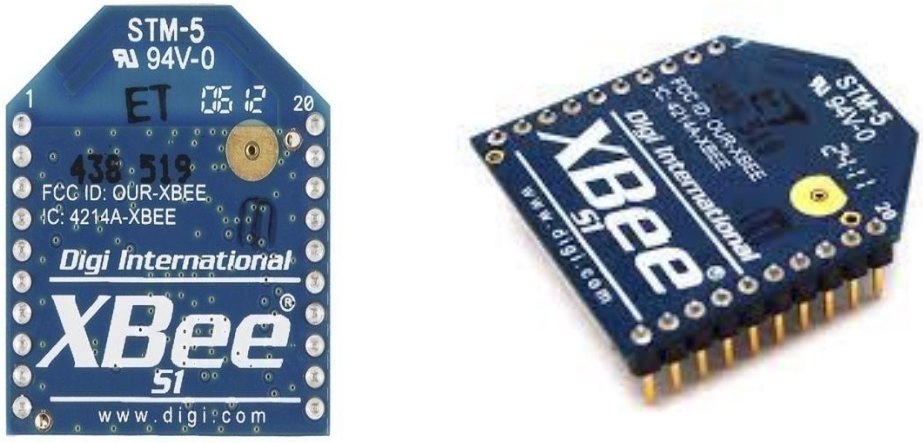

Figure 2.10: X-Bee Series 1 (802.15.4).

2.10 Software

The design used several software, includes: visual basic to create Graphical user Interface (GUI) and Arduino Software.

2.10.1 Arduino IDE

The Arduino is programmed using an open source application that runs on computer called as IDE and freely downloaded from the Arduino website's software area .The Arduino language is based on C/C++. This IDE simply translate script into C language and compile it using avr-gcc, which makes it understandable to the micro-controller. [9]

Figure 2.11:.Arduino IDE

2.11 Graphical User Interface

The graphical user interface (GUI /guːiː/), is a type of user interface that allows users to interact with electronic devices through graphical icons and visual

indicators such as secondary notation, instead of text-based user interfaces, typed command labels or text navigation. GUIs were introduced in reaction to the perceived steep learning curve of command-line interfaces (CLIs).

2.11.1 Visual Basic Programming Language (VB)

Visual basic programming is a very easy programming language to learn and used by beginner programmer but can also develop complex applications. It is a well-developed programming language and supporting resources are available everywhere. Types of VB exist in the market VB 2005, vb2008, VB 2010 and VB 2012. The VB2008, VB 2010 and VB 2012 are fully object oriented programming (OOP) language. Visual basic is events driven Programming Language. In visual basic, just need to drag and drop any graphical object anywhere on the form, and can change its color any time using the properties windows .visual basic as shown in Figure 2.13. Visual Basic6.0 is a structured high-level programming language developed by Microsoft US in 1991, which is visual, object oriented and event-driven and can be used to develop various types of application programs in Windows. You can easily use it for computer serial port communications management by embedding the MSComm control provided by Visual Basic6.0. [21]

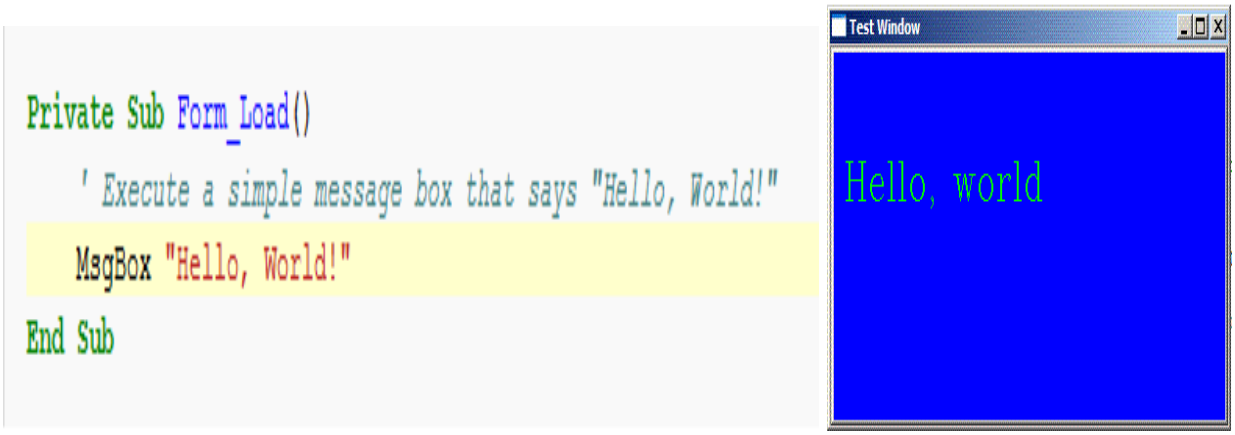

Figure 2.12: Example of visual basic code.

CHAPTER THREE

(SYSTEM DESIGN)

CHAPTER THREE
SYSTEM DESIGN

This chapter, describe the overall architecture of the system, design of the circuit and the tools which are used. It requires hardware and software for system implementation.

3.1 The Basic Design and Requirements

This system consists of two parts to be the integrated system to control the fuel station electronically:

1- The first part of the electronic system about sale of fuel inside the station, which is designed electronically to reduce the workers inside the station. The components used in this part are PC with GUI, XBee wireless, Microcontroller, DC motor. As shown in Figure 3.1.In the computer Visual basic uses to write a program to create GUI interface for enable the customer enters his data and to select counter among the existing counters in the station to enable him obtain fuel. When the customer select counter from GUI this customer request is sent by XBee connected with the computer to another XBee connected with Arduino mega. After Arduino mega receives this data, it only selects a certain counter that is chosen by the customer in GUI for refueling his /hers vehicle.

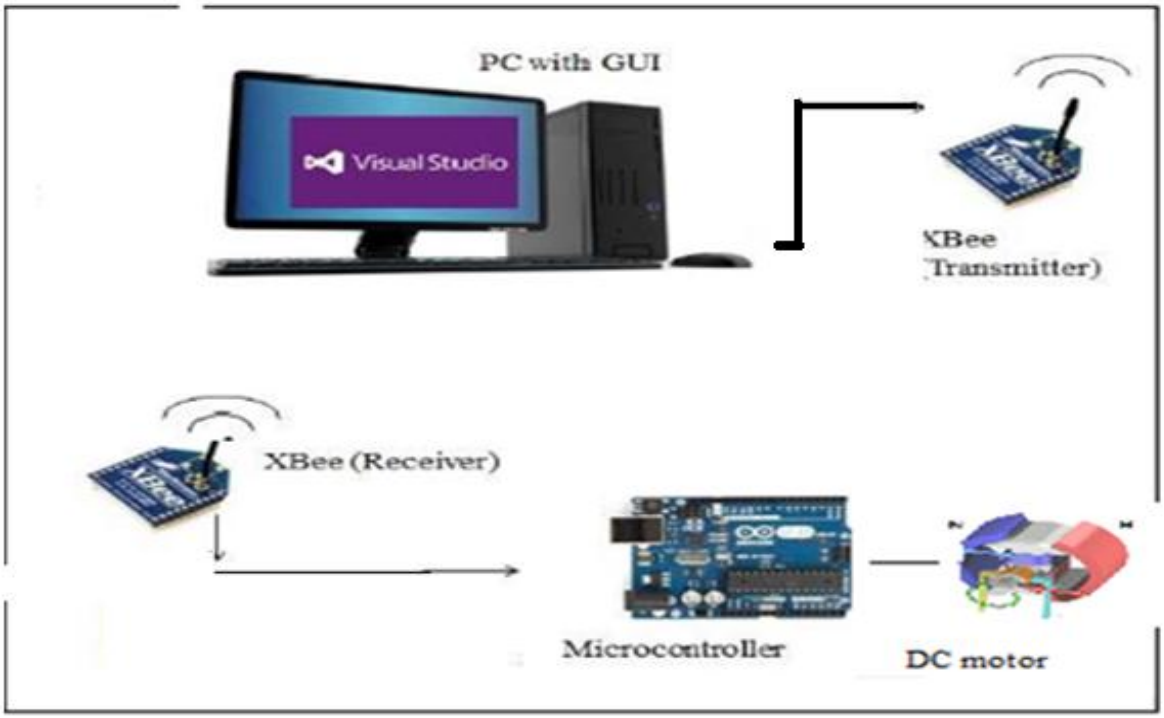

Figure 3.1: components of first part in system.

2-The second part of the electronic system of the fuel station is monitoring fuel level in the station that belongs to a certain company and display values of real time fuel level in company interface to make management easy and fast and reliable, high accuracy, real-time monitoring, and rapid detection to assist in quick decision making. The components used in this part are PC with GUI, XBee wireless, Microcontroller, ultrasonic sensor. Arduino Uno the major part of getting the fuel level reading from the ultrasonic sensor. The trigger and echo pin in the ultrasonic sensor connected with the Arduino Uno digital port. Arduino programmed with a code that sends the input data from digital port via XBee to another XBee that is connected with a computer. Visual Basic uses to create a GUI interface for display fuel level in fuel station it also displays the readings According to time and date. Figure 3.2 shows monitoring fuel level wirelessly with computer contain of GUI.

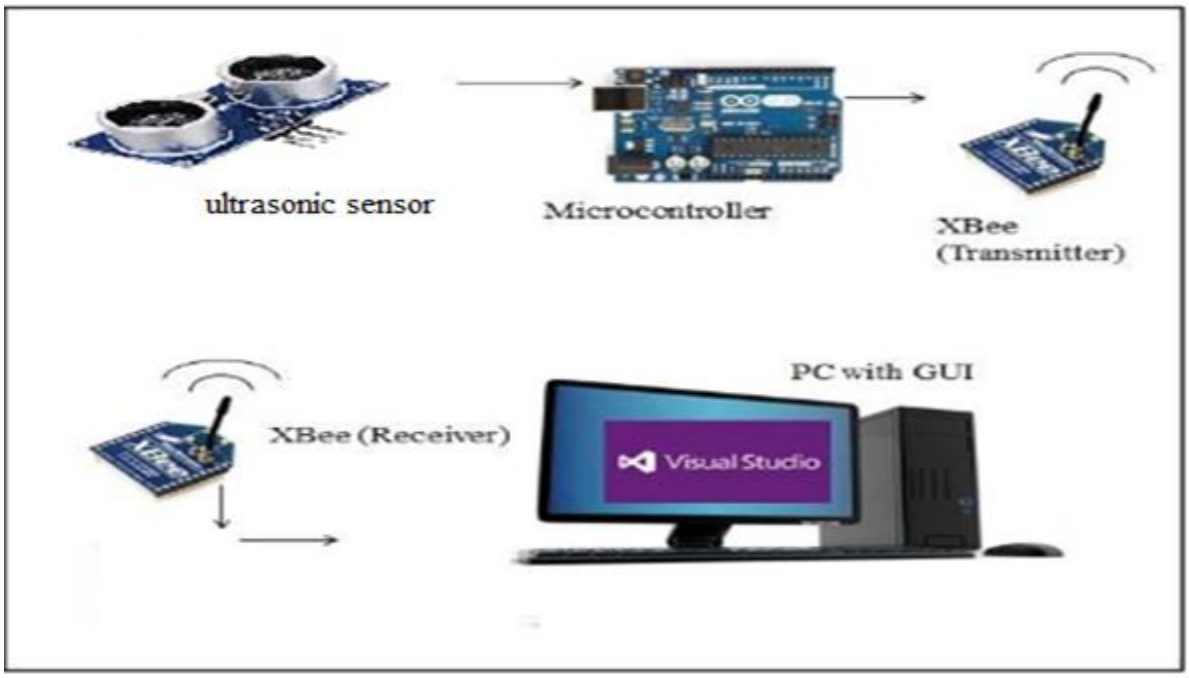

Figure 3.2: components of second part in system.

3.2 The First Part of System

The system designed to control of the fuel Sale process in fuel station consists of two units: interfaces and Controllers. These two units are collaborative with each other, and connected by wireless technology. Figure3.3 below illustrate block diagram for Contents of the first part of system.

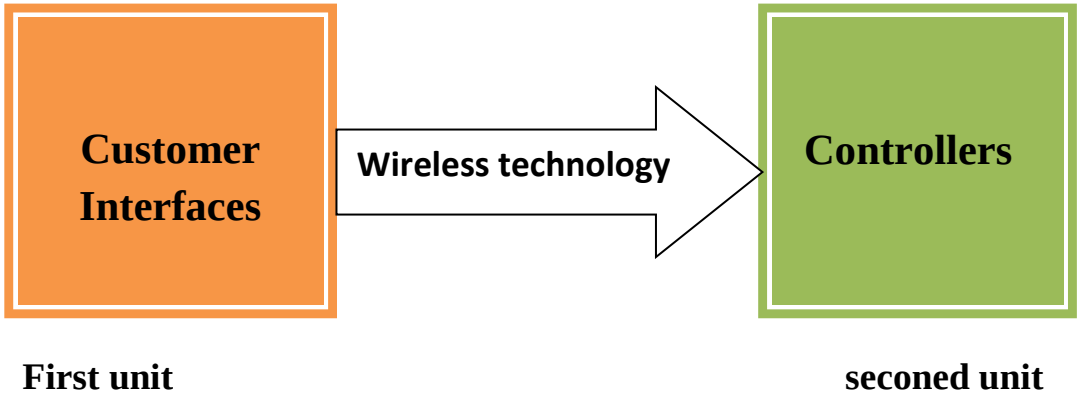

Figure 3.3: Block Diagram of concepts the first part.

The two units are:

(1) Interfaces: to deal with the customer.

(2) Controllers:

a- Main controller: receives customer's data and determine counter chosen by customer for starting operation.

b- Sub controllers representing counters.

Figure 3.4 show the flow chart of Fuel Sale Process in fuel station.

