Smart Billing and Retail System

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

in

Computer Science and Engineering/Information Technology

By

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Under the supervision of

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to

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Candidate's Declaration

I hereby declare that the work presented in this report entitled **" Smart Billing and Retail System"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/Information Technology** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2015 to May 2016 under the supervision of **Prof. Dr. Satya Prakash Ghrera** (H.O.D. - Department of Computer Science & Engineering).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

(Student Signature)
Apurva Sahay, 121238.

This is to certify that the above statement made by the candidate is true to the best of my knowledge.

(Supervisor Signature)
Prof. Dr. Satya Prakash Ghrera
Head of Department
Department of Computer Science & Engineering
Dated: 31st May 2016

Acknowledgement

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Dated: 30th May 2016

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Abstract

In the Internet of Things (IoT), devices gather and share information directly with each other and the cloud, making it possible to collect, record and analyze new data streams faster and more accurately. The rapid development of Internet of Things (IoT) technology makes it possible for connecting various smart objects together through the Internet and providing more data interoperability methods for application purpose. Recent research shows more potential applications of IoT in information intensive industrial sectors such as commercial services. In this project, we present an IoT-based system for smart and efficient point of sale system to demonstrate how to collect, integrate, and interoperate IoT data flexibly in order to provide new realms to commercial services. The IoT has already brought in significant changes in many areas of e-commerce. It is rapidly changing the commercial scenario by focusing on the way people, devices and apps are connected and interact with each other. Shopping is a very common and important activity. People these days prefer big retail stores, shopping malls and supermarkets rather than the common small scale grocery shops as these multi-product, multi-brand retailers serve as a one stop solution to shopping.

A very common observation is that at these supermarkets people use shopping carts and trolleys to buy products and then have to get into big queues to get there purchased items billed for payments. This is both time consuming and irritating, and with the ever increasing number of people turning towards supermarkets this problem is going to grow by leaps and bounds. Therefore we through our project present a solution to this problem which would save time and would be very convenient to use. We have designed an IoT based retail & billing system which would be installed in the shopping cart along with a RFID scanner. Products marked with RFID tags would get scanned as soon as they are put into the cart and the billing would be done automatically as soon as the customer exits the through the payment terminal. The payment can be made through any e- payment method. This system would also provide a web portal for both customers and shopkeepers from where they can easily keep track of their expenses and sales respectively, and also shopkeepers would be able to track inventories. Records and Analysis of all the expenditures would be available to both type of users.

CHAPTER 1: INTRODUCTION

1.1 Introduction: Internet of Things

Internet of Things represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the Internet where it can be processed and utilized for various interesting purposes.

Internet of Things or IoT is an architecture that comprises specialized hardware boards, Software systems, web APIs, protocols which together creates a seamless environment which allows smart embedded devices to be connected to internet such that sensory data can be accessed and control system can be triggered over internet.

The idea of devices connecting directly with each other is, as the man who coined the term Internet of Things puts it, “a big deal.”1 As Kevin Ashton explained a decade after first using the phrase at a business presentation in 1999, “Today computers—and therefore, the Internet—are almost wholly dependent on human beings for information. The problem is, people have limited, time, attention and accuracy—all of which means they are not very good at capturing data about things in the real world.”1 The solution, he has always believed, is empowering devices to gather information on their own, without human intervention.

