RFID in Supply Chain Management of Gas Cylinders

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Abstract

This investigates the impact of radio-frequency identification (RFID) on supply chain management in strategic, tactical, and operational dimensions. In our research we develop framework for evaluating some of the pertinent issues that have arisen with the availability of RFID technology in the broad field of supply chain management. A vast general literature on RFID technology is available today, and many researchers have addressed some of the supply chain related aspects qualitatively. However, as of the writing of this dissertation, there is very little available in terms of quantitative, model-based research. Our aim is to develop a solution for small size Gas Distributor and Ensures timely reports generated for complete control on Supply Chain .And to get the information about the Minimum stock at warehouse and thus increase ROI (Return on Investment) and Proper maintenance of Assets which results in less investment.

Keywords—Active and Passive tags, RFID (RADIOFREQUENCYINDENTIFICATION), An antenna, A transceiver (with decoder), A transponder (RF tag).

1. Introduction

Radio frequency identification (RFID) is a generic term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object or person wirelessly, using radio waves [1]. It's grouped under the broad category of automatic identification technologies. Unlike the bar-code technology, RFID technology does not require any direct contact or line of sight for data communication. These kind of RFID data can be read through the human body, clothing and non-metallic materials [1]. A basic RFID system consists of three components like an antenna or coil and a transceiver (with decoder) with a transponder (RF tag) electronically programmed with unique information. The antenna emits radio signals for acquiring the data from the tag and to read and write data to it. Were the reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, were it is completely based on the power output and the radio frequency used. When an RFID tag exposed to the electromagnetic waves, the reader's signal will be activated.

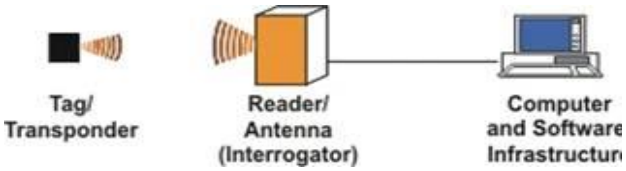

Figure 1.0 Overview of RFID

A typical RFID tag consists of a microchip attached to a radio antenna mounted on substrate. The chip can store as much as 2 Kilobytes of data. A typical reader is a device that has one or more antennas that emit radio waves and receive signals back from the tag and the reader passes the information in digital form to a computer. The scanning antenna puts out radio-frequency signals in a relatively short range. The RF radiation does two things like it provides a means of communicating with the transponder (the RFID tag) and it also provides the RFID tag with the energy to communicate.

Tags and Features	Passive Tag	Active Tag	Semi Passive Tag
Internal Power Source	No	Yes	Yes
Signal by backscattering the carrier wave from the reader	Yes	No	Yes
Response	Weaker	Stronger	Stronger
Size	Small	Big	Medium
Cost	Less expensive	More expensive	Less
Potential Shell life	Longer	Shorter	Longer
Range	10 centimeters to few meters	Hundreds of meters	Hundreds of meters
Sensors	No	Yes	Yes

Table 1.0 RFID Tags

2. Problem descriptions

A barcode is an optical machine-readable representation of data relating to the object to which it is attached. Barcodes systematically represented data by varying the widths and spacing of parallel lines, which referred to as linear or one-dimensional (1D), later it emerges to (2D). The main problem of using Barcode is they can be easily scratched or crumpled were the reader may not be able to read and another major technical disadvantage is the ability to display and convey information using a limited series of thin and wide bars[2]. So they switched to the technology name RFID is more complex and secure and cannot be counterfeited easily. RFID tags can be hidden to protect against the environment. RFID plays a major role in many fields like (TRACKING AND IDENTIFYING PEOPLE, VEHICLES AND COMMUTERS, TRACKING of ANIMALS and ASSETS in Supply chain management).Our aim is to provide a framework with RFID IN SUPPLY CHAIN MANAGEMENT OF GAS CYLINDERS and generate a reports on (stock of cylinders , daily movement of cylinders ,Spurious cylinders, Pending returns. Location wise & customer wise, Maintenance of Assets).

3. Proposed system

Auto ID technologies are a new way of controlling information and flow of material, especially used in large production networks [7]. The RFID technology is a means of gathering data about a certain item without the need of touching or seeing the item which carries the data, which uses inductive coupling or electromagnetic waves.

3.1 Passive Tags

Here we used Passive Tags were these tags have no internal power supply. The small amount of electrical current enters into the antenna by the incoming radio frequency signal provides just enough power for the complementary metal-oxide-semiconductor (CMOS) integrated circuit in the tag to power up and transmit a response [13]. Most passive tags signal by backscattering the carrier wave from the reader. This says that the antenna has to be designed both to collect power from the incoming signal and also to transmit the outbound backscatter signal. Communication Range of this tag is very short range (3m or less).Sensor capability done by the ability to read and transfer sensor values only when tag is powered by Reader. They don't have any date/Time stamp.

3.2 Antennas

An Antenna is a device which uses radio waves to read and write data to the Tags .The antennas and controllers are used by systems independently while some others may integrate into a single Reader or Reader/Writer.

3.3 Controllers

The Controller manages the communication interface between an Antenna and a PLC, PC, Server or Network Interface Module. The host system embedded with the Controller and communication of tag takes place through parallel or serial bus. [11]. RFID Controllers can also be programmed to perform process control directly from the data in the Tag memory.

3.4 Transponder

An RFID tag which consists of transceiver which automatically sends and receives signal and basically consists of a chip for storage, an antenna for transmitting and receiving as well as a substrate material.

3.5 Chip

The chip act as a main functional component of an RFID transponder. The required read/write operation and other data's are stored in a chip and it is determined according to the selection and dimensioning of the chip. And these chips are classified into three main categories

3.6 Read-Only

In its simplest form (read-only), RFID is used as a direct replacement for barcode technology. The advantages it offers include 100% accuracy, the ability to withstand in call for environments, and to eliminate line of sight requirements.

3.7 Read/Write (Reusable)

In a more advanced state (read/write), RFID can be used as a dynamic electronic manifest, allowing users to reduce traffic on networks, link remote production stations and to backup host PCs (or) PLCs.

3.8 Read/Write (Disposable)

To make the system more advanced, disposable labels are applied to products during manufacturing and utilized throughout the entire supply chain (from manufacturing through retail and out to the customers).

4. Frequencies used in RFID

RFID is fundamentally based on wireless communication, where it uses the radio waves, which

is the part of electromagnetic spectrum (i.e. frequencies from 125 kHz to 3GHz).

	Frequency	Distance	Example Application
LF	125 - 134 KHz	Few cm	Vehicle Immobilizer
HF	13.56 MHz	1m	Building Access, Smart cards
UHF	860 - 930MHz	~ 3m	Supply Chain and logistics
microwave	2.45 GHz	10m	Traffic toll collections

Table 2.0 Frequencies used in RFID

4.1 Interfaces used to connect with system

Readers can be connected to IT systems via different interfaces which include RS 485, RS 422, RS 232 or USB, WLAN as well as LAN. For industrial applications, connections via field bus systems like profile bus or CAN bus are possible as well. And here we use RS232 as an interface for data communication between the front end and back end.

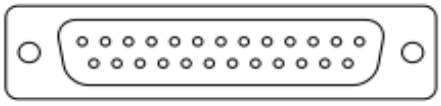

Figure 2.0 RS232

5. PIC16F877 CKT Description

The PIC Microcontroller board consists of circuits necessary to operate a Microcontroller with PC interface. Board consists of provisions like for interfacing 8 analog inputs and 23 Digital level signals.

5.1 Analog inputs

Pin no 2 to 10 can be used to connect any analog signals of range 0-5v.

5.2 Digital signals

As mentioned in the circuit the pin outs from the port is taken to a 26 pin FRC connector through which we can connect our Digital level signals 0 or 5 volts.

5.3 Clock

The PIC16F877 can be operated in Four Different oscillator modes where user can program two configuration bits FOSC1 and FOSC0 to select one of these four modes. The clock we have used is 10 MHZ which full under HS category.

- LP - Low Power crystal
- XT - crystal / resonator
- HS - High speed crystal/resonator
- RC - Resistor capacitor

5.4 MCLR/VPP

This is master clear will be input pin to the IC. And a logic low signal will generate a reset signal to the microcontroller. This pin is tied to VCC for the proper operation of the microcontroller.

5.5 TXD and RXD

To communicate with the outside world the microcontroller has an inbuilt USART. The USART gets the O/P and I/P line and given to a MAX232 IC for having communication with the PC.Since we have used comport for interfacing the microcontroller.

5.6 VCC and Ground

Pin no 31, 12 are grounded to provide power supply to the chip and Pin no 32, 11 are tied to VCC.

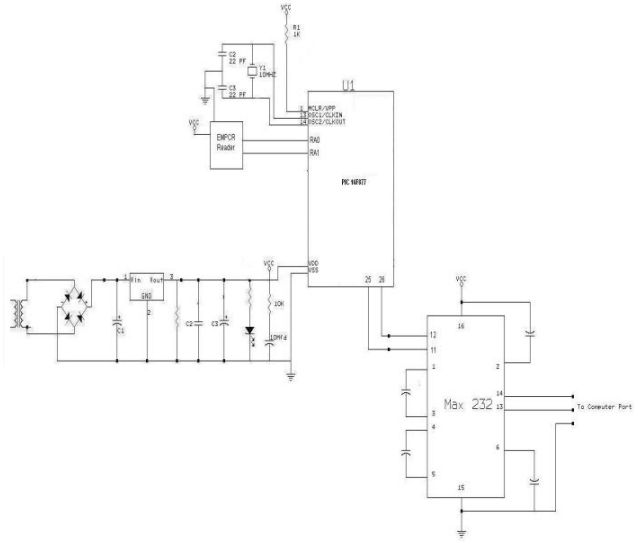

Figure 3.0 Circuit diagram of RFID

6. Work flow of gas cylinder SCM

The customer and distributor will have a Passive RFID tag that contains information like (Customer id, Customer name, Location, Local ID, Distinct ID Stock availability, Location of the customer). Once the customer needs to book the cylinder they will have their own unique RFID Tag with them and this will be sensed by the RFID reader by the distributor and each tag have their Local ID (unique number) which is mapped with the Distinct ID created specifically for each customer [12]. Once the RIFD Tag comes in contact with the reader they collect the information from the tag and it will be displayed .If the Local ID and Distinct ID matches then it will be declared as a proper transaction and the count will be reduced from the stock available. If these two ID were mismatched the Card or Tag will not be accepted and an alert message will be displayed which leads to the conclusion there is some kind of theft or any misplace of the cylinder and there won't be any change in the stock number [10].

Here we use the Hardware kit which contains Power Supply Unit the cheapest and commonly available energy source of 230v-50Hz and stepping down, filtering, rectifying, and regulating the voltage. It also contains a Step down Transformer because when AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of Direct Current needed. In the circuit, the transformer of 230v/15-0-15v is used to perform the step down operation where a 230V AC appears as 15V AC across the secondary winding. Rectifier unit is used for rectification which is normally achieved using a solid state diode. Diode will let the electron flow easily in one direction at proper biasing condition.

As Alternating Current is applied to the diode, electrons flow when both anode and cathode is negative. If the voltage polarity is reversed then electron flow will not takes place. A commonly used circuit for supplying large amounts of DC power is the bridge rectifier. A bridge rectifier of four diodes (4*IN4007) are used to achieve full wave rectification.

We also have Filtering unit and these filter circuits which are usually capacitors acting as a surge arrester always follow the rectifier unit. These kind capacitor is also known as a decoupling capacitor or a bypassing capacitor, is used not only to 'short' the ripple with frequency of 120Hz to ground but also to leave the frequency of the DC to appear at the output.

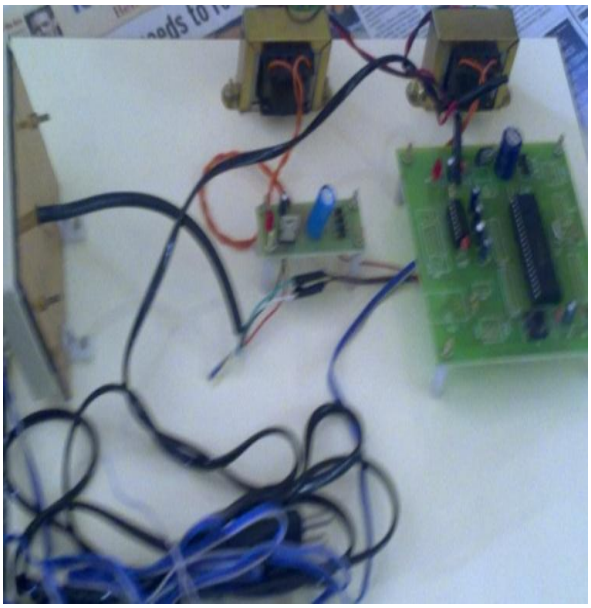

Figure 4.0 Hardware Kit

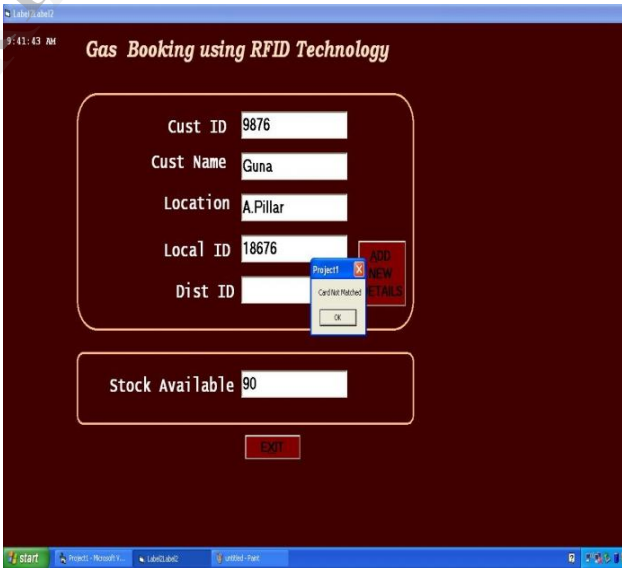

Figure 5.0 Pseudo Information from RFID Tags

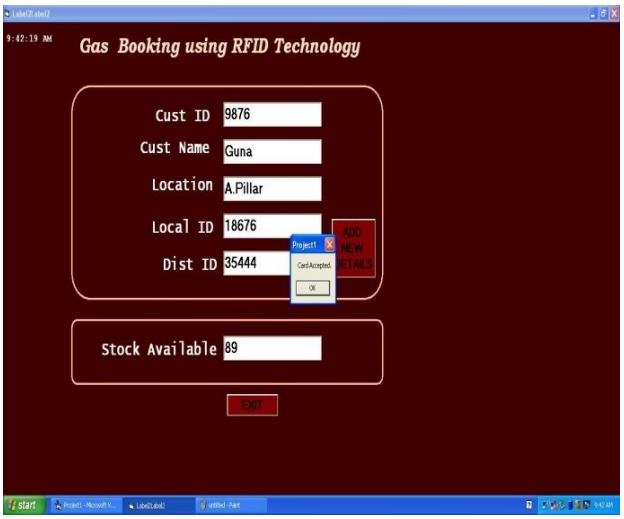

Figure 6.0 Correct Information from RFID Tags

6. Conclusions and future work

RFID increasingly leverages other cutting-edge technologies and activities, such as Smartphone's, social networking, and robotics which creates a new range of innovative business and consumer applications We have sensed the data and find about the movements of the cylinders with help of Even though there are some hurdles needed to overcome before RFID technology becomes widespread in this world. Here costs and privacy issue are the major problem.. Our works will are reliable, fault tolerance and recoverability. It is easy to use and it works in efficient manner .Here we use Passive Tags for collecting the information of the customer which have some disadvantage like these tags can't be used for large scale of stock and we can't track the movement of the goods by using these Passive tags .Our future work can be extended by using Active tags which uses (Global Positioning System) GPS for tracking the goods and also by using the Active Tags we can also find the leakage of Gas from the cylinder where the alert message will be sent to nearest service station .We can also make use of sensors to detect the amount of gas present in the cylinder .

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