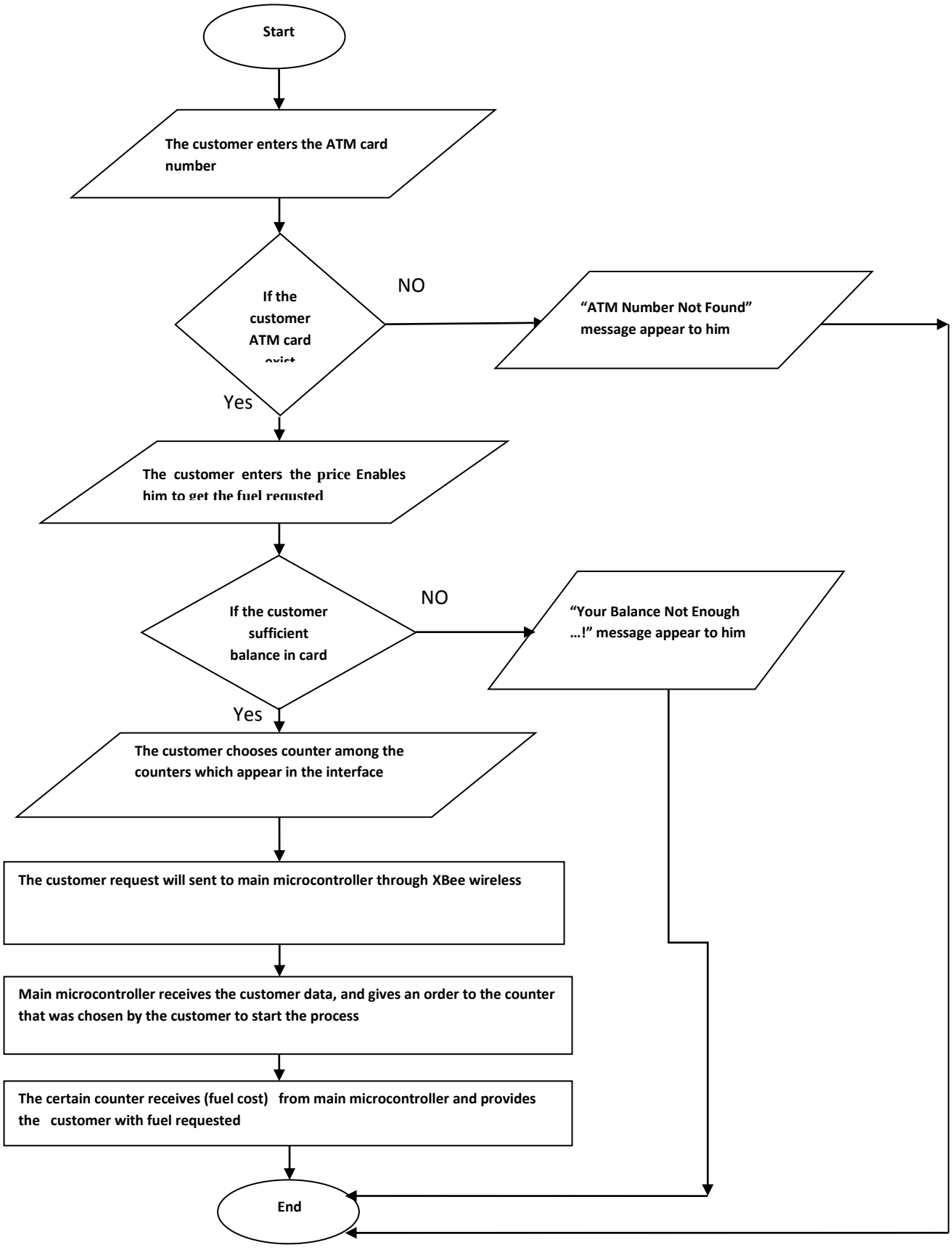

Figure 3.4: Flow Chart of control fuel sale.

3.2.1 Customer Interfaces unit

Customers data had been stored (ATM card number and the balance in the ATM card). To differentiate between authorized and unauthorized customers so those who can obtain fuel.

This unit consist the number of GUI interfaces that appear to the customer, which enables him to enter data, and verification of customer's data incoming in GUI interface with customer information it was previously stored. The interfaces that appear to the customer shown in Figure 3.5

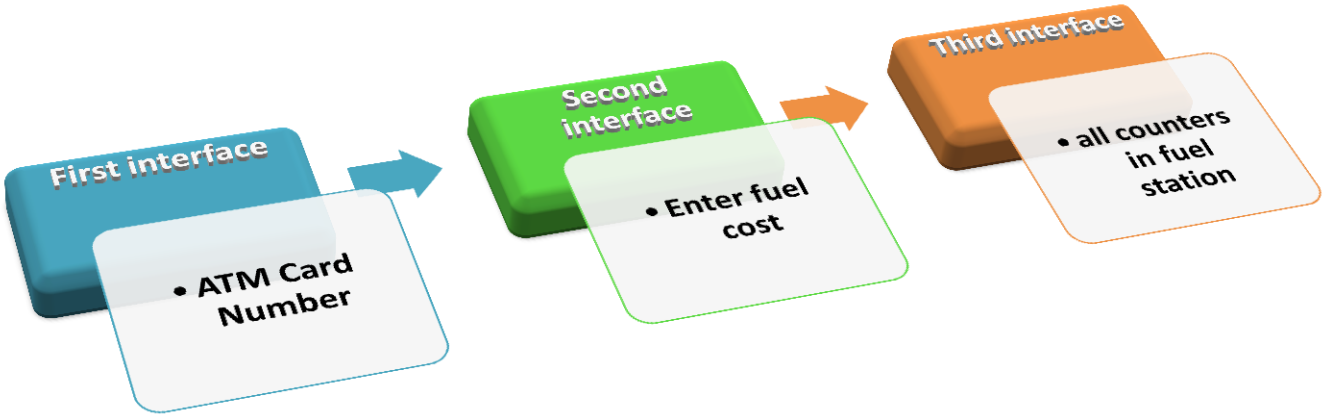

Figure 3.5: Sequences of GUI interfaces.

- **First interface:**

The First interface, which appear to the customer allow him enter his card number as shown in figure 3.6 below .This interface containing:

- **ATM Card Number** (Text Box): In this place, the customer will enter his card number.
- **OK** Button**:** when a button has been pressed, the data entered by the customer will be compared with customer information which was previously stored for verification; is it actually identical to the information introduced by the customer (ATM Card Number)? Is he/she permitted to obtain fuel?
- **Exit** Button**:** When the customer pressed this button the system exit from this interface and close.

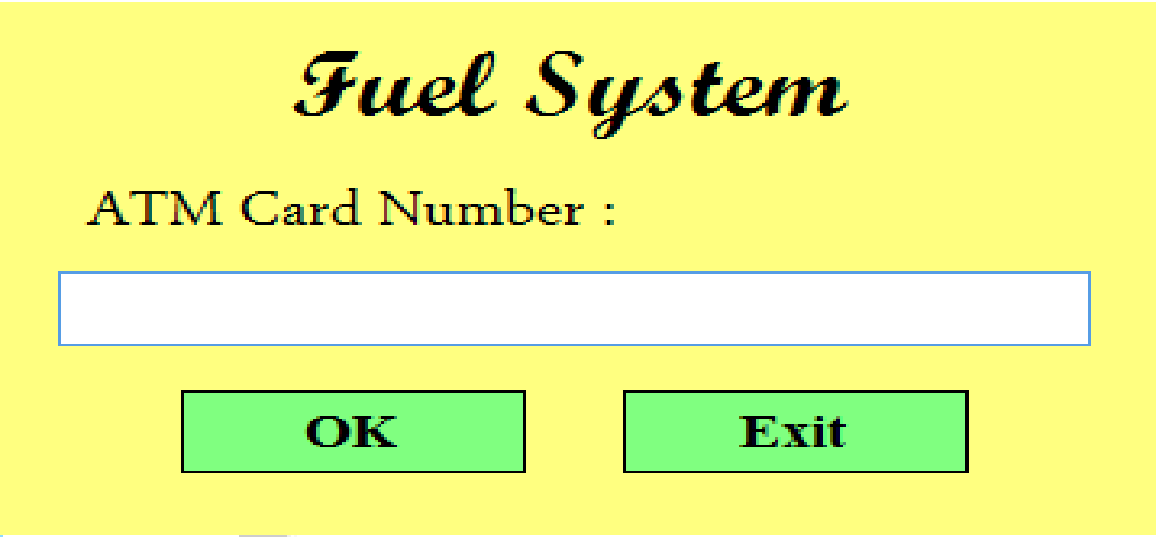

Figure 3.6: First interface.

After that the customer enters his card number and press **OK** button, if the card number does not exist (wrong) "ATM Number Not Found" a message will appear to him. But if the card number exists (true) this interface will disappear and new interface (second interface) will appear to him.

- **Second interface:**

The second interface enables the customer to enter the price. That allows the customer to get the amount of fuel which he wants as shown in figure 3.6 below .This interface containing:

- **Your Balance Is** (Text Box)**:** it displays the Balance exits currently in the ATM card.
- **Enter fuel cost** (Text Box): In this place, the customer will enter the price which enables him to get the fuel he need.
- **OK** Button: when a button has been pressed, it is compared the price that had been introduced by the customer with the Balance currently existing in the ATM card, to see whether there are sufficient balance in the ATM card; if the customer had not sufficient balance to obtain the fuel, "Your Balance Not Enough …!" a message will appear to him. But if he has sufficient balance to obtain fuel, new interface (third interface) appear to the customer
- **Exit** Button**:** When the customer pressed this button the system exit from this interface and close.

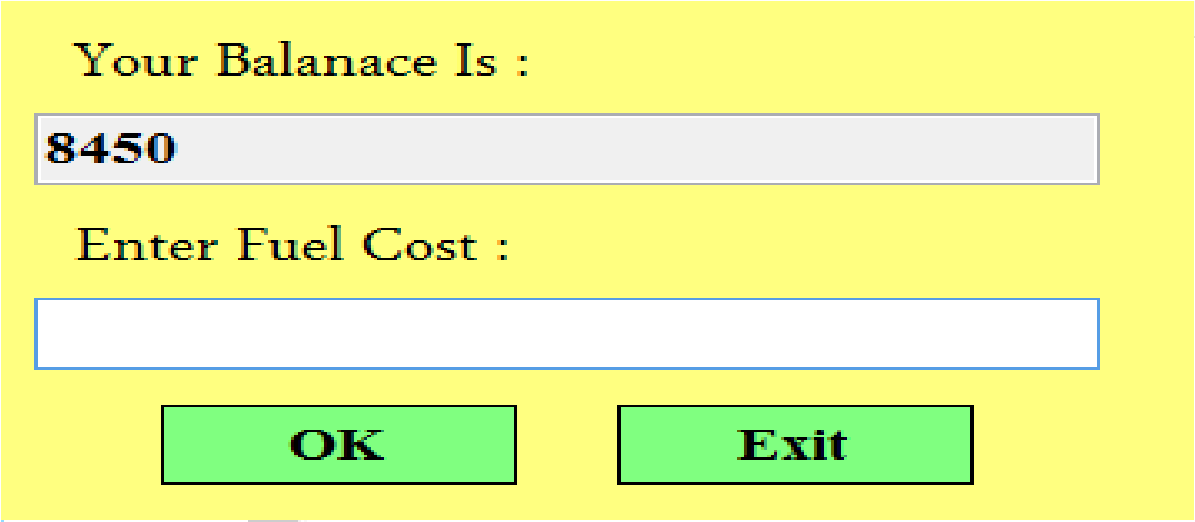

Figure 3.7: Second interface.

- **Third interface:**

The third interface which contains all the counters existing in fuel station, the Customer selects the appointed counter among the counters that appear in

interface, after choosing the appointed counter; “Thanks …!” message will appear to him, and this means that customer data is valid and allow him to obtain fuel. As shown in figure 3.8 below.

Figure 3.8: Third interface.

3.2.2 Steps That Carried Out in These Interfaces

The verification of customer’s data; by comparing the data Introduced by the customer with customer information was previously stored in the system.

Verification from:

 The ATM card number that had been introduced by the customer really exists; is this a card number entered by the customer is the same card number it was previously stored?

After confirming card number that he actually exists.

Verification from the price entered by the customer with the balance on the ATM card; is he had a sufficient amount of money in the card or not?

If one of this information entered by the customer is wrong it means that the customer is not authorized to obtain fuel.

If the customer's data is correct (ATM Number, Fuel Cost); a message "Thanks …!" Appear to him, which means that the customer is authorized to obtain fuel, and then it will be send to the second unit of a system that contains the controllers. The second unit associated with the first unit by X-Bee.

3.2.3 Controllers Unit

This unit electric circuit design consists of main microcontroller and sub controllers (counters). As shown in Figure 3.9 use to receive customer's request by XBee that connected with main microcontroller (Arduino Mega) in pin0 (Rx0), then give order for certain counter(Arduino Uno) chosen by customer for running a DC motor to supply his/hers vehicle by fuel.

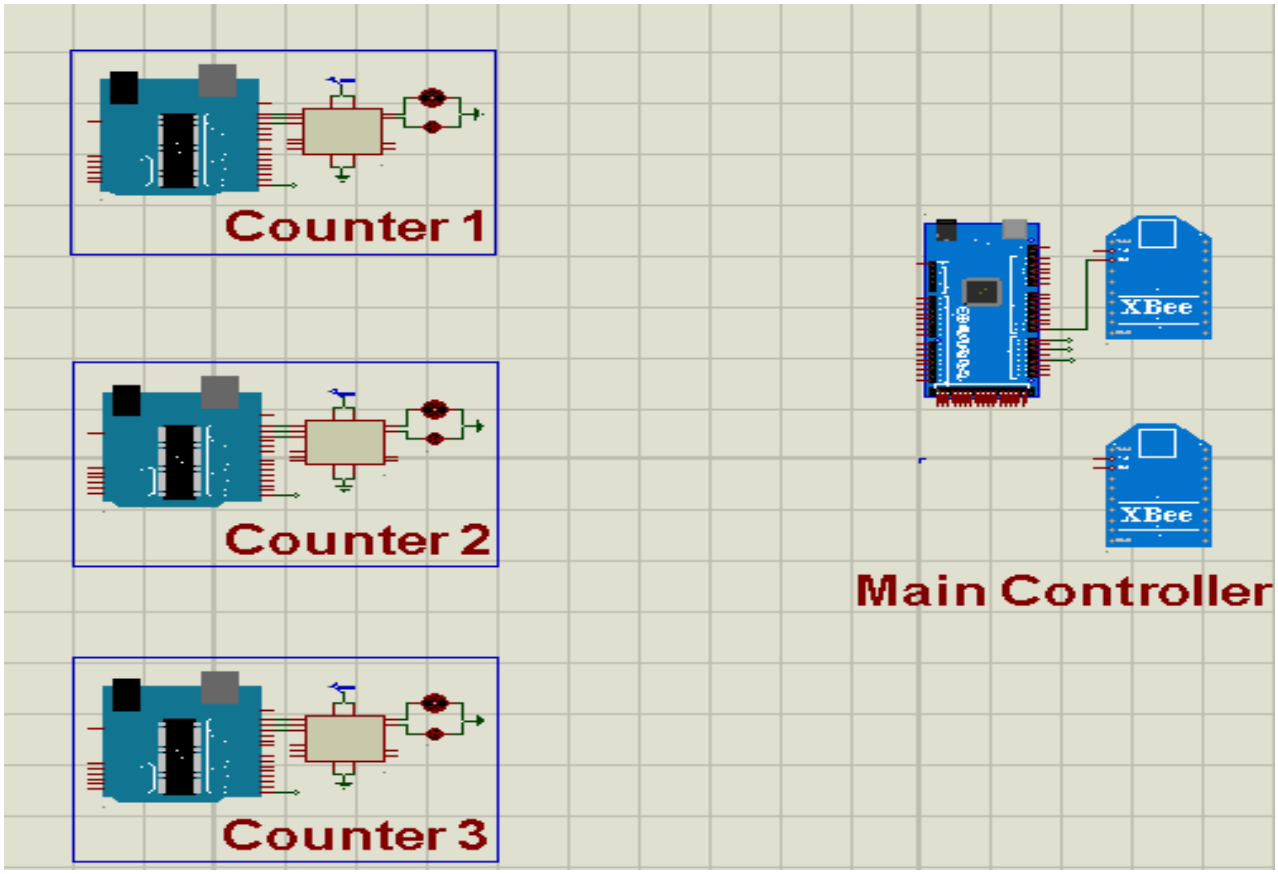

Figure 3.9: Electronic circuit of controllers.

3.2.4 Pins Connection of Main Controller

In this design use Arduino Mega2560 in first part of system because it contain four serial ports, which is needed for interfacing with XBee module and Arduino UNO microcontrollers, Arduino Mega2560 is a microcontroller board based on the ATmega2560. Arduino Mega2560 has 54 digital pins Input / Output, of which 15 pins can be used as PWM outputs, 16 pins as Analog Inputs, and 4 pins as UART (Serial Port Hardware), 16 MHz crystal oscillator, a USB connection [10].

In this part of system, the pins of the controller are assigned serial ports to connect with X-Bee and Arduino Uno (counters). RX0 of Serial port0 connected with X-Bee in order to receive the input customer's data from computer (GUI interface). TX1, TX2 and TX3 of Serial port 1, serial port 2, and serial port 3 respectively are connected with three Arduino Uno represent (Counter1, counter2 and counter3). TX1, TX2 and TX3 are used as transmission pin to select counter chosen by the customer in GUI interface to operate and supply his/her vehicle by fuel. The pin assigned is expressed in below Figure 3.10.

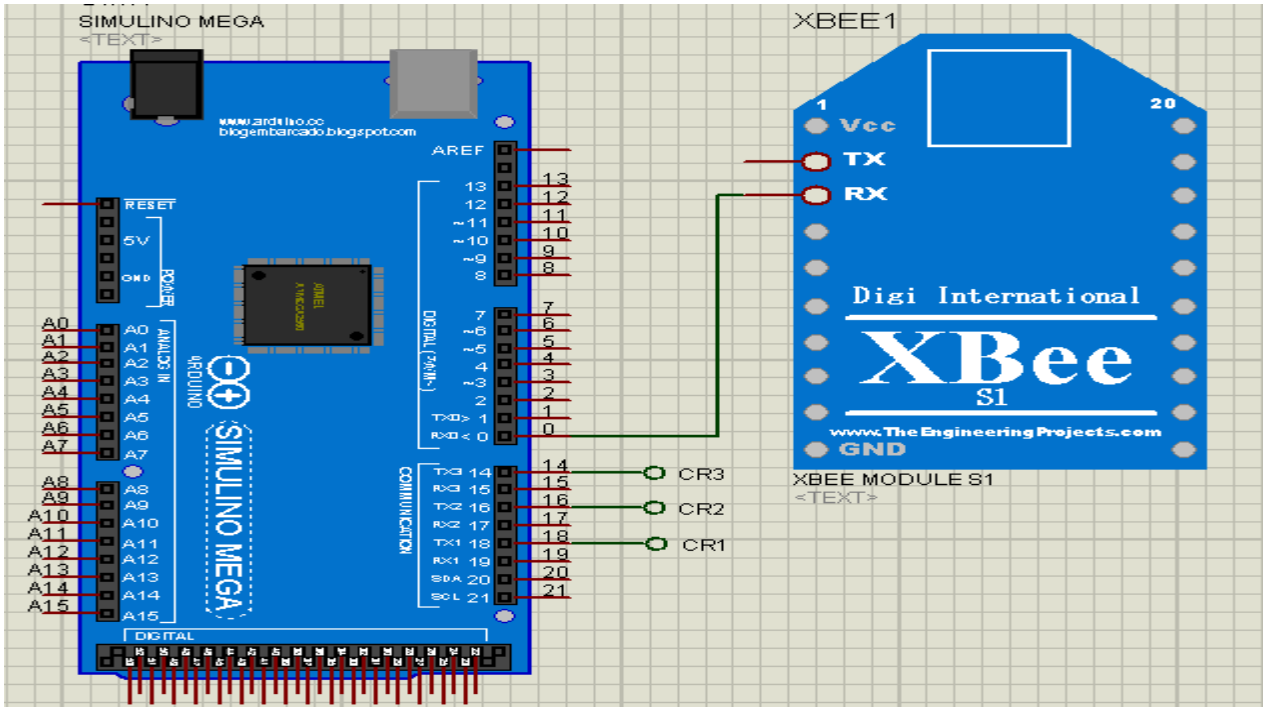

Figure 3.10: Pin Assigned of the main microcontroller.

3.2.5 Main Controller

the Function of main microcontroller for receiving customer's data from GUI interface and control of counters, the customer's request, which sent via XBee2 associated with the computer, which contains the GUI interfaces to XBee1 that connected with main microcontroller in pin0 (Rx0). After the main microcontroller received customer's data it select only the counter chosen by the customer to start working and supply his/hers vehicle by fuel, For example: if counter, which was selected by the customer = counter 2, then main Microcontroller order counter2 to operate. Figure 3.11 show the flow chart of min microcontroller work.

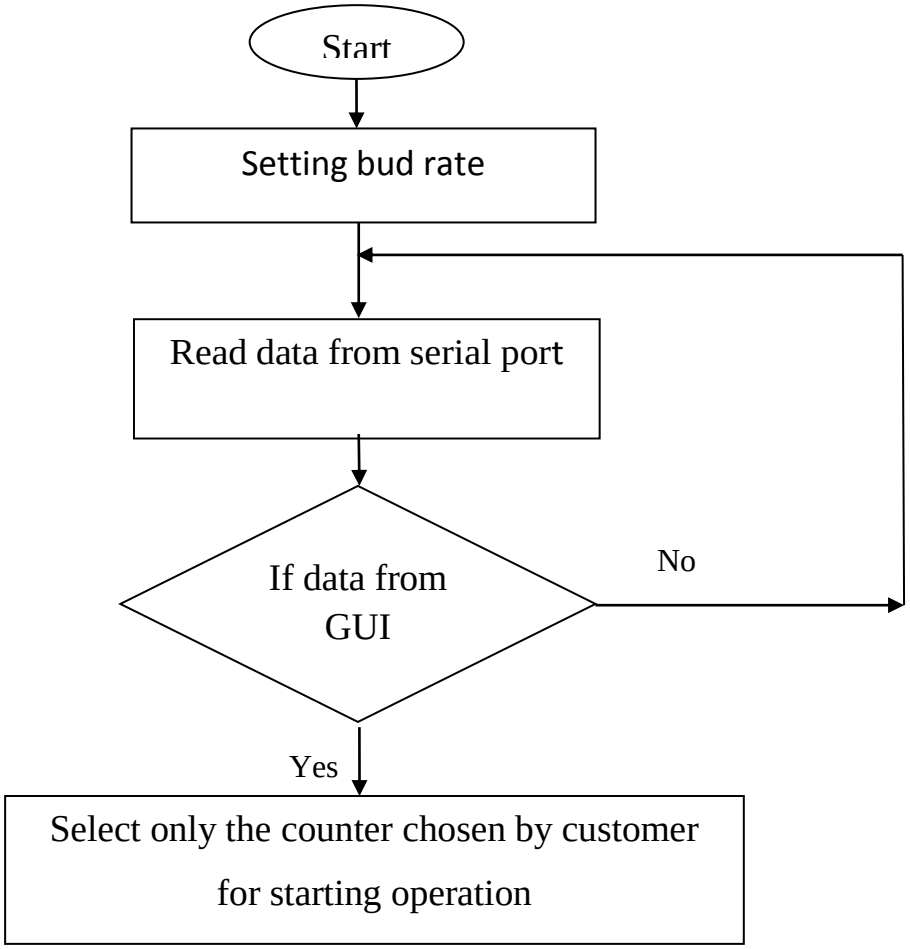

Figure 3.11: Flow Chart of main microcontroller.

3.2.6 Sub Controllers (Counters)

Sub controllers (Arduino Uno) which connected with main microcontroller via serial port for receiving operational order from main microcontroller to driving a DC motor. We cannot connect a motor directly with Arduino Uno microcontroller because microcontroller cannot give sufficient current to drive the dc motors. Motor driver is a current enhancing device. Thus motor driver take the input signals from microcontroller and generate corresponding output for motor.

L293 is a typical motor driver or motor driver IC which allows DC motor to drive on either direction.L293 is 16 pin IC which can control of two DC motor there are two Enable pins Pin 1 and pin 9 on l293d that use to control of driving or stop the DC motor. In this design we need to control of one DC motor by use Pin 1 for being able to drive the motor, the pin 1 needs to be high. If pin 1 goes low then the motor in the corresponding section will stop working.

The input/output of drive circuit L293 which connect to the Arduino uno and DC motor respectively, when particular counter (Arduino Uno) receiving positive value in serial port from the main Microcontroller, it send a high signal to pin 2, 7, and 1 for driving DC motor for refueling the customer's vehicle as shown Figure 3.12. Then Arduino uno send low signal to pin 1 for stop DC motor to finish the refueling process.

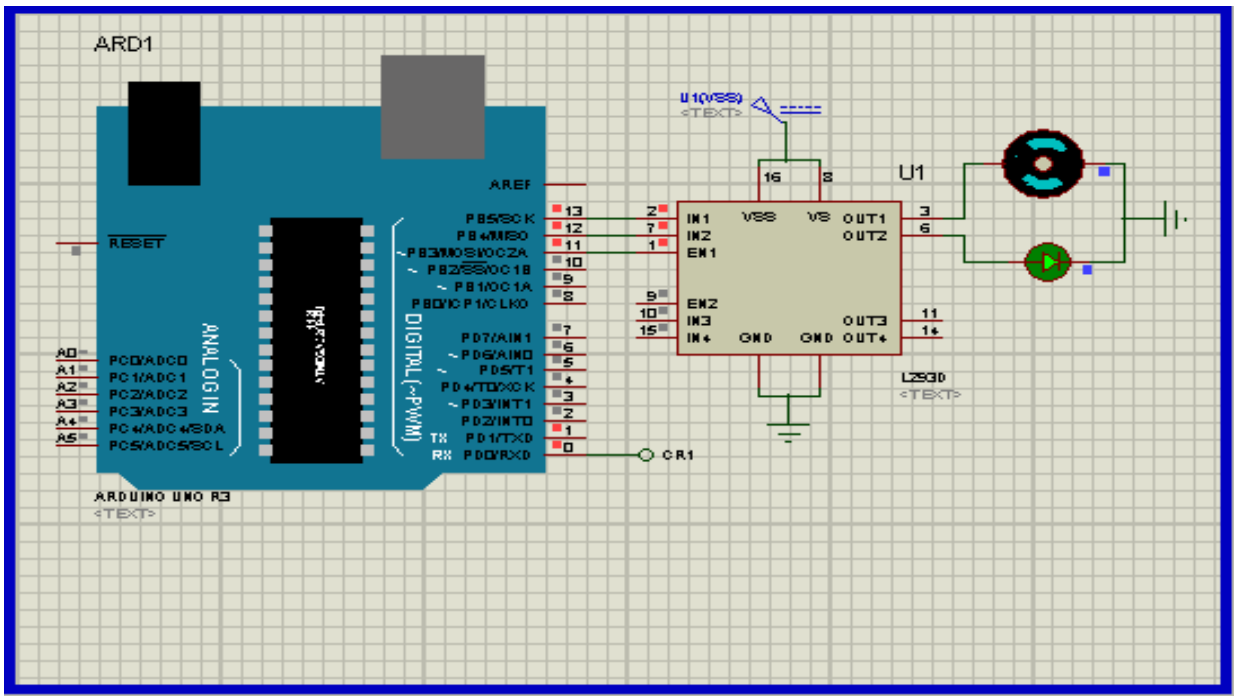

Figure 3.12: the motor running.

Figure 3.13: below illustrate block diagram how communication between the first unit (customer interfaces) and the second unit (main& sub controllers) in first part of the system.

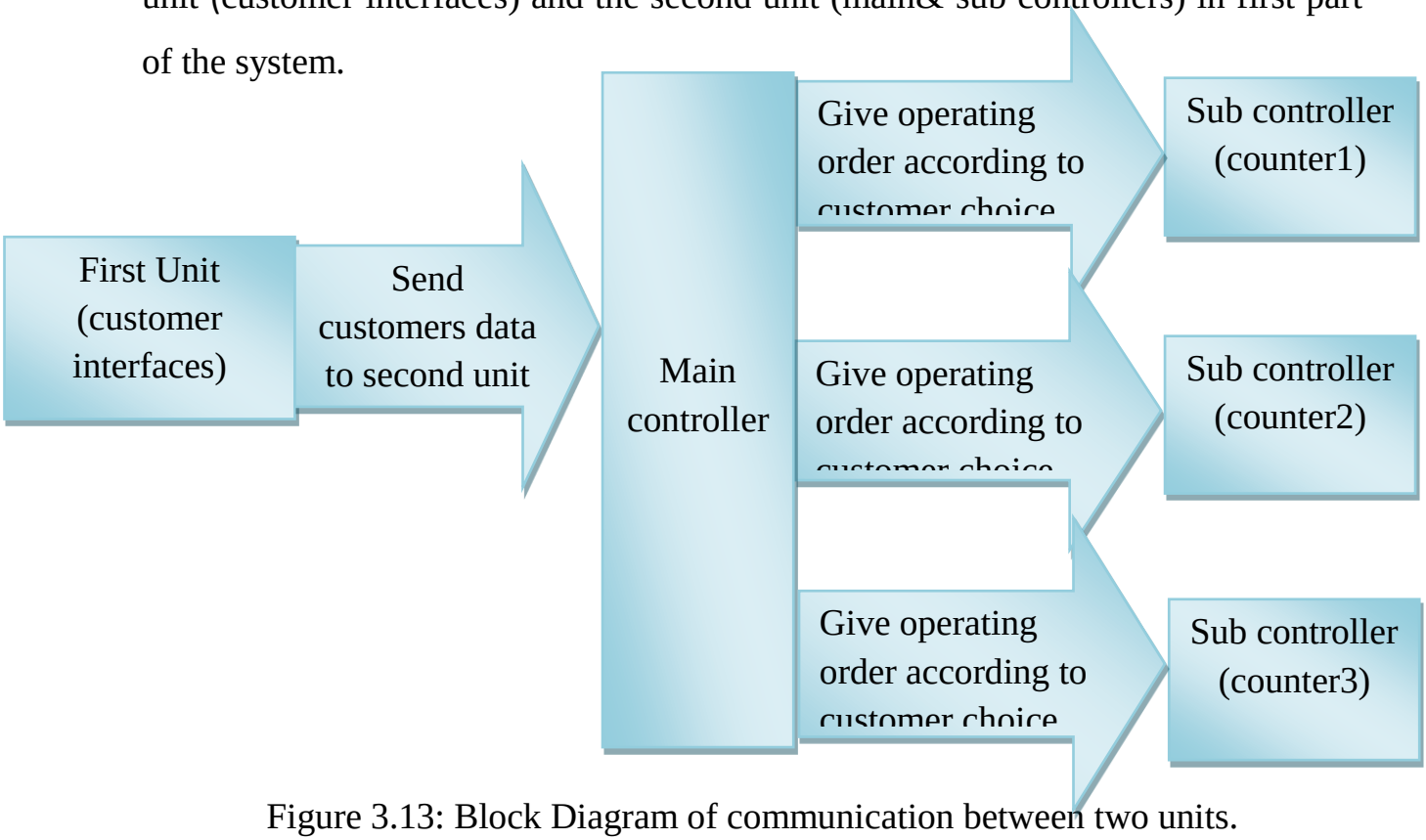

Figure 3.13: Block Diagram of communication between two units.

3.3 The Second Part of System

The company is monitoring remotely the amount of fuel in all fuel stations that belong to it; the real time fuel level is displayed in the station and the owner company simultaneously to assist in quick decision making.

The second part contains two units also: company interface and circuit of fuel level measurement.Figure3.14 below illustrate block diagram for Contents of the second part of the system.

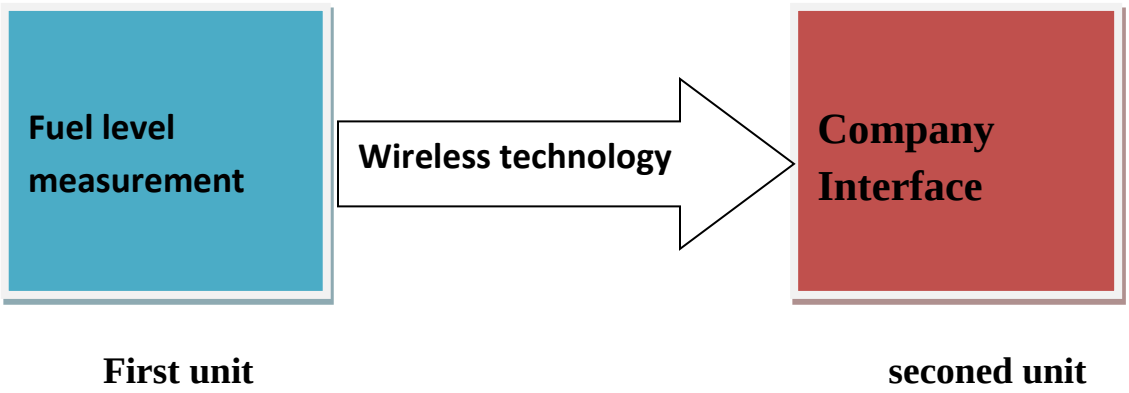

Figure 3.14: Block Diagram of concepts the second part.

3.3.1 Fuel Level Measurement Unit

This unit electronic circuit measures the real time fuel level inside the fuel tank and sends fuel level values via XBee to another XBee that is connected to a computer. To design it we use ultrasonic Sensor located at the top of the fuel tank as shown in Figure 3.15, Ultrasonic Module contains 4 pins (Ground, VCC, Trigger and Echo). The trigger and echo a pin of the module needs to be connected to any Digital input/output pin on the Arduino Board. Arduino Uno getting the fuel level reading from the ultrasonic sensor. The data point in the ultrasonic sensor connected with

the Arduino Uno digital port. Then Arduino Uno sends the input data from digital port via XBee to another XBee that is connected with a computer.

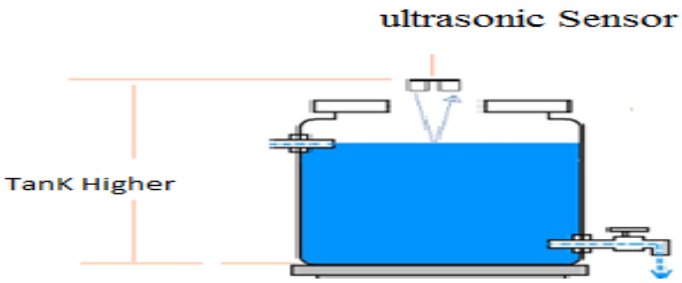

Figure 3.15: ultrasonic Sensor to measure fuel level.

The Arduino Uno is a microcontroller board grounded on the ATmega328. It comprises of 14 digital input/output pins (out of which 6can be utilized as PWM outputs), 6analog inputs, a 16MHz ceramic resonator, a facilitation for USB connectivity. [11]

The pins of the Arduino Uno controller are assigned to connect with X-Bee and Ultrasonic sensor. TX of serial port is connected with X-Bee to. In order transfer data (fuel level) for computer, pin 2 and 3 of digital port is connected with Ultrasonic sensor. Pin 3 is used as output pin to control of the Ultrasonic sensor work. Pin 2 is used as an input pin data.

To emulation the change in the fuel level within fuel tank by connecting a potentiometer (variable resistance) with ultrasonic Sensor. The terminal pins of resistance connected with 12 volt and ground we change the amount of resistance value on either side of the wiper which is connected to the center pin of the potentiometer. These changes giving us different values of voltage that input for ultrasonic sensor. Therefore ultrasonic sensor gives different values of output (fuel level values).

These values of fuel level reading by Arduino uno it will send through XBee1 Connected with Arduino uno Microcontroller in pin 1 and receive these values by XBee2 Connected with computer that contain GUI interface in the Petroleum Company. As shown in Figure 3.16 circuit component of the fuel level measurement.

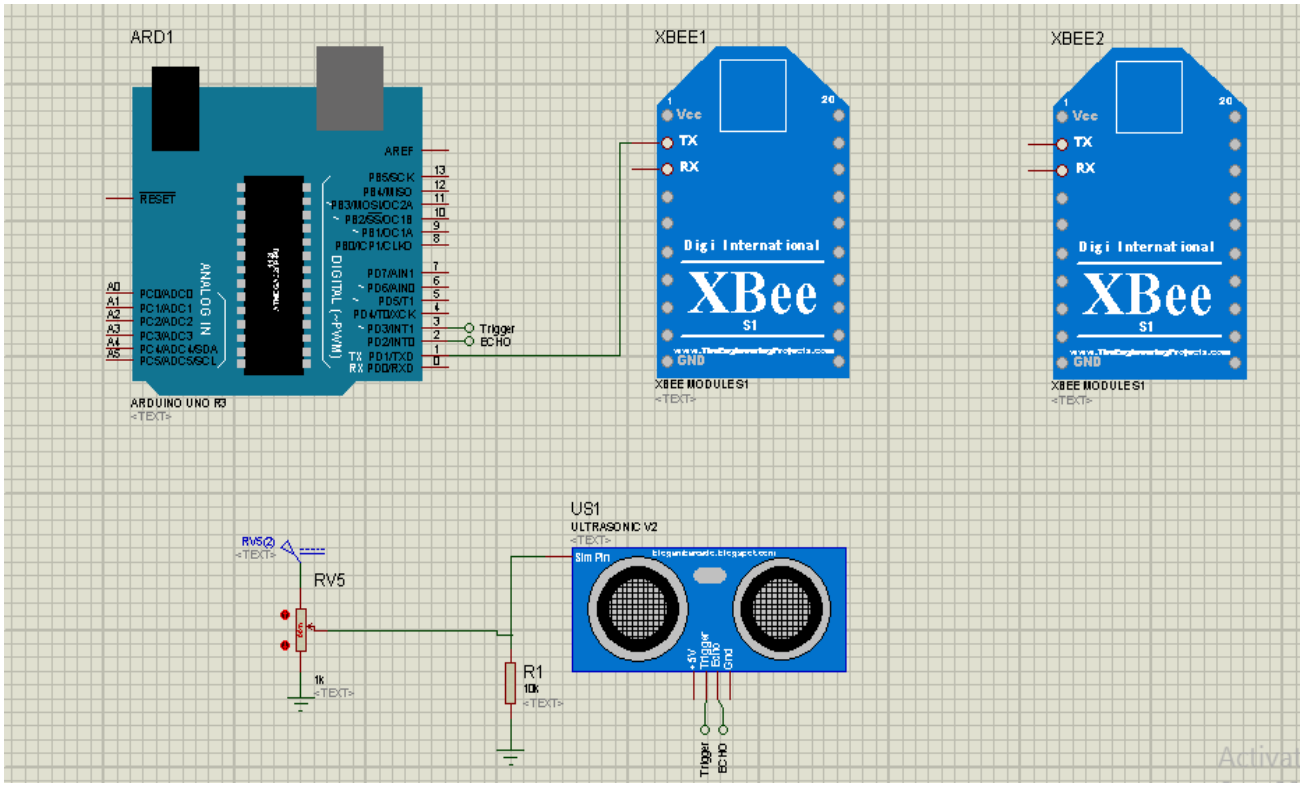

Figure 3.16: simulation circuit of measure the fuel level.

3.3.2 Company Interface Unit

The company receives the values of real time fuel level from the first unit. That provides high accuracy, real-time monitoring, and rapid detection to assist in quick decision making, this data received are displayed in the GUI interface; to create this interface all we need is a desktop interface coded with Visual Basic (VB). Figure 3.17 shows the flow chart measuring of fuel level inside the fuel tank.

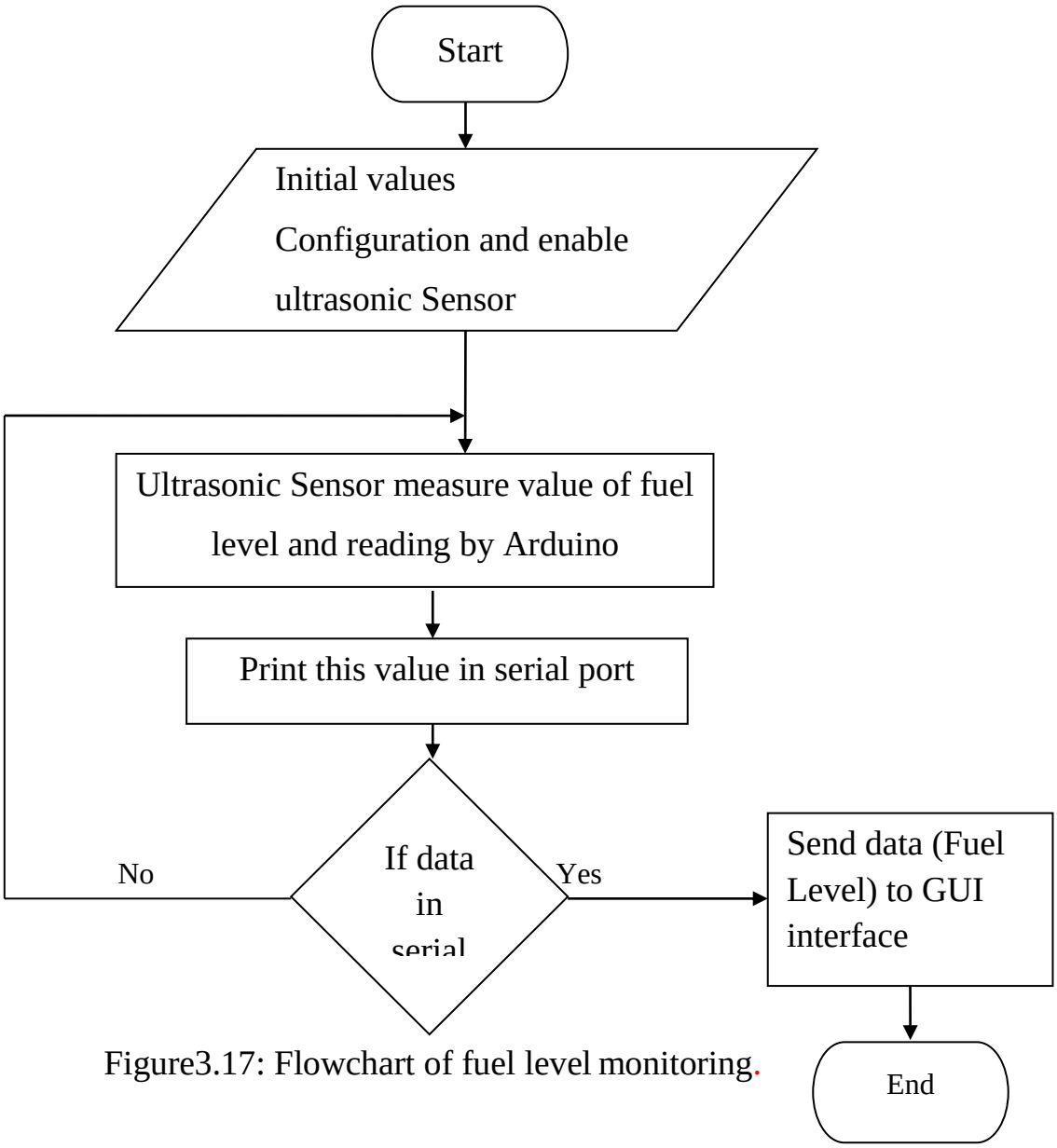

Figure3.17: Flowchart of fuel level monitoring.

Company interface displays these values (real time Fuel Level) as shown in Figure 3.18. These interface which containing:

- **Fuel level:** display the amount of the existing fuel currently in the tank.

- **Time:** shows the time at which the fuel level is measured.

- **Date**: shows the date in which the fuel level is measured.

- **Exit:** Button is used to stop receiving data in the interface and close.

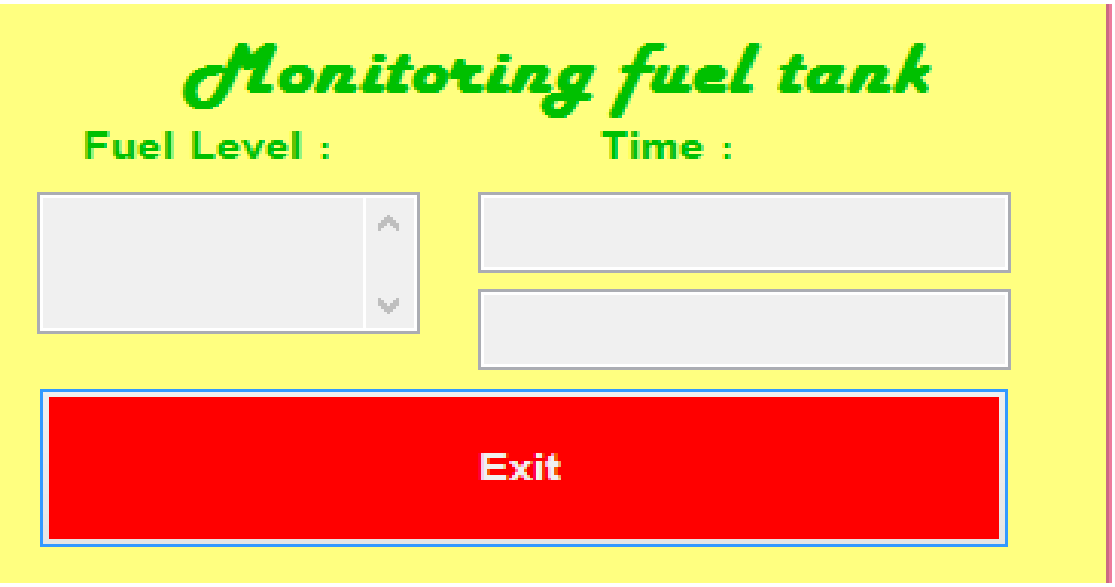

Figure 3.18: Company interface showing fuel level.

3.3.3 The GUI Programming

The GUI is an interface programmed with visual basic2010, this language is used because it's easy to learned very applicable with the needed design .Visual basic is events driven programming language. In visual basic, programming is done in a graphical environment. Visual basic language was installed in PC and programmed to get the final interface.

CHAPTER FOUR

(RESULTS AND DISCUSSION)

CHAPTER FOUR

RESULTS AND DISCUSSION

In this chapter there will be a whole description (associated with the figures) is the procedure of the project.

4.1 Results

4.1.1 Scenario One of Setting the Virtual Serial Ports

And through virtual serial ports can connect between applications. As shown in the figure 4.1 below.

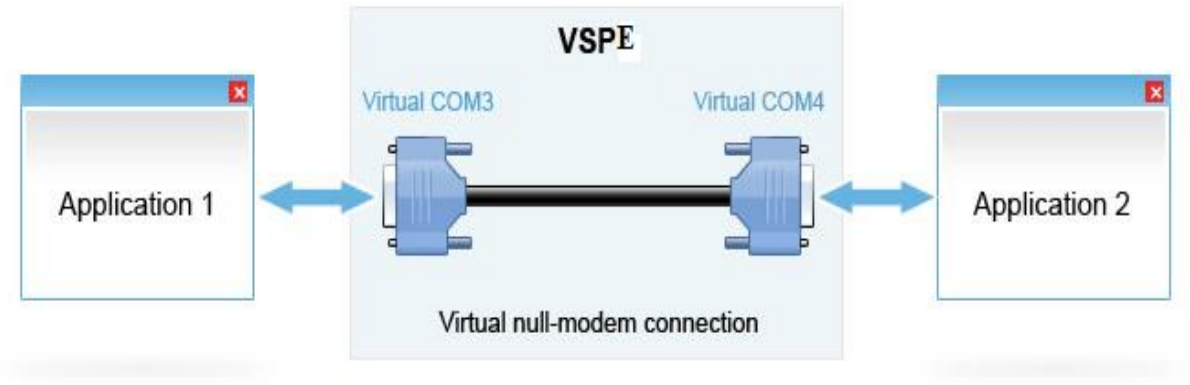

Figure 4.1: VSPE to connect two applications.

First thing to do is to setting the virtual serial ports, as shows in Figure 4.2 Select pair option from the drop down list. Then Press next button next.

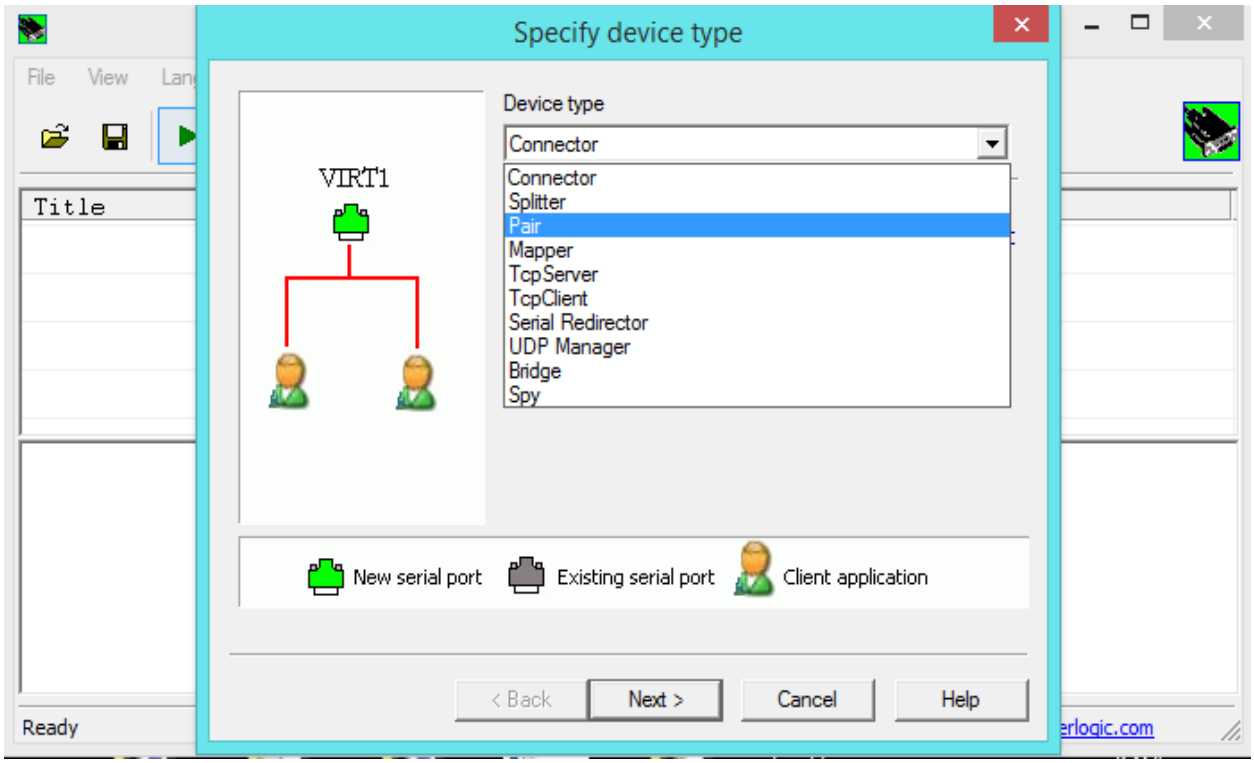

Figure 4.2: Setting of Virtual serial ports.

After press next button, the Figure 4.3 will appear to select available com ports. Suppose com1 and com2 is selected for used by first part of system (fuel sale). Then press finish button.

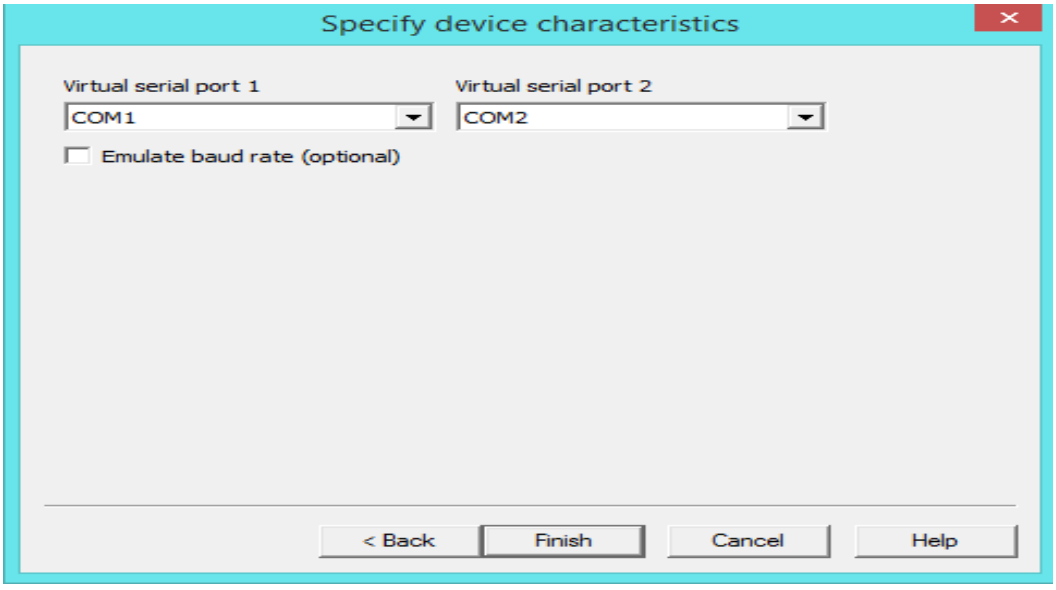

Figure 4.3: Selected (com1, com2).

As previous steps of select two com ports, other new com port will be chosen, which used by second part of system (monitoring fuel level). Suppose com3 and com4 is selected. As shown in Figure 4.4.

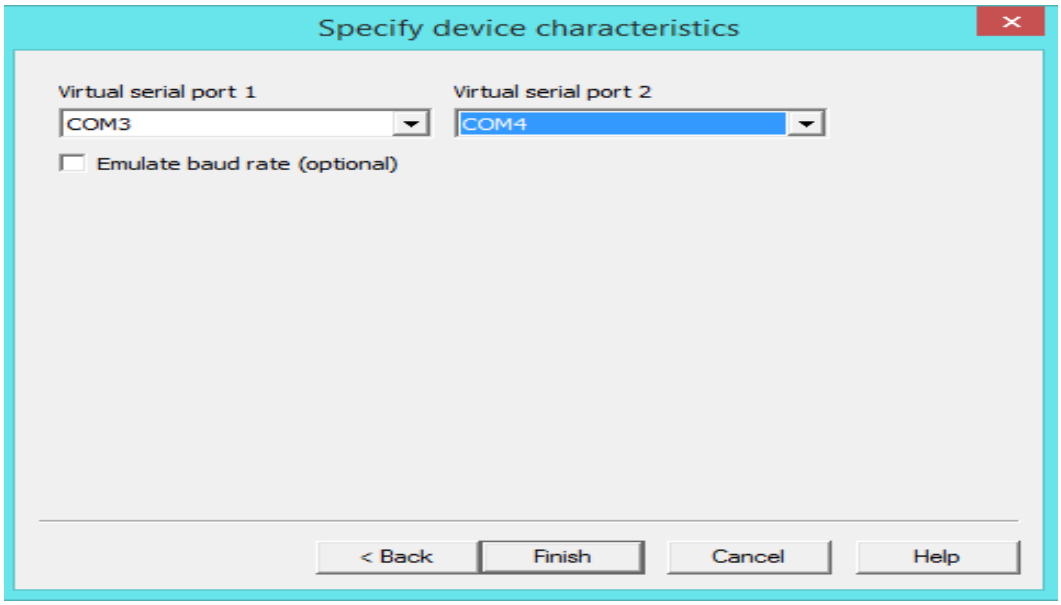

Figure 4.4: Selected (com3, com4).

In Figure 4.5 Illustrates notifications that (COM1 and COM2) (COM3 and COM4) Running. And ready to work.

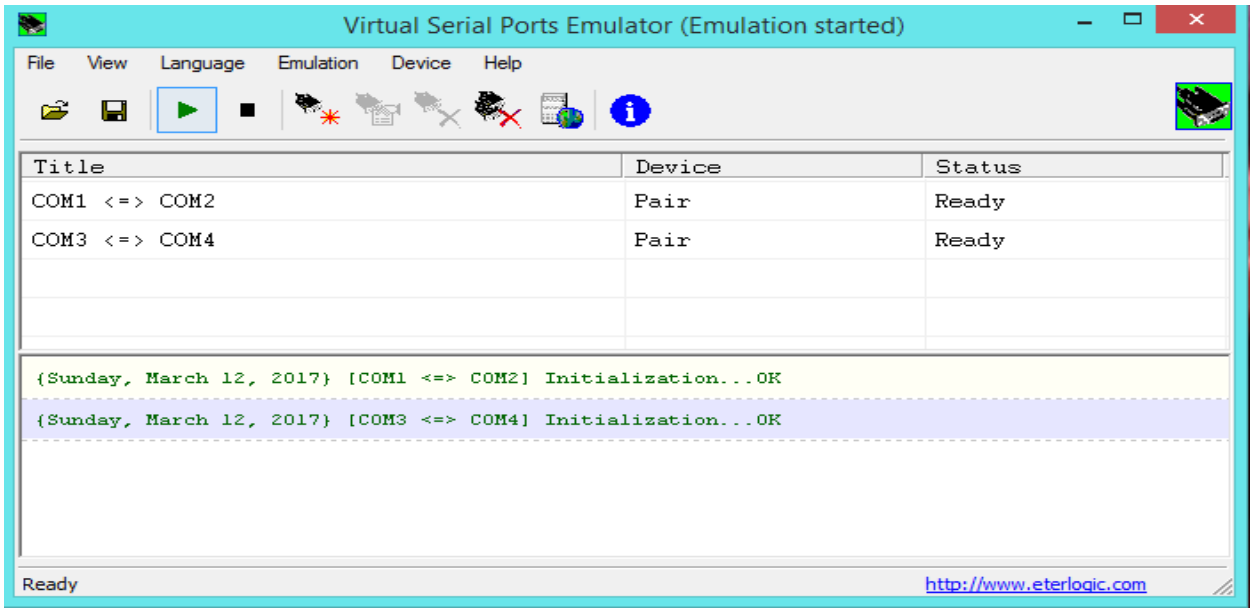

Figure 4.5: Connection of (Com1 with Com2) and (com3 with com4)

4.1.2 Scenario Two to Control of Fuel Sale

In the Customer Interfaces unit، which appear to the customer a number of interfaces that enables him to communicate with the system. Figure 4.6 shows the first interface which appear to the customer to allow him to enter his card number.

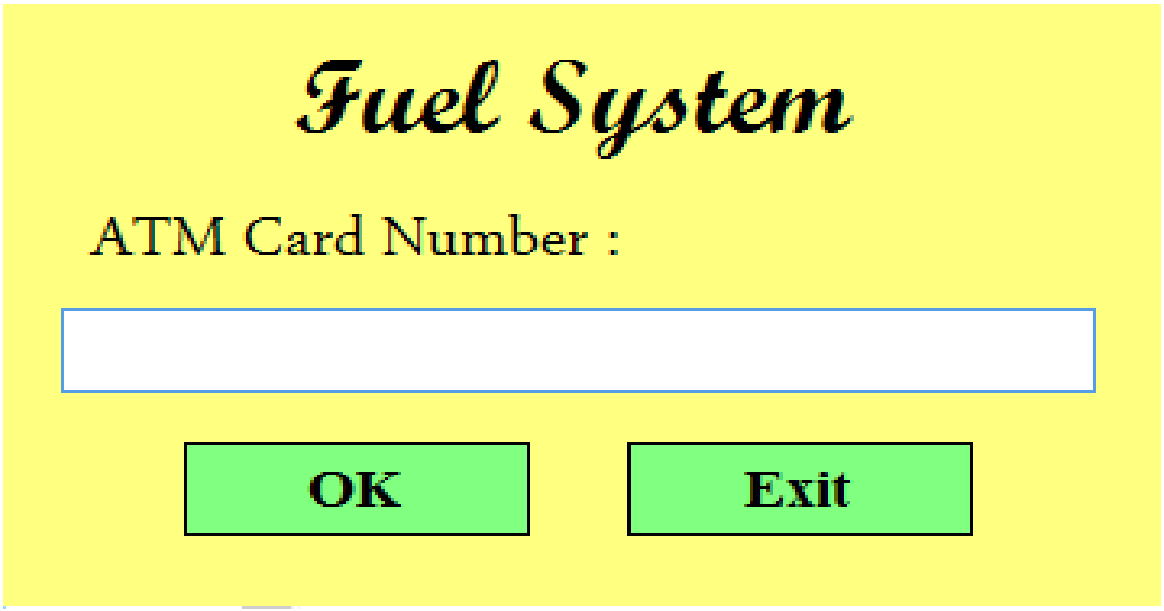

Figure 4.6: ATM card number GUI interface.

After that the customer enters the card number and pressed **OK** button; if the card number entered by the customer is not exist (wrong).This means that the customer is not authorized for obtain fuel because the card number, which introduced by the customer wrong and "ATM Number Not Found" a message appear to him.

Figure 4.7: Illustrate this message when the customer card number is wrong.

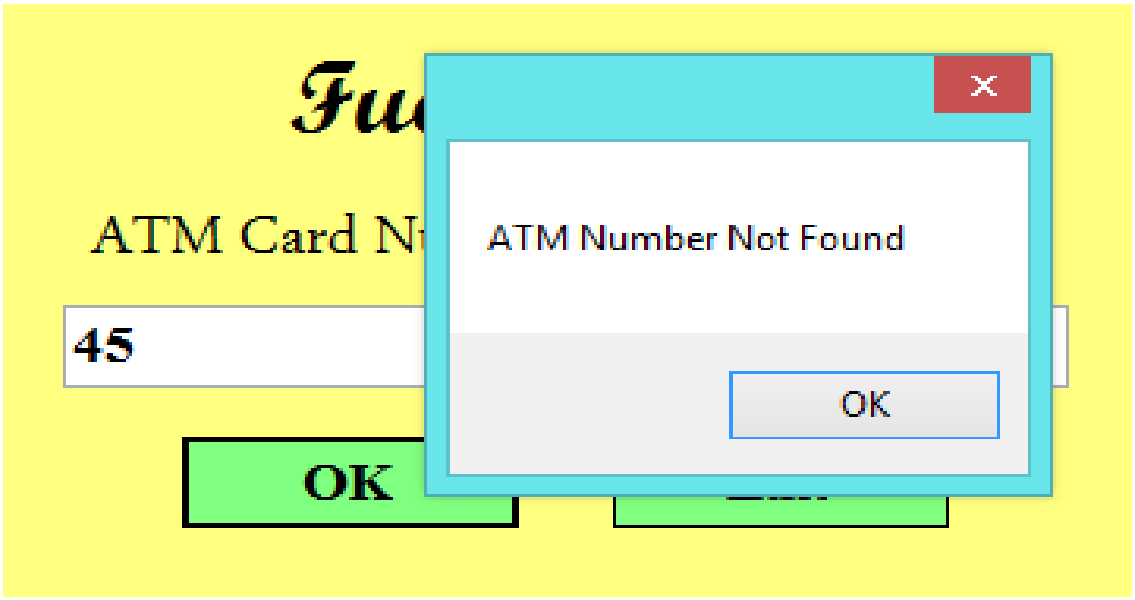

Figure 4.7: customer ATM card number error.

However if the card number which entered by the customer is exist (true). This interface is hiding and new interface will appear to him. Figure 4.8: Illustrate if the customer card number is true.

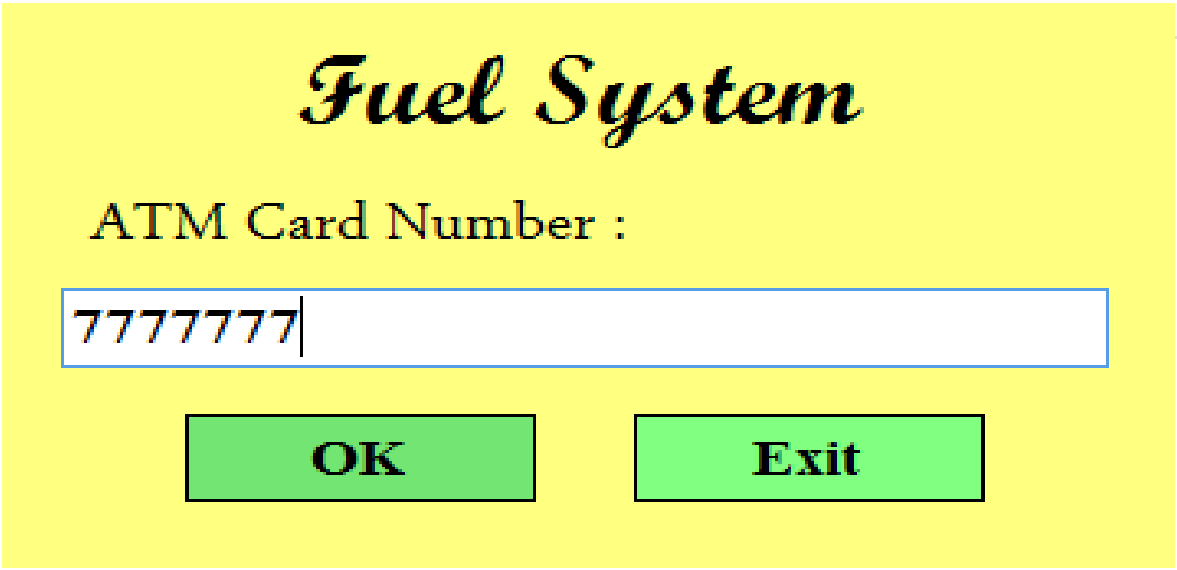

Figure 4.8: Customer ATM card number true.

After confirming the customer card number that he actually exists. The second interface will appear to him enables the customer to enter the price. That allows the customer to get the amount of fuel which he wants.

Figure 4.9: shows the second interface (new interface) displays the current balance in the customer's ATM card and it allows the customer to enter the price which enables him to getting fuel he needs.

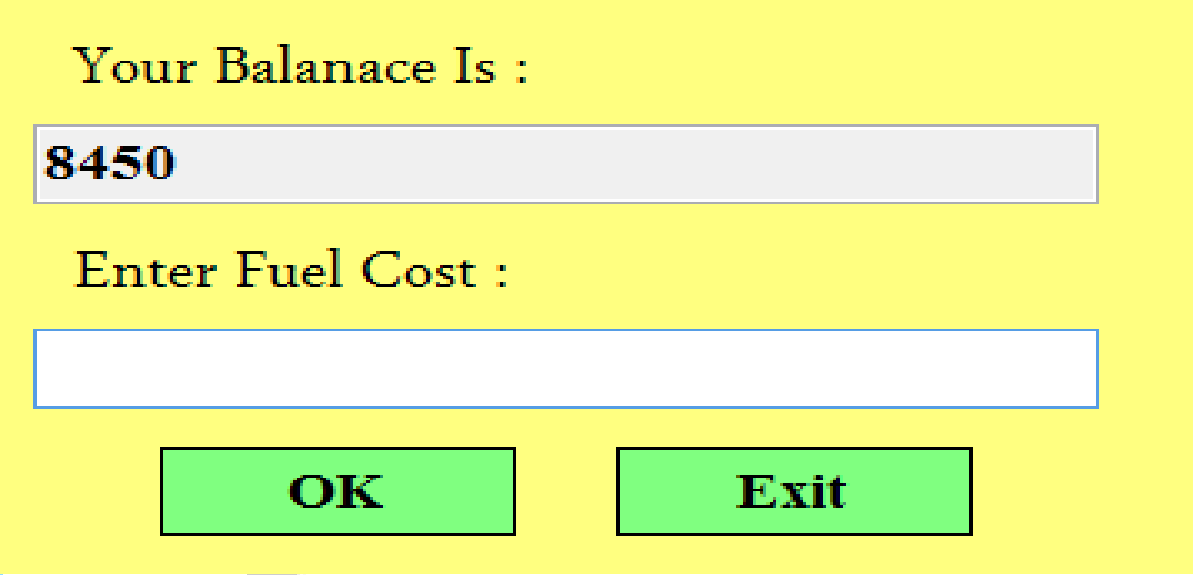

Figure 4.9: Balance and price GUI interface.

After the customer enters the price which want then will press the **OK** button. The customer's balance in ATM card will be verified to insure that he had enough balance allow him to obtain the fuel requested .In case he does not have sufficient funds in the ATM card "Your Balance Not Enough …!" a message appear to him. This means he will not get the fuel that request.

Figure 4.10: shows if the customer had not sufficient balance to obtain fuel, "Your Balance Not Enough …!" a message appear to him.

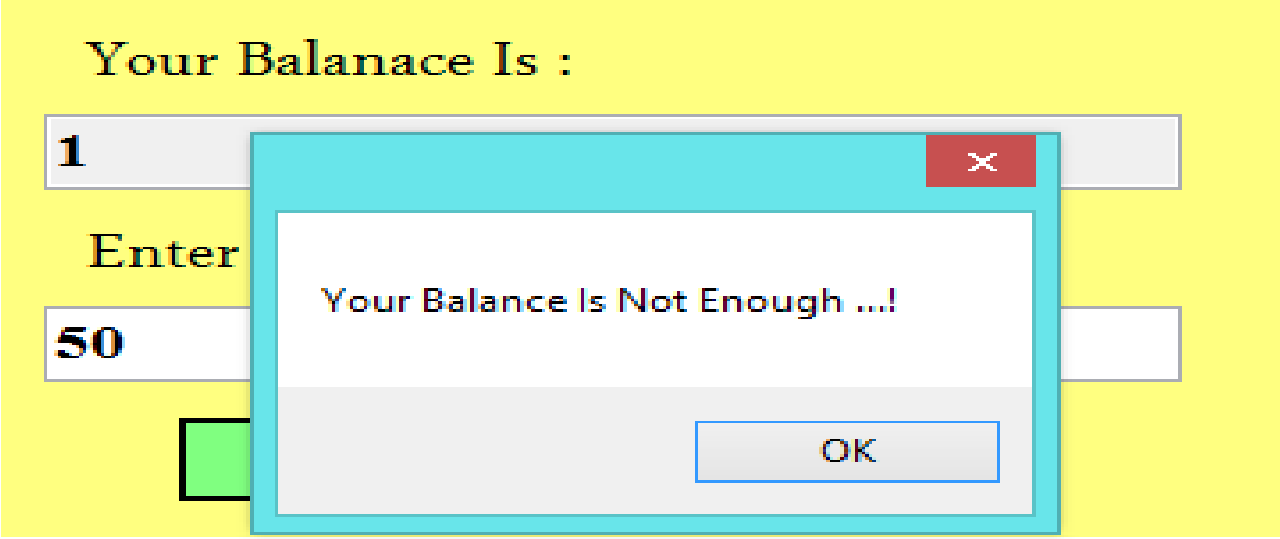

Figure 4.10: Customer balance reply in cases balance not enough.

But if he/she has sufficient balance to obtain fuel, new interface (third interface) appear to the customer. Figure 4.11: shows if the customer has enough balance in the ATM card, he will be allowed to get the fuel he requested.

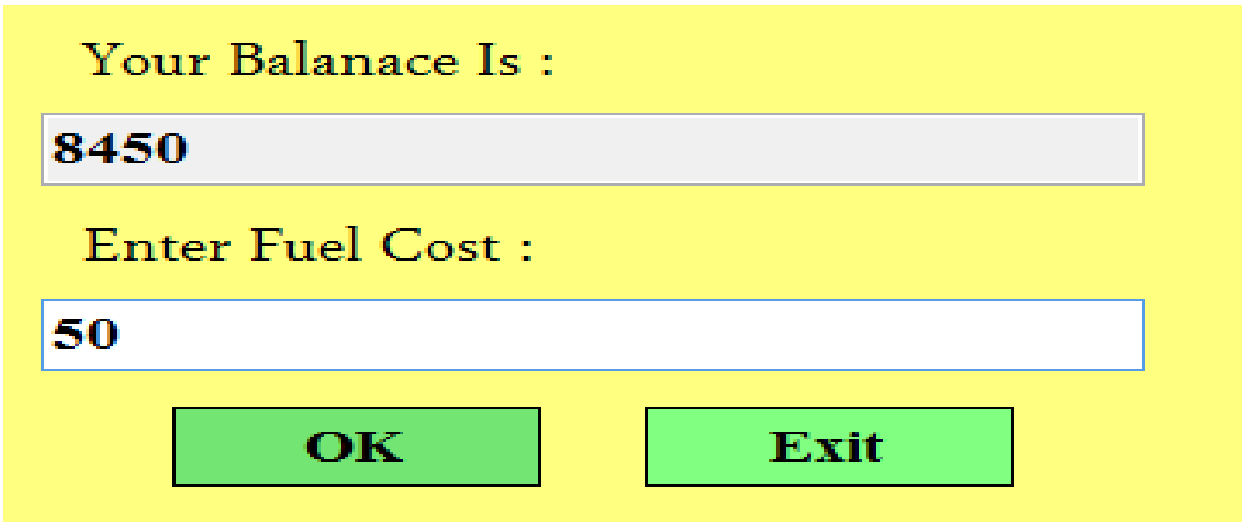

Figure 4.11: Customer has enough balance.

After verification that the customer has sufficient balance to get the fuel he need, the second interface is hiding and new interface (third interface) will appear to him.

The third interface Appear all counters in fuel station, this interface enable the customer to selects a certain counter among these counters to obtain fuel. As shown in Figure 4.12.

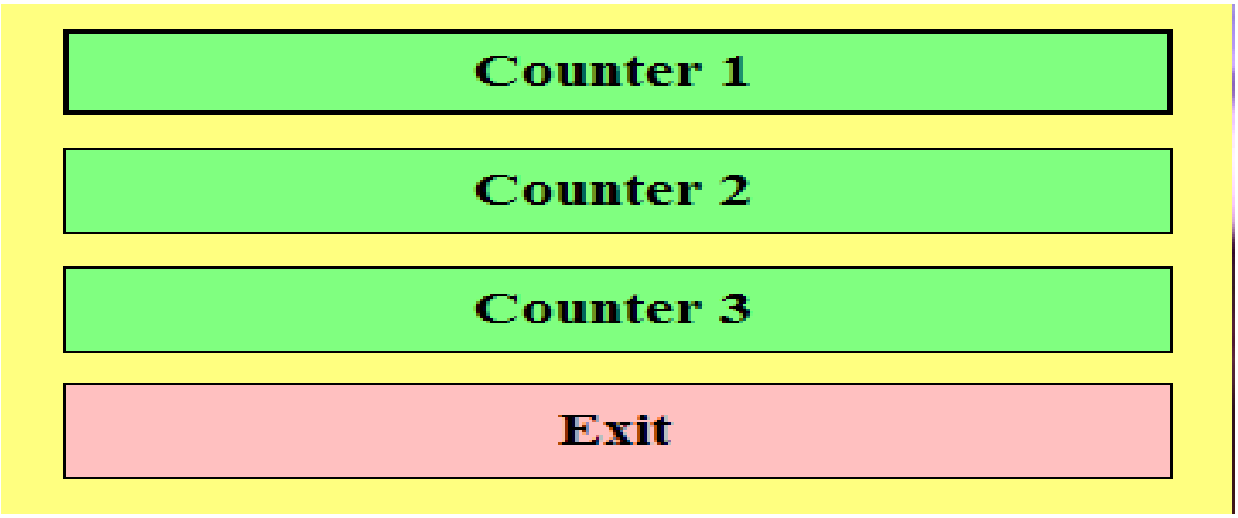

Figure 4.12: Counters options.

Figure 4.13: shows when the customer choosing the counter, "Thanks …!" Message will appear to him. This means that the operation was completed successfully and the customer will get the amount of fuel requested.

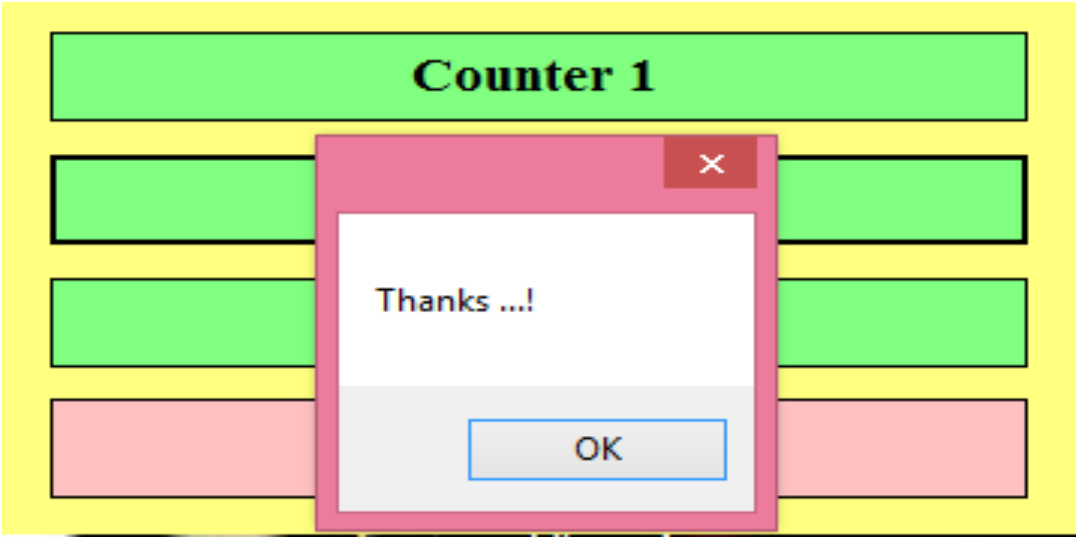

Figure 4.13: Reply for chosen option.

after make sure customer’s data is correct, then the customer’s request is sent by wireless XBee to main microcontroller for selected counter chosen by the customer in GUI to operate and supply his/hers vehicle by fuel.

Figure 4.14 shows electronic circuit of receiving customer request and give an order for selected counter (counter 2) to run the motor to supply customer's vehicle by fuel.

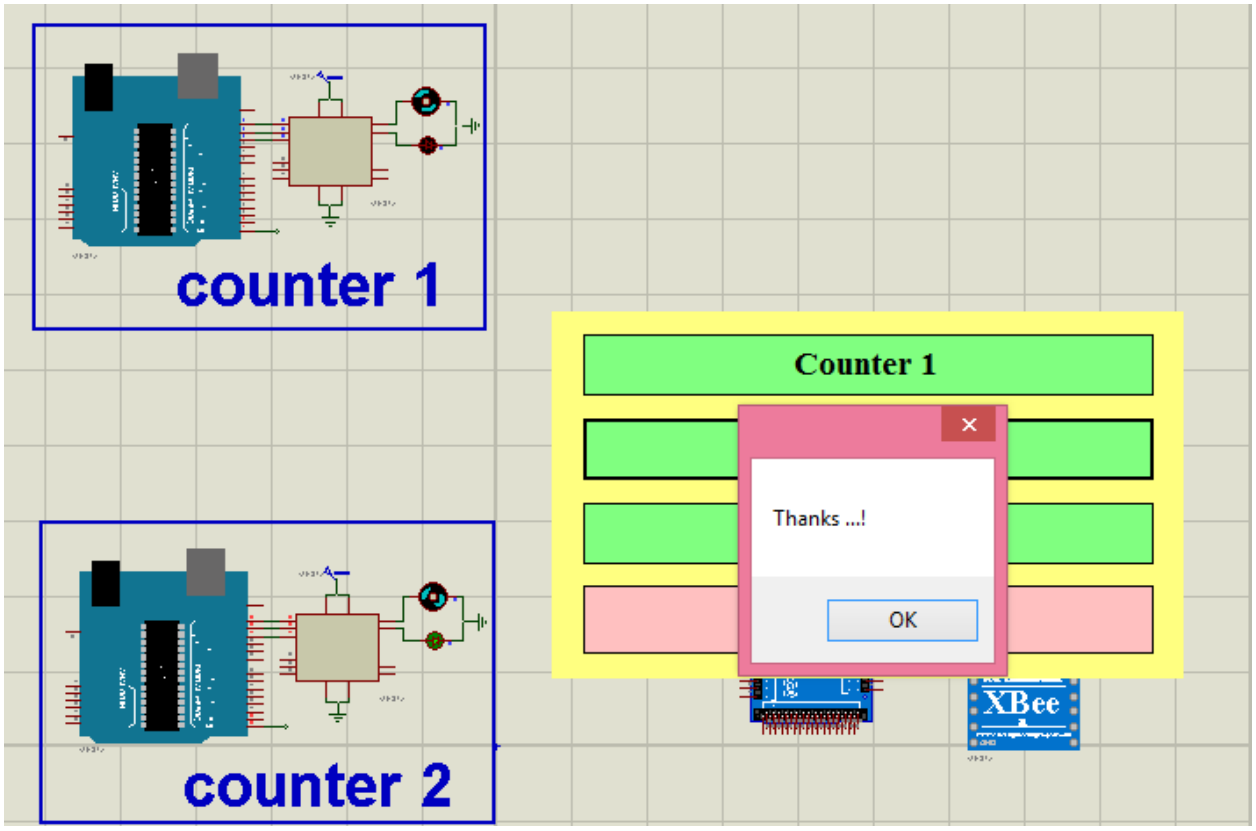

Figure 4.14: Running particular counter for fuel supply.

4.1.3 Scenario Three of Monitoring the Fuel Tank

In monitoring the fuel level in tank station after Fuel level measurement will be send wirelessly to the company interface to display values of real time fuel level. Figure 4.15 shows GUI interface that appears for the Petroleum Company and inside the station in real time, which display the fuel level of tank ،date and time).

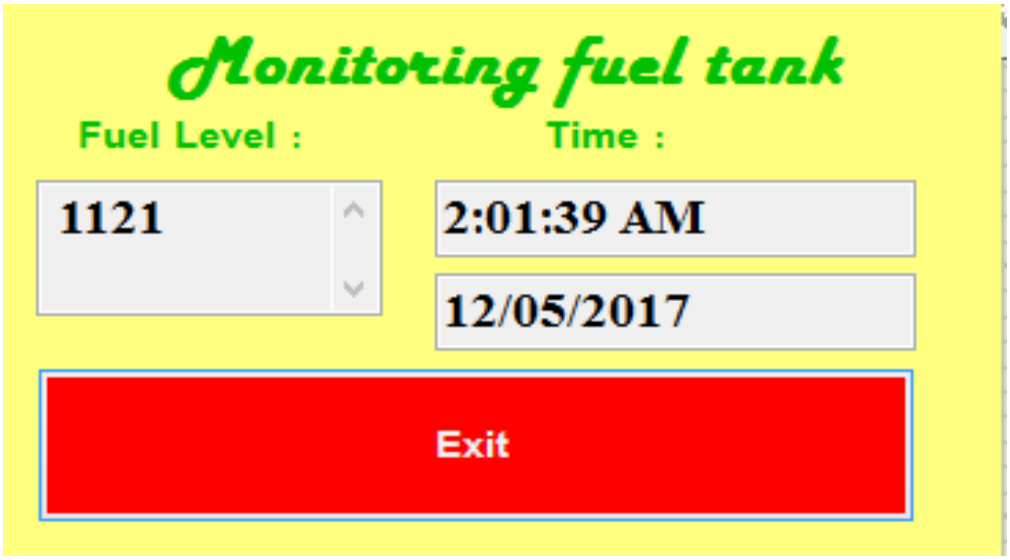

Figure 4.15: demonstrate fuel level (1121) liter in time 2:01AM.

The existing fuel in the tank decreases gradually as a result of selling the fuel and it gives new values to the fuel level. These values are sent periodically to the company that owns the fuel station and shows in GUI interface.

Figure 4.16 (a): Shows Company interface when fuel level is decreased during a period of time (When change in variable resistance values, correspondingly there is change in fuel level).

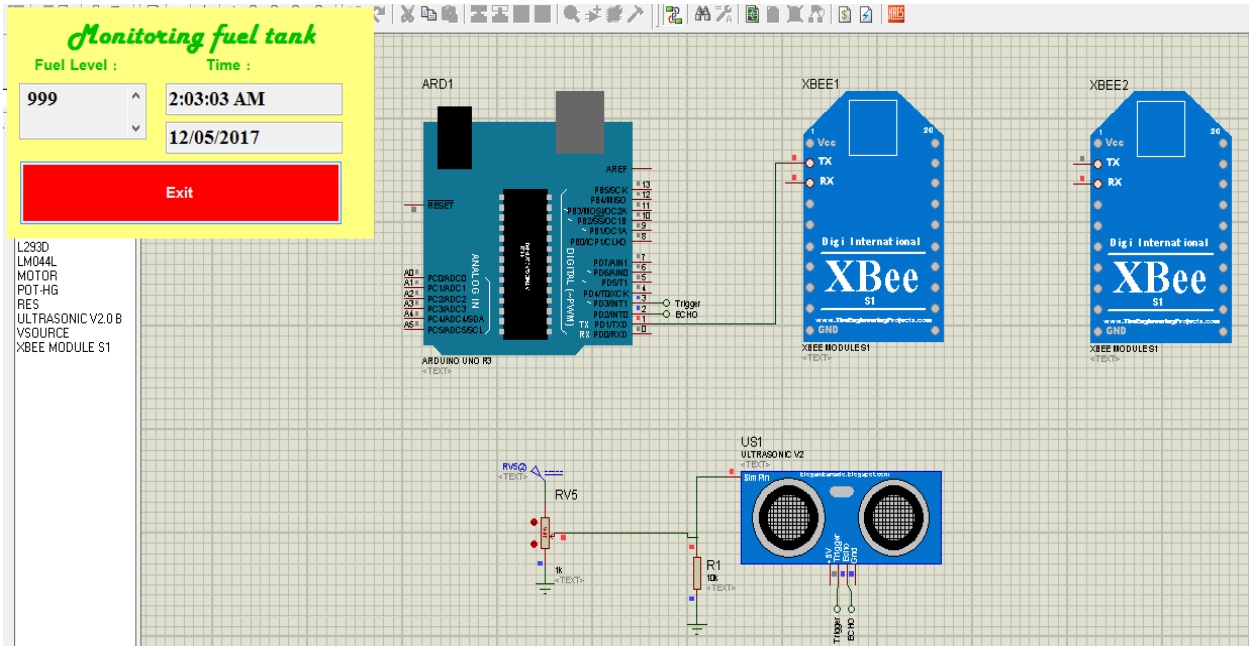

Figure 4.16 (a): Fuel level in tank (999) liters in time 2:03 AM.

Figure 4.16 (b): Shows Company interface when in fuel level is decreased (608) liters after period of time.

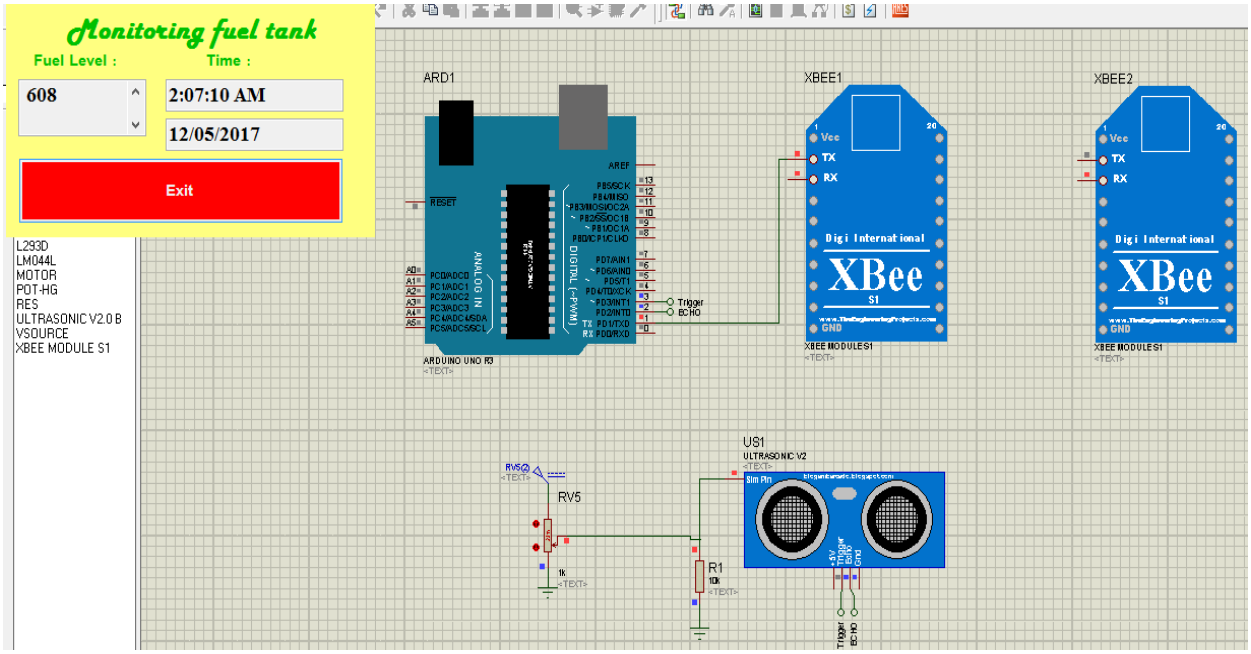

Figure 4.16 (b): Fuel level in tank (608) liter in time2:07 AM

Figure 4.16 (c): Shows Company interface when fuel level is decreased (324) liters after period of time.

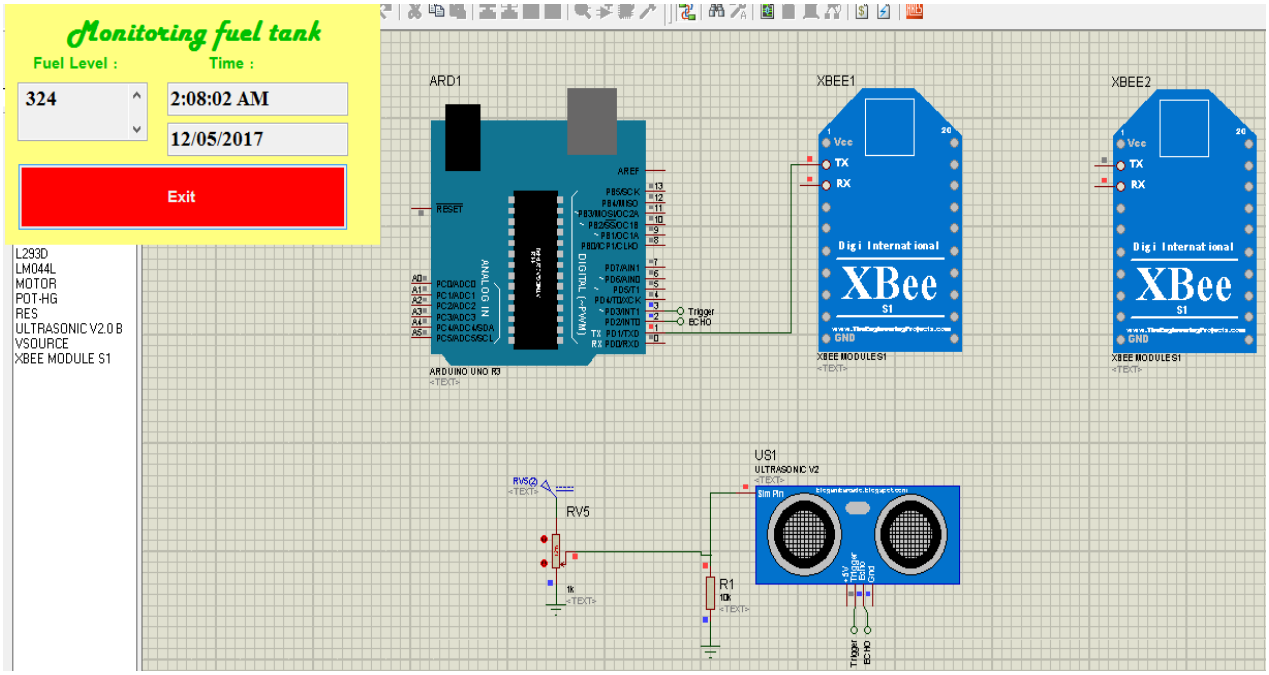

Figure 4.16 (c): Fuel level in tank (324) liters in time 2:08 AM.

4.2 Discussion

In sale fuel process we supposed one station that contain three counters to supply customers by fuel and customer authorized who are hold ATM card number (7777777), (8888888), and (9999999). Each card number contains of certain balance to identify customer who has enough balance to obtain fuel. Any non-stored card number does not allow obtaining fuel and is considered unauthorized. After the customer enters his data and determine the authorized customer, the data will be sent to the second unit (controllers) to determine certain counter chosen by customer in first unit for refueling.

And the current way to know of the quantity of fuel inside the tank is a manual which means an increase in the number of workers, time and lack of accuracy. We proposed is an automated monitoring of the fuel tank to know the real time fuel level by using ultrasonic sensor connected with the microcontroller (Arduino Uno) to measuring fuel level .then sending the fuel level wirelessly to GUI interface. And we supposed the change in fuel level values is expressed by change in values of variable resistor, which connected with ultrasonic sensor.

CHAPTER FIVE

(CONCLUSIONS AND RECOMMENDATIONS)

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

In this modern era, wireless technology made communication easier, faster, and more efficient.

The proposed fuel level monitoring design is based on wireless technology, so an ultrasonic sensor connected with Arduino uno use to measure the fuel level, and X-Bee transmits measurement to the computer. Two X-Bees will be use in this project, one to transmit and another to receive the data. An interfaces unit which is created by using Visual Basic to display real time fuel level in GUI interface.

The design is also control the process of selling fuel with wireless system which links to computer, the interfaces are created for customers using visual Basic which enables them to enter the data (ATM Number, Fuel Cost) .If the customer's data is valid, selected counter option will be transmitted by X-Bee to another X-Bee connected to a microcontroller to receive the data and give the order to the counter chosen by the customer to start work.

This project shows the new methods of refueling are more accurate and trustful compared with manual method .it lead to reduce the human resources and save the time. Monitoring of the fuel level provide accurate information about the real time fuel level to the owner company's. This method saves money, time, and human recourses for the company and clear picture of the state of fuel stations moment by moment to help in decision-making.

5.2 RECOMMENDATIONS

It recommended that this project is easier and faster for use by customers; it can be applied in their mobile phones application, where the user can choose the counter through his mobile phone without the need for interfaces inside fuel station, also can create a database for storing all information about fuel level, and database fuel selling transactions.

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Appendix A

(SOURCE CODE)

Control of fuel sale

First interface

```
If (TextBox1.Text = "7777777" Or TextBox1.Text = "8888888" Or TextBox1.Text = "9999999")
Then
            If TextBox1.Text = "7777777" Then
                Me.Hide()
                Form2.Show()
            End If

            If TextBox1.Text = "8888888" Then
                Me.Hide()
                Form4.Show()
            End If

            If TextBox1.Text = "9999999" Then
                Me.Hide()
                Form5.Show()
            End If
        Else : MessageBox.Show("ATM Number Not Found")

        End If
```

Second interface

```
Dim A As Integer
        A = TextBox1.Text
        Dim B As Integer
        B = TextBox2.Text
        Dim C As Integer
        C = A - B
        If (B < A) Then
            Dim objwriter As New System.IO.StreamWriter(file)
            objwriter.WriteLine(C)
            objwriter.Close()
            Me.Hide()
            Form3.Show()
        Else : MessageBox.Show("Your Balance Is Not Enough ...!")
        End If
```

Third interface

```
SerialPort1.PortName = "COM3"
        SerialPort1.BaudRate = 9600
        SerialPort1.Open()

Handles Button1.Click
        If SerialPort1.IsOpen = True Then
            SerialPort1.WriteLine("1")
            MessageBox.Show("Thanx You ...!")
            Me.Hide()

        End If
    End Sub
```

```
Handles Button2.Click
        If SerialPort1.IsOpen = True Then
            SerialPort1.WriteLine("2")
            MessageBox.Show("Thanx You ...!")
            Me.Hide()

        End If
    End Sub
Handles Button4.Click
        If SerialPort1.IsOpen = True Then
            SerialPort1.WriteLine("3")
            MessageBox.Show("Thanx You ...!")
        End If
    End Sub
```

Main microcontroller

```
void setup() {

 Serial.begin(9600);

 Serial1.begin(9600);

 Serial2.begin(9600);

 Serial3.begin(9600);

}



void loop() {

 if (Serial.available() > 0) {

  int First;

  String string = Serial.readStringUntil('\n');

  First = string.toInt();

  if (First == 1) {

   Serial1.println(1);

   delay(500);

   Serial1.println(-1);

  }
```

```
    if (First == 2) {
      Serial2.println(2);
      delay(500);
      Serial2.println(-1);
    }
    if (First == 3) {
      Serial3.println(3);
      delay(500);
      Serial3.println(-1);
    }
  }
}
```

Counter1

```
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(11, OUTPUT);
  Serial.begin(9600);
}

// the loop function runs over and over again forever
void loop() {
  if (Serial.available() > 0) {
    int First;
    String string = Serial.readStringUntil('\n');
    First = string.toInt();
    if (First == 1) {
      digitalWrite(11,HIGH);
      digitalWrite(12,HIGH);
      digitalWrite(13,HIGH);
    }
    else {
      digitalWrite(11,LOW);
    }
  }
```

```
}
```

Counter2

```
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(11, OUTPUT);
  Serial.begin(9600);
}

// the loop function runs over and over again forever
void loop() {
  if (Serial.available() > 0) {
    int First;
    String string = Serial.readStringUntil('\n');
    First = string.toInt();
    if (First == 2) {
      digitalWrite(11,HIGH);
      digitalWrite(12,HIGH);
      digitalWrite(13,HIGH);
    }
    else {
      digitalWrite(11,LOW);
    }
  }
}
```

Counter3

```
void setup() {

  // initialize digital pin 13 as an output.

  pinMode(13, OUTPUT);

  pinMode(12, OUTPUT);

  pinMode(11, OUTPUT);
```

```
  Serial.begin(9600);
}

// the loop function runs over and over again forever
void loop() {
  if (Serial.available() > 0) {
    int First;
    String string = Serial.readStringUntil('\n');
    First = string.toInt();
    if (First == 3) {
      digitalWrite(11,HIGH);
      digitalWrite(12,HIGH);
      digitalWrite(13,HIGH);
    }
    else {
      digitalWrite(11,LOW);
    }
  }
}
```

Fuel level monitoring

Arduino UNO

```
const int pingPin = 3;

const int echoPin = 2;

void setup()

{

  Serial.begin(9600);

}

void loop()

{

    String str = Serial.readStringUntil('\n');

    //Serial.println(str);

      long duration, inches, cm;

    pinMode(pingPin, OUTPUT);

    digitalWrite(pingPin, LOW);

    delayMicroseconds(2);

    digitalWrite(pingPin, HIGH);

    delayMicroseconds(10);

    digitalWrite(pingPin, LOW);

    pinMode(echoPin, INPUT);

    duration = pulseIn(echoPin, HIGH);

    // convert the time into a distance

    cm = microsecondsToCentimeters(duration);

    // SERIAL DEBUG
```

```
    Serial.println(cm);

    delay(3000);

{

long microsecondsToCentimeters(long microseconds)

{

  // The speed of sound is 340 m/s or 29 microseconds per centimeter.

  // The ping travels out and back

  // object we take half of the distance travelled.

  return microseconds / 29 / 2;

}
```

Company Interface

```
Public Class frmMain
    Dim myPort As Array

    Delegate Sub SetTextCallback(ByVal [text] As String)

    Private Sub frmMain_Load(ByVal sender As System.Object, ByVal e As System.EventArgs)
Handles MyBase.Load
        SerialPort1.PortName = "COM2"         'Set SerialPort1 to the selected COM port
at startup
        SerialPort1.BaudRate = 9600         'Set Baud rate to the selected value on
        SerialPort1.Open()
    End Sub

    Private Sub SerialPort1_DataReceived(ByVal sender As Object, ByVal e As
System.IO.Ports.SerialDataReceivedEventArgs) Handles SerialPort1.DataReceived
        ReceivedText(SerialPort1.ReadExisting())    'Automatically called every time a
data is received at the serialPort
    End Sub
    Private Sub ReceivedText(ByVal [text] As String)
        If Me.rtbReceived.InvokeRequired Then
            Dim x As New SetTextCallback(AddressOf ReceivedText)
            Me.Invoke(x, New Object() {(text)})
        Else
            textBox2.Text = Format(Now, "hh:mm:ss")
            textBox2.Text = TimeOfDay
            textBox3.Text = Date.Today.ToString("dd/MM/yyyy")
            Me.TextBox1.Text = [text]
```

```
        End If
    End Sub
    Private Sub frmMain_FormClosing(ByVal sender As System.Object, ByVal e As
System.Windows.Forms.FormClosingEventArgs) Handles MyBase.FormClosing
        If SerialPort1.IsOpen = True Then
            SerialPort1.Close()
        End If
    End Sub

    Private Sub buttonStop_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles buttonStop.Click
        Beep()
        End
    End Sub
```