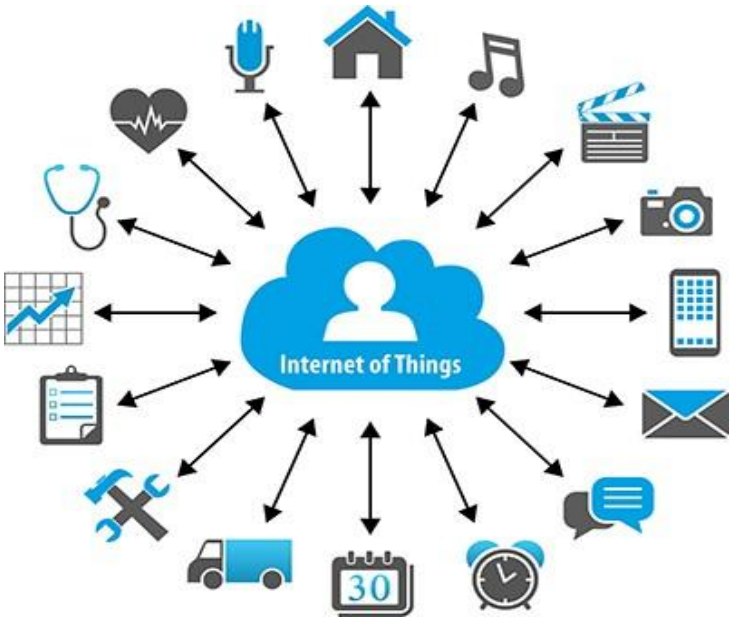


Figure 1: World of IoT

IoT can be defined as an interconnected group of uniquely identifiable devices that can communicate with themselves, their owners and control centres. Home automation, health monitoring and vehicle tracking are areas where the IoT is at work today. IoT services focused on recording and relaying sensory data simply scratch the surface if it's potential. IoT services become much more interesting when more sophisticated applications treat things as agents empowering devices to autonomously trigger actions based off the date they receive and record. By programming these agents to act in alignment with complex business rules, businesses benefit from increased productivity from reduced intervention. Suddenly devices evolve from merely sensing and reporting environmental data or sensing and reporting their own status to devices that can carry out actions autonomously from predefined rules.

"Smart" objects play a key role in the Internet of Things vision, since embedded communication and information technology would have the potential to revolutionize the utility of these objects. Using sensors, they are able to perceive their context, and via built-in networking capabilities they would be able to communicate with each other, access Internet services and interact with people.

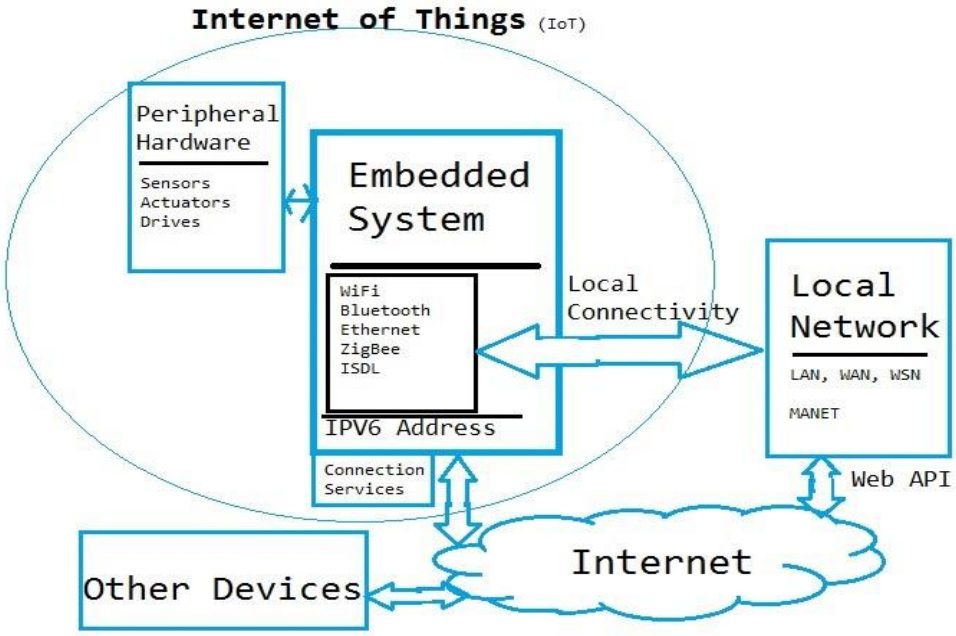


Figure 2: Internet of Things: Technical Layout

In other application domains, Internet connectivity of everyday objects can be used to remotely determine their state so that information systems can collect up-to-date information on physical

objects and processes. This enables many aspects of the real world to be "observed" at a previously unattained level of detail and at negligible cost. This would not only allow for a better understanding of the underlying processes, but also for more efficient control and management The ability to react to events in the physical world in an automatic, rapid and informed manner not only opens up new opportunities for dealing with complex or critical situations, but also enables a wide variety of business processes to be optimized. The real-time interpretation of data from the physical world will most likely lead to the introduction of various novel business services and may deliver substantial economic and social benefits.

The use of the word "Internet" in the catchy term "Internet of Things" which stands for the vision outlined above can be seen as either simply a metaphor – in the same way that people use the Web today, things will soon also communicate with each other, use services, provide data and thus generate added value – or it can be interpreted in a stricter technical sense, postulating that an IP protocol stack will be used by smart things.

From a technical point of view, the Internet of Things is not the result of a single novel technology; instead, several complementary technical developments provide capabilities that taken together help to bridge the gap between the virtual and physical world. These capabilities include:

õ **Communication and cooperation:** Objects have the ability to network with Internet Resources or even with each other, to make use of data and services and update their state. Wireless technologies such as GSM and UMTS, Wi-Fi, Bluetooth, ZigBee and various other wireless networking standards currently under development, particularly those relating to Wireless Personal Area Networks (WPANs), are of primary relevance here.

õ **Addressability:** Within an Internet of Things, objects can be located and addressed via discovery, look-up or name services, and hence remotely interrogated or configured.

õ **Sensing:** Objects collect information about their surroundings with sensors, record it, forward it or react directly to it.

õ **Actuation:** Objects contain actuators to manipulate their environment (for example by converting electrical signals into mechanical movement). Such actuators can be used to remotely control real-world processes via the Internet.

õ **Embedded information processing:** Smart objects feature a processor or microcontroller, plus storage capacity. These resources can be used, for example, to process and interpret sensor information, or to give products a "memory" of how they have been used.

õ **Localization:** Smart things are aware of their physical location, or can be located. GPS or the mobile phone network are suitable technologies to achieve this, as well as ultrasound time measurements, UWB (Ultra-Wide Band), radio beacons (e.g. neighboring WLAN base stations or RFID readers with known coordinates) and optical technologies.

õ **User interfaces:** Smart objects can communicate with people in an appropriate manner (Either directly or indirectly, for example via a Smartphone). Innovative interaction paradigms are relevant here, such as tangible user interfaces, flexible polymer-based displays and voice, image or gesture recognition methods.

1.1.1 Smart Objects

A Smart Object is an object that can describe its own possible interactions.

Any object which not only has a state, which has certain data associated with a state but an object which can also determine nature of connectivity, duration of connectivity and connectivity protocol are called smart objects.

Radio Frequency Identification **(RFID)**, Bluetooth Low Energy **(BLE)**, and Near Field Communication **(NFC)** makes it possible to use our phone as readers. We can extract information from certain objects just by tapping it or bringing our device close to it. RFID tags does not have any embedded system nor does a NFC tag has. But data can still be brought to internet by reading through a reader. These are called smart objects. Non-processor entity whose data can be acquired and migrated over internet falls under these category.

Short-range low-energy sensor technology has given rise to smart objects. So say a T-Shirt comes with a smart tag. We can tap our phone over it and we get information about the quality of material, it's size, other colour variants, dye information and so on which helps us making our purchase decision. As the information is acquired, it can be passed as a search query to obtain similar results where we can compare the price-quality for similar tags.

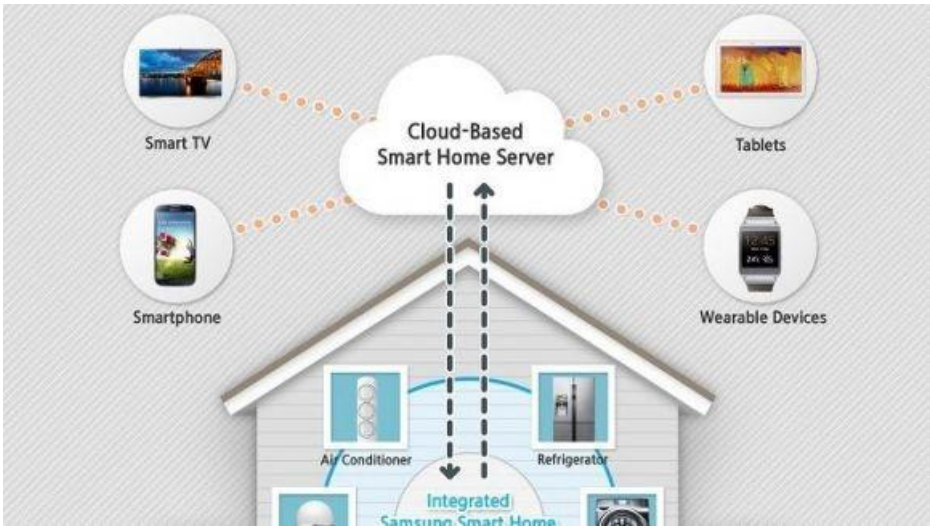


Figure 3: Smart Home System Architecture based on IoT

1.1.2 IoT Platforms

Arduino is probably the best starting point for embedded based IoT. Basic Android boards don't come with Ethernet shield and for Arduino to be able to work as IoT device, we need to select Android with Ethernet shield. Android Yun on the other hand is a board that comes ported with Ethernet shield.

Raspberry Pi is probably one of the best things to happen in DIY IoT. A wide range of Data driven applications like Home Automation Server to Home Multimedia server, File Server can be developed with Pi. PI like Arduino has general purpose IO pins. But seamless working with sensors is bit tedious in Pi.

Another efficient IoT board is Intel Edison which has integrated BLE, Wi-Fi among host of other features. It supports wide range of Industry standard hardware (over 30) through 70-pin interface. What is important is it supports wide range of platforms including Arduino and Node.js. Intel

Galileo is another good offering by Intel which supports the same shielding that of Arduino Uno. So it can be said to be first Intel powered device which is Arduino compatible. It has also a USB host controller like Raspberry Pi which makes this an attractive hardware.

There was a time when Microsoft used to dictate technologies and trends. Industries used to follow. That is no more the story. With several companies gunning for a space in wearable sector, Microsoft seems to be doing all the catching up and does not look too impressive at this moment. None the less Netduino is a .Net Micro Framework based platform where hardware is similar to Arduino. But Netduino has 12 bit ADC as against 10 bit Arduino ADC channels and uses 32 bit Controller. There are few more differences. But the reason why Arduino is a preferred over Netduino is because of its cheap price.

Figure 4: Well-known IoT platforms

1.1.3 IoT Building Blocks Emerging Everywhere

Even though only "1 percent of things are connected today," according to Joseph Bradley, general manager of Cisco Consulting Services, businesses across a variety of industries are establishing the building blocks of the IoT infrastructure. Here are a few examples:

- **Home and building automation:** Digital marketer Lauren Fisher points to the Nest Learning Thermostat, which takes data about the home environment and owners' temperature preferences and programs itself to operate efficiently within the context of that information. This technical framework provides energy providers with the connectivity to better manage the energy grid.

- **Automotive design and manufacturing:** Mobile virtual network operator Alex Brisbourne describes how the automotive industry is increasingly designing automated applications into vehicles to provide maintenance monitoring, fuel and mileage management, driver security and other capabilities that cost little to integrate but have significant earning potential. The addition of a cloud-based server to analyze the data and automatically act on it—automatically scheduling a maintenance appointment at the appropriate time, for example—would move this further in the direction of the IoT.

- **Public transportation/smart cities:** Technology writer Martyn Casserly cites the London iBus system, which "…works with information from over 8,000 buses that are fitted with GPS capabilities alongside various other sensors which relay data about the vehicle's location and current progress,"5 so bus stop signposts can display details of a bus's impending arrival.

IoT concepts have already been adopted in areas such as energy (e.g., smart lighting, smart grid) and industrial automation. According to a report in eWeek2 about a Cisco conference call with journalists, "…as more connections are made, the value to businesses and the global economy will only go up." The eWeek story describes a Cisco vision that goes beyond the IoT to IoE, or the Internet of Everything. This is what Cisco sees as a system of connections that includes not only devices, but also people, data and processes—"…essentially whatever is connected to or crosses over the Internet." Cisco expects the IoE to be worth $14.4 trillion to the global economy by 2020.

1.1.4 The Evolving World of Payments

Payments have always been about conveniently exchanging value, whether by bartering, swapping livestock, using metal coins or paper money. As commerce has gone global, payment methods have had to adapt in order to enable broader acceptance. Not so long ago, after paper money had firmly established its place as the primary mechanism of exchange for goods and services, came the idea of a global payment standard that would manifest itself through what is now known as the credit card. Soon after its inception, the credit card swiping phenomenon took off and people were using credit cards at an increasing rate. By 2017 a staggering 20 billion cards are expected to be in circulation worldwide.

As payment methods go global so do challenges with security and protecting these exchanges of value. Security standards are forced to change in order to keep up with changing payment mechanisms and, since commerce is now a global phenomenon, need to be applied around the world. The latest evolution of these standards is EMV. Originally known as the Europay, MasterCard and Visa standard, EMV is the new security blanket for merchants and consumers. At its core, EMV is designed to offer higher levels of protection against fraud. This protection comes by way of a dynamic duo that includes an embedded computer chip and a PIN. When chip-and-PIN card are broadly adopted the number of fraudulent transactions has been seen to decrease by almost 75%. With EMV enabled in 86% of cards worldwide, the US remains the final frontier for mass adoption. With the EMV mandate coming this October this is going to change.

The EMV mandate accomplishes a few things. First, it compels issuers to upgrade their customers' cards to smart cards. Second, the liability shift will provide merchants and banks alike the motivation to ensure they are equipped with payment terminals that can support EMV technology. However, with all the innovation taking place in mobile, EMV is certainly not the final frontier for payments. As payments migrate to the phone to drive further convenience and a better consumer experience, technologies like NFC are likely to see a greater level of adoption.

Payments - the exchange of value - is constantly evolving. For merchants this poses a challenge as they now need to accommodate more than just cash and plastic. To do so they will need to rethink the technology they have in store. Payments technology is often viewed as an expensive annoyance - confusing and complicated tools that cost too much and add overhead, particularly for small and medium sized businesses. Unfortunately, too often this is true.

The migration to EMV presents an opportunity for merchants to rethink the technology they use, the best way to future-proof their stores, and to ensure they aren't forced to constantly upgrade their hardware or software with every new innovative payment method. As we enter the new age of commerce centred on the experience as opposed to waiting to pay, technology will play an ever increasing role in driving efficiency and productivity within a business. Businesses that embrace the amazing tools and technology available to them will untether themselves from the traditional, payment-centred commerce experiences of the past and have the freedom to shape a unique commerce future for their customers.

1.1.5 'Internet of Things' Helping Ecommerce Merchants

The adoption of Internet of Things has grown in the retail world since December 2013. While larger companies are benefitting from this technology, many smaller merchants are not sure if it can help them.

The process of IoT becomes more useful with two-way communication, when a device senses something and then sends data. As an example, a car could alert the owner if someone is trying to break in by deploying a sensor to detect broken window. This two-way communication is the primary reason for the increased adoption of IoT.

Retailers have been using one type of sensor, radio frequency identification, or RFID, in their warehouses for monitoring inventory for several years. RFID is also used in brick-and-mortar stores for a variety of purposes like smart labelling, which can detect theft.

With costs for a single tag, or sensor, coming down to around 5 cents, more retailers are adopting these solutions in their environment. It is beneficial and makes economic sense to do so. These tags are very small, as shown in the picture below, which makes them easy to deploy. They often have adhesive backing to easily attach to labels. They typically have a small built-in battery that can last up to three years, more than sufficient for tagging a single item but also enables reuse of the tag.

Five Ways Retailers Benefit from 'Internet of Things':

- **Inventory Management:** Managing inventory is a challenge. IoT helps by deploying sensors, such as radio frequency tags, on products to track them in real-time. The tracking can be done anywhere, such as on store shelves, in a storage area, or in a warehouse. The sensors can also track the location of an entire pallet. All the data generated by the sensors can be connected to a real-time event-processing solution to monitor inventory levels, raise alerts, and automatically place orders. This can also be used by a retailer's vendors to replenish inventory by remotely monitoring the data from the sensors. This leads to greater inventory accuracy and better use of the retailer's working capital. Walmart was an early adopter of IoT for inventory management to optimize its warehouse and supply chain operations. Other large retailers are now using IoT in their supply chains too.

- **Fleet Management**: GPS devices have been used for years to track movement of delivery trucks. IoT takes this to another level by allowing rules to be defined — the delivery route, the recommended speed, adjusting the storage temperature automatically while transporting perishable items, raising alerts for any unplanned or extended stoppages, and identifying maintenance issues before the truck breaks down. This results in lowering fuel costs, reduced theft and loss, accurate lead times, and extending the life of the fleet. Customers can also use the data from the IoT devices to track their products in real-time, versus getting intermittent updates from shipping providers. UPS's fleet, for example, is now fitted with tracking devices to cut costs and improve driver efficiency.

- **Maintenance and Warranty:** Products that require post-sale service or are covered by a warranty can be tracked using IoT. This results in real-time data being sent from sensors on the products back to the retailer, which helps in identifying malfunctions or warranty issues. Additionally, this data can be used to improve the products, as retailers know how the customers use them. High-ticket items use the embedded sensors to track the product in case of a theft. General Electric is the best example of using IoT for predictive maintenance in its jet engines, turbines, and wind farms.

- **Real-time Promotions:** Mobile phones are a key part of IoT. Many retailers use them to send real-time promotions, which are typically sent based on variables like the customer's shopping history, personal preferences, location, as well as real-time weather, traffic, and special events. It is important to prioritize the promotions and send only one promotion to the customer's phone to reduce confusion. So-called Omni-channel retailers use this feature to send promotions for products in the physical store that the customer has already researched on their laptop or mobile device. Location-based tracking is also being used to offer assistance to customers who have been roaming the store.

- **Next Generation Vending Machines:** IoT has helped the vending machine industry. Now vending machine companies can communicate in real-time to monitor machines' inventory levels, enable predictive maintenance, find the nearest machine that has the product a customer wants, and also elastically price products based on factors like demand, weather patterns, and available inventory. Some vending machines are using sensors to monitor if the consumable product is spoiling and can reduce the price instantly to generate revenue before the product goes

bad. Interactive vending machines are also available that can access a customer's history and recommend the right set of products, whether it's in the vending machine, in the physical store, or available online.

1.2 Introduction: Raspberry Pi Model B+ V1.2

The Raspberry Pi is a series of credit card–sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools and developing countries The original Raspberry Pi and Raspberry Pi 2 are manufactured in several board configurations through licensed manufacturing agreements with Newark element14 (Premier Farnell), RