

AUTOMATED FUEL DISPENSER

Software Requirements Specification

Group 1

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1. Introduction

An automated fuel dispensing system provides semi-attended operation utilizing a computerized credit authorization and billing technique by means of a direct connection to a regional credit center over communication lines. A control console for multiple pump dispensers interconnects with a local central controller for providing preliminary verification checks and generating an authorization request message for transmission to a central computer at the regional credit center. This initial verification is to identify a particular user with a credit document inserted into the control console. Following receipt of an authorization message from the central computer in response to an authorization request, a user selects one of the pump dispensers by actuating a push button at the control console; he then dispenses the amount of fuel desired. Following completion of the fuel dispensing routine, billing information is assembled in the local central controller as a message for transmission to the regional computer for credit billing to a particular account number.

Gasoline pumps have become information appliances. In addition to allowing customers to fuel their cars and pay for gasoline at the pump, gasoline pumps now offer a completely automated system to do the same. Competitive pressures are requiring stations to monitor and control their gas pumps remotely, instead of having personnel on-site. Pumps now contain touch screens or LCD displays with keypads and have enhanced features to allow credit/debit/fuel card based transactions to take place.

This eventually leads to many benefits viz.

- (a) Drives higher purchase prizes
- (b) Speed up fuelling process for customers
- (c) Reduced man-power
- (d) Maintain transaction details electronically thus avoiding clerical errors while entering details into the computer systems.

1.1 Purpose

The purpose of this Software Requirement Specification is to establish and maintain a common understanding between the client and the software developer regarding the requirements for the proposed software. The connections and work dependencies between the client and the software system proposed has been illustrated.

1.2 Scope

The proposed software “Automated Fuel Dispenser” is the control system for a series of gasoline pumps to be used at gas stations. The software will control many aspects of the gas refueling process including:

- Enabling of each pump for use
- Starting the pump’s motor
- Engaging the clutch on each pump which in turn will dispense the gas
- Displaying the current amount of gas pumped
- Recording each transaction and archiving them.
- Authenticating credit/debit cards

The proposed automated system will eventually lead to many benefits viz.

- ✓ Drive higher purchase prizes
- ✓ Speed up fuelling process for customers
- ✓ Reduced man-power
- ✓ Maintain transaction details electronically thus avoiding clerical errors while entering details into the computer systems.

The use of this system automates many processes such as measuring the amount of gas dispensed and recording the details of each transaction. This system also increases the quality of the gas being dispensed by not allowing a pump to be enabled if the tank that services the pump is below 20%. This is because the sediment in the bottom of the gas storage tank is never pumped into the customer’s car.

1.3 Overview

This Software Requirements Specification is organized into two main sections:

- General description
- Specific requirements

The general description section provides information describing general factors that will affect the requirements of the software. This will provide an overview of the entire software briefly highlighting its various functionalities. The specific requirements section describes in detail the working methodology of the automated system coupled with in-depth working knowledge that governs the effective execution of the functionalities it provides and the requirements the software must meet in order to support its effective and error-free working.

2. General Description

2.1 Product Perspective

Automated Fuel Dispenser is an independent software that is totally self-contained. It is developed in response to the call for automated systems which is the popular demand of these times. The benefits of automated systems ranges from reduced labor cost to automated cash payment systems.

2.2 Product Functions

The Automated Fuel Dispenser system is designed to automate the entire fuelling process that takes place at the gas station. Not only does it deal with dispensing of gasoline it also handles customer payment and monitors tank levels. The software will control many aspects of the gas refueling process including:

- Enabling of each pump for use
- Displaying the current amount of gas pumped
- Implementing transaction process and archiving these details for future reference
- Reading coded data from a credit/debit card presented to a terminal console at a remote station
- Authentication of credit/debit cards
- Actuating a fuel dispenser in response to a successful authentication to thereby allow the dispensing of fuel

Insert card : The initial step towards making a refuel is placing/inserting the card into the card reader followed by authentication of the card. The card must be verified to be valid and ZIP/PIN values required to be input ensures the authenticity of the cardholder. If the card is

authorized then the merchant (gas station) is authorized with an estimated amount which is locked on the customer's account and is termed as hold amount.

Fuel dispense : Fuel type and amount is determined and selected fuel quantity is then dispensed.

Payment : Payment is made after successful refuel. After the transaction was successful, the details are saved in the server machine at the corporate office for future references and security reasons.

Monitor tank : When the storage tank is below a certain level (20%), a signal will be sent to the pump system to notify it that it needs to be refilled. When the storage tank is below the critical level (4%), another signal is sent to the pump system to notify it that that grade can no longer be used.

2.3 User Characteristics

Customer :

Customer should be able to read, understand, and follow English instructions without assistance.

He should be familiar with the traditional swipe system prevalent for credit/debit cards.

He must be familiar to the use of a touch-screen based interface.

Manager :

He will require some 30 minutes to understand the working of the entire system and familiarize himself with the various functionalities it provides. Must have a knowledge of extracting information from databases by throwing relevant queries into the system.

2.4 Assumptions and Dependencies

- The gas station provides only diesel and petrol fuel facilities.
- The system uses licensed third party software products.
- The gas station premises will not be affected by frequent power outages.
- The station permits credit cards and only those debit cards which are verified by visa.

3. Specific Requirements

3.1 External Interface Requirements

3.1.1 User Interfaces

Gas station (Pump Interface)

- ✓ The gas station shall support touch-screen operations and have a standard keyboard for operations that cannot be performed with the touch-screen.
- ✓ It will have a card reader which can be a swipe mechanism or an RFID based reading method.
- ✓ The system will now verify the authenticity of the credit/debit card inserted by transmitting the authorization request message to the central computer(server)
- ✓ Keypad will be displayed on screen through which the PIN number and passwords will be entered.
- ✓ On successful authentication, the pump will be enabled for dispensing fuel and the subsequent amount will be debited from the customer's account.
- ✓ Every transaction detail will be stored in the database(server) at the main office.

Management Interface

- ✓ The personnel who have management status will be welcomed to a screen providing advanced operations.
- ✓ The management interface shall allow the user to execute ad hoc queries about sales management such as total volume of fuel sold, total income for the day, and number of customers.

- ✓ The manager will be able to disable a pump or dispensing of a particular grade of fuel as and when needed.

Pump interface

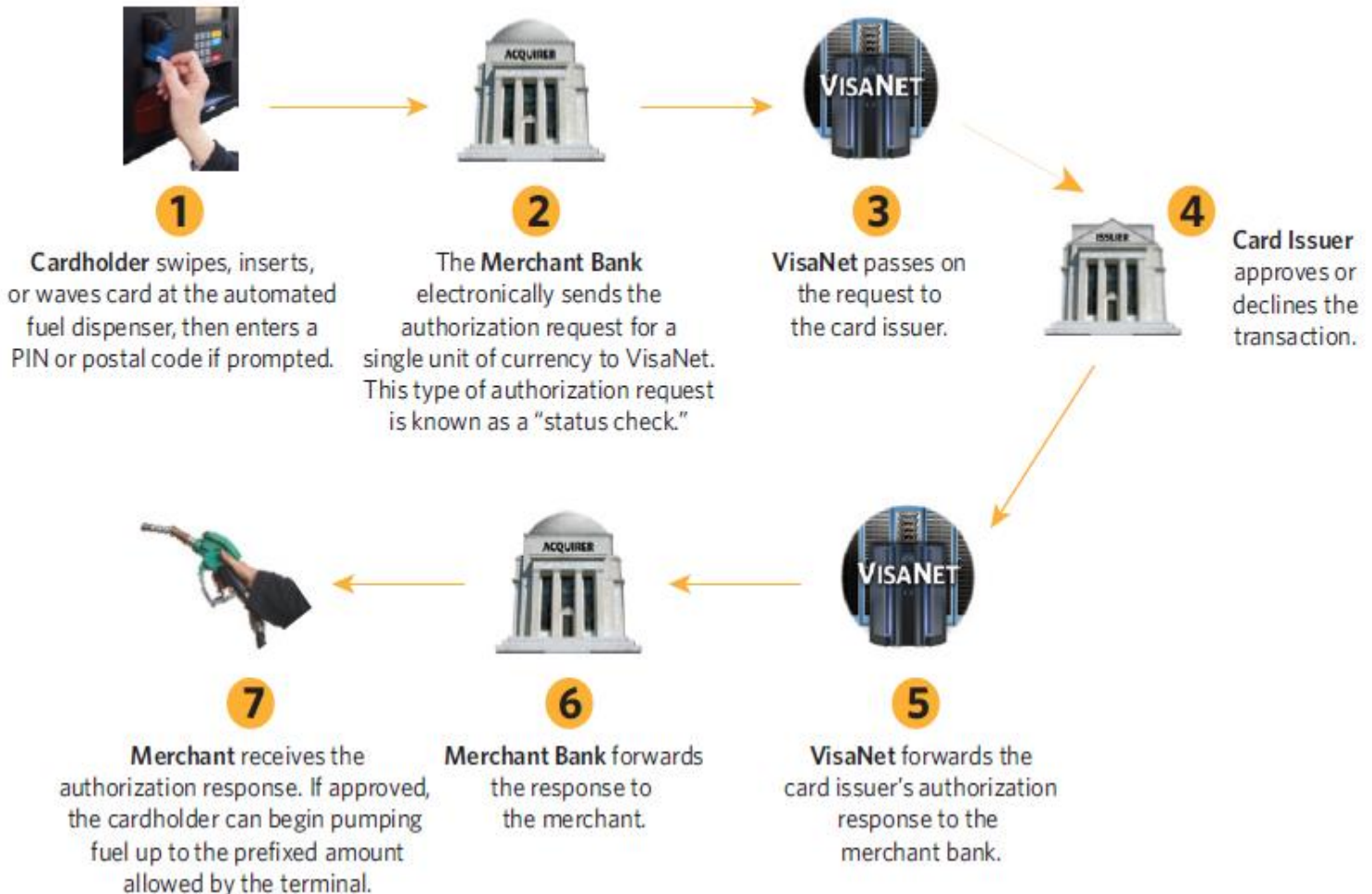
This is the interface the customers use to operate the pump. Since the pump interface will be used by people of different backgrounds with varying levels of knowledge about computers, the interface needs to be as simple and easy to use as possible. It should be possible for a user with no training or experience to walk right up to the pump and do everything that is needed for refueling their vehicle's fuel tanks. If the interface is too complex, it will drive away customers. With this in mind, the interface should not provide too many options such that it overwhelms the user. It also needs to allow the user cancel or go back to the previous step until the actual transaction is made. Once the final amount is set and transaction has started, the user cannot go back.

Detailed working of the automated system at the gas station:

Every pump in the gas station is provided with the automated system and a touch based interface to help customers place a request for refuel. When a customer comes to the gas station for a refuel, the software system greets the him and asks him to click on "Proceed to Refuel". Now he is asked to select from one of the two options: Credit card and Debit card. After selecting one option, the screen prompts the user to insert the credit/debit card into the card reader. If Credit card is selected then the customer will have to enter the ZIP code for verification purposes. In case of Debit card, the PIN number has to be inserted. Once the debit card is verified and the final transaction amount is determined, the customer will have to enter the permanent password or one time password to proceed to the transaction process. This is not applicable for credit card users.

The following illustrations show the lifecycle for a credit/ debit transaction at a fuel outlet.

AUTHORIZATION AT THE AUTOMATED FUEL DISPENSER



After the card is read there could be two possibilities: (a) Authorization success (b) Authorization failure.

Failure of authorization maybe due to many reasons: insufficient balance, wrong PIN/ZIP code entered, error is reading the card to name a few.

If the card is authorized then the merchant (gas station) is authorized with an estimated amount which is locked on the customer's account and is termed as hold amount.

- If the Cardholder does not continue with the Transaction, an authorization reversal must be issued for the full amount.
- If the approved amount is not fully dispensed, an authorization reversal must be issued for the remaining amount.
- If the transaction is cleared for an amount greater than the authorization amount—whether implicit for status checks or explicit for estimated amounts—the issuer has a chargeback right for the amount that exceeds authorization amount.
- This estimated amount is decided based on the one-time limits of various banks, rules put forth by Visa and the pattern of fuel consumption in the area of the gas station. The system ensures that it dispenses fuel only upto the authorized amount because if this amount is exceed then merchant can be subjected to charge-back charges

This is an effective measure to protect the system from fraudulent customers. An authorization protects the merchant, and may also be used to optimize interchange qualification. "Floor limits" define the amount above which authorizations must be performed. In most countries, this floor limit has been set to zero, meaning all fuel transactions must be authorized. We follow the same system for our software.

After he card is authorized, the customer is provided with two options:

- ✓ **Petrol**
- ✓ **Diesel**

User must select the appropriate option after which the screen displays two other options:

- ✓ **Pre-set Amount in INR**
- ✓ **Pre-set Volume in Litres.**

Customer must select either of the two above options and fill in the relevant digits. If amount is entered then litres is computed and vice versa.

Once the option is selected and relevant values entered, the user must press on "Confirm" to proceed. When user confirms the refuel, the pump is enabled and the pump hose is unlocked. User can now refuel the tank. System will dispense the fuel as per the order placed after which the user must put back the hose in the holster which is then locked. The pump is now reset and disabled. User must now press on "Proceed to Billing". Here the actual amount is

now known and the transaction begins. After successful transaction the screen prompts the user with two options: "Done" and "Print Bill". "Print bill" option prints out the invoice carrying details about the amount charged, customer name and first few digits of the credit/debit card used to make the payment after which the card is ejected. On pressing "done", the card reader ejects the card. The user collects the card and leaves the gas station.

Once the user begins pumping gas, the pump interface will show a new screen showing the amount of gasoline that has been dispensed, and the cost of that gasoline. The screen will update for every 1/100 of a gallon dispensed.

All successful transactions are updated in the main office's (server) database with all information regarding the customer, the pump used for refuel, fuel type: petrol/diesel, fuel quantity and total amount.

Manager Interface

Manager will be able to login to this system and access all the information about every transaction made. All this can be done at the main office itself.

Manager has access to all the information including:

- ✓ Transaction details : amount, date, time
- ✓ Details of customers who used the pump at the gas station
- ✓ Volume of fuel present at each gas station
- ✓ Volume of fuel sold
- ✓ Which pumps are enabled/disabled
- ✓ Total amount collected at the gas station
- ✓ Number of customers

FUNCTIONS

- ✓ Manager is authorized to enable or disable certain pumps.
- ✓ He can also disable the option to choose a particular fuel type if not available.
- ✓ He can modify the price of per litre of fuel as and when it changes in the market.
- ✓ Can use queries to access all the information he is authorized to.

3.1.2 Hardware Interfaces

Pump

- ✓ The pump system shall use an “ON/OFF” switch to enable and disable the pumps respectively. This switch can be enabled or disabled by the admin or authorized personnel only.
- ✓ “ON” shall start the pump and free the clutch while an “OFF” shall stop pump and secure the clutch.
- ✓ The pump system shall control dispensed gasoline by using a metering device on the gas line.
- ✓ A pulse shall be sent to the pump system to notify it of the dispensed gasoline after every 1/100 of gasoline dispensed.
- ✓ Each pump shall have a direct connection to the server computer, which will be used for sending transaction data and archiving them for future use.

Gasoline storage tank

- ✓ Each gasoline storage tank shall have a direct connection to the server computer which will be used for sending messages regarding how full each tank is.
- ✓ The gasoline storage tank shall have a meter on it.
- ✓ The pump system shall be notified that the tank needs refill when the gasoline level in the storage tank reaches 20%.
- ✓ The pump system shall be notified that the gasoline grade can no longer be used when the gasoline level in the storage tank reaches 4%.

The pump system needs to be able to enable and disable pumps. This will be done by done with a switch that the pump system interfaces with to control the pump. When the system sets the switch to on, the pump will be started and the clutch freed. When the switch is set to off, the pump is stopped and the clutch is secured. The system will need to be able to control one of these switches for each pump.

Each pump will have a metering device on the gas line. For each 1/100 of a gallon dispensed, a pulse will be sent to the pump system to notify it of the dispensed gasoline. The pump system will need to be able to receive pulses for each pump independently.

Each gasoline storage tank will have a meter on it. When the storage tank is below a certain level (20%), a signal will be sent to the pump system to notify it that it needs to be refilled. When the storage tank is below the critical level (4%), another signal is sent to the pump system to notify it that that grade can no longer be used.

Each individual pump will have a microcontroller that is capable of network operations. The microcontroller will support a network protocol such as TCP/IP. The microcontroller will send messages to the main computer informing it of pump operations. Each storage tank will also have a microcontroller that supports TCP/IP and will send messages to the main computer informing of changes in status.

The main computer itself will also have either an analog modem or an ISDN modem that is used to connect to the corporate computer.

So we sum up the hardware requirements:

- ✓ Pentium IV 1 GHz processor
- ✓ Minimum of 1 GB RAM (in pumps at Gas station)
- ✓ Minimum of 32 GB RAM (server)
- ✓ 100GB Hard disk for storage of transactions and other details.
- ✓ Metering device
- ✓ Analog or ISDN modem
- ✓ 8051 microcontroller (or any other advanced microcontroller)

3.1.3 Software Interfaces

- ✓ The pump system shall support transfer of daily transactions to the corporate computer.
- ✓ The pump system shall receive updates from the corporate computer that modifies operation of the pump system.
- ✓ Admin/manager can disable/enable pumps as when required.
- ✓ Admin/manager may change the fuel cost per litre depending upon changes in the market values.

The pump system needs to be able to interact with the corporate computer. The pump system needs to support transferring the transactions for the day. The pump system should also be able to receive updates of gasoline price from the corporate computer. The pump system should also be able to receive updates from the corporate computer that modifies operation of the pump system. For instance, the pump system could receive an update that allows the manager to perform a new query.

3.1.4 Communications Interfaces

The main computer will need to be able to support TCP/IP to be able communicate with the corporate computer.

3.2 Functional Requirements

Functional requirements give a description of how the system will function from the users' perspective. In order to realize a good control of the gasoline pumps, the system should be able to respond adequately to every stimulus receive. Each stimulus for the system presents some pre-conditions that are required conditions the system should meet to react correctly (i.e. to perform all the function associated with this stimulus).

Insert card

❖ SRS001: Verifying card

The initial step towards making a refuel is placing/inserting the card into the card reader followed by authentication of the card. The card must be verified to be valid and ZIP/PIN values required to be input ensures the authenticity of the cardholder.

If the card is authorized then the merchant (gas station) is authorized with an estimated amount which is locked on the customer's account and is termed as hold amount.

- If the Cardholder does not continue with the Transaction, an authorization reversal must be issued for the full amount.
- If the approved amount is not fully dispensed, an authorization reversal must be issued for the remaining amount.
- If the transaction is cleared for an amount greater than the authorization amount—whether implicit for status checks or explicit for estimated amounts—the issuer has a chargeback right for the amount that exceeds authorization amount.
- This estimated amount is decided based on the one-time limits of various banks, rules put forth by Visa and the pattern of fuel consumption in the area of the gas station. The system ensures that it dispenses fuel only upto the authorized amount because if this amount is exceed then merchant can be subjected to charge-back charges.

Fuel dispense

❖ SRS002: Select Fuel Type

Pre-Condition:

The panel should be turned on. The card must be successfully verified.

After credit/debit card is verified, the customer can now proceed to the process of refueling. Here he must first select the type of fuel he needs: Petrol/Diesel.

❖ SRS003: Enter amount or volume to dispense

Pre-Condition:

**The panel should be turned on. Card must be verified and fuel type must be selected*

Processing the inputs:

User must select the appropriate option after which the screen displays two other options:

- ✓ Pre-set Amount in INR
- ✓ Pre-set Volume in Litres.

Customer must select either of the two above options and fill in the relevant values using the on-screen numeric keypad. If amount is entered then litres is computed and vice versa. For each input in this sequence of prompt, the system will check the validity of that input. The system should require that a value is entered (i.e. the user cannot press the enter button without entering a value) and that this value is within the permitted limits. A validity limit should be specified later. Only if the input is correct, will the system allow the user to process the next input.

❖ ***SRS004: Pump enabled***

Pre-condition:

- ✓ *The pump should be disabled i.e. there should be no transaction in progress at this pump.*
- ✓ *Credit/debit card must be verified.*
- ✓ *Fuel type must be chosen and the quantity needed must be determined.*
- ✓ *The tank serving this pump should be over the 4% limit. If not the system should take the proper actions to prevent the pump from being enabled.*

The pump is enabled by the operator touching the ENABLE button for the pump.

Motor and metering device started: When the pump is enabled, a signal (ON) shall be sent to microcontroller of the pump concerned. The microcontroller receiving this signal should start the motor. If it is already started, the signal should be ignored. When the motor is on, the pump clutch should be freed. The metering device in the gas line of this pump shall also responds to the same signal in the same way that the motor does.

❖ ***SRS005: Display prompt when gun taken out of its holster***

Pre-condition:

- ✓ *Credit/debit card must be successfully verified.*
- ✓ *Type of fuel must be chosen.*
- ✓ *Quantity of fuel must be determined.*
- ✓ *Pump must be enabled.*

In order to pump the gas, the user should take the gun out of the holster.

When the gun is out, the system shall prompt the user to start pumping the gas. This message should be displayed in the LCD panel of the concerned pump.

❖ **SRS006: Update display**

Pre-condition:

- ✓ *The pump should be enabled. If the pump is disabled, pressing the trigger will not do anything because the pump clutch will be secured.*
- ✓ *Credit/debit card must be successfully verified.*
- ✓ *Type of fuel must be chosen.*
- ✓ *Quantity of fuel must be determined.*
- ✓ *Pump must be enabled.*

After the gun has been removed from the holster, the user can start pumping the gas by pressing the gun trigger.

The system should update the display devices at the pump with the current values of the cost and volume.

When the gas is pumped in the line, the metering device in that line will send a pulse to the system for each 1/100 of gallon dispensed. The system should increment the value of the volume for each pulse received. If p is the price per gallon (in cents), then for every pulse received the system should increment the value of the cost by $p/100$ cents.

Payment

❖ **SRS007: Make Payment**

Pre-condition:

- ✓ *Cost display for this pump not equals to 0. If there is no cost engender on this pump, the system should inform the operator by sending a message.*
- ✓ *Fuel dispense must have been successful.*

The operator will enable the payment by touching the button Payment for the appropriate pump. The credit/debit card is already inserted into the card reader. After the fuel is dispensed, the final amount is calculated and the payment is made through secure gateways.

❖ **SRS008: Update Transaction details**

Pre-condition:

A successful transaction must take place.

After the transaction was successful, the details are saved in the server machine at the corporate office for future references and security reasons. The system should establish a connection to the global database in order to transfer the data about the transactions to the corporate database.

All these details are confidential and accessible by authorized official only.

❖ **SRS009: Receipt request**

Pre-condition:

A successful payment must be made.

After successful transaction the screen prompts the user with two options: "Done" and "Print Bill". "Print bill" option prints out the invoice carrying details about the amount charged, customer name and first few digits of the credit/debit card used to make the payment. On pressing "done", the card reader ejects the card. The user collects the card and leaves the gas station.

Monitor tank

❖ **SRS010: Warning limit reached**

Precondition: None

To be able to order a tank refill before all the pumps shut down, the system should send a warning the operator that a tank stores less than 20% of gasoline.

Warning message: When the gasoline in a tank reaches the 20% limit, the system shall send a warning message to the operator interface indicating which tank is concerned.

❖ **SRS011: Shutdown limit reached**

Pre-condition:

All pumps that link to this tank should be disabled. If not, the system will allow the transaction in process to terminate before shutting this pump down.

When the quantity of gasoline reaches 4% in a tank, the system shall shut down all the pumps supplied by this tank.

❖ **SRS012: Tank refill**

Pre-condition:

All the pumps linked to this tank should be turned off. If not, this action should engender no reaction from the system.

When the tank is refilled, all the pump that may have been shut down should be turned on.

3.3 Non-Functional Requirements

Non-functional requirements dictate properties and impose constraints on the project or system. They specify attributes of the system rather than what the system will do.

3.3.1 Performance

The proposed "Automated Fuel Dispenser" is an independent and self-contained system which operates with complete reliability and ensures secure transactions. Its "easy-to-comprehend" user interface makes the system acceptable among customers from all backgrounds with different levels of knowledge in English as a language. Its touch based interface is user-friendly and is widely accepted among users. The system is easy to maintain, portable to different platforms and can be changed/improved without any issue. We provide 24 hours availability to suit the requirements of various users.

3.3.2 Reliability

Reliability is most important for basic pump operation. The pumps must accurately report the amount of fuel dispensed. If the pump reports less fuel than what is actually used, it will become a very serious and costly affair for the owner of the gas station. If the pump reports that more fuel is used than is actually used, it will create disgruntled customers which may never come back. To ensure that no such thing happens, our system is fully checked and tested using various parameters. All the meters are checked and guaranteed to function effectively and accurately.

3.3.3 Availability

At initial release, the basic functionality should have an availability of at least 99.999%. Basic functionality includes pump interface and operation. Also we ensure that these basic features and the later introduced advanced features will be available 24 hours at the service of the customers.

3.3.4 Security

This "Automated Fuel Dispenser" involves credit/debit card based transactions which must be authenticated and secure. Any holes in the security mechanisms can prove detrimental. All these transaction details that are stored at the server in the corporate office must be confidential and accessible by authorized personal only. For the security of these data and other confidential information, these are encrypted. Transactions are carried out using secure mechanisms and every measure is taken to ensure security of the customers' details and transactions.

3.3.5 Maintainability

Maintenance is the longest and time consuming part of the Software Development Life Cycle (SDLC). After the software is made and delivered, it is the the duty of the developer to take care of its maintenance.

The system must be divided into modules as modules make the maintenance easier and effective.

The different modules maybe as follows:

- ✓ one module for the pump control logic
- ✓ module taking care of authentication of card
- ✓ modules taking care of inputs provided by customer
- ✓ module dedicated to carrying out transactions
- ✓ module to keep check of the fuel level in tanks
- ✓ module which deals with the functionalities provided to manager (different modules for different functionalities)

3.3.6 Portability

Portability is one major thing that needs to be taken care of. The system is implemented in a language popularly accepted and supported by all platforms. Any low level code (i.e., code to control operation of pump motor, et cetera) will be contained in a separate module and written in assembly language. This will allow the pump control software to be moved to another microcontroller with a minimal amount of work. Now-a-days Arduino is gaining popularity and hence codes can be written in C# (a C like language which is easier to learn and understand).

3.4 Design constraints

3.4.1 Report format

All reports generated by the system should follow the standards for corporate report formatting.

3.4.2 Data naming

Any data that is to be uploaded to the corporate system must follow the naming schemas set for the corporate system. In other words, data values and types and other parameters must match those that have been set in the database and queries must be made in accordance with the naming schemas followed.

3.4.3 Accounting procedures

The system will be able to keep track of how much money the gas station has at hand at any given time. The system will also be able to generate reports about the day's transactions. It will be able to generate reports such as total revenue, total profit, station load per hour, and so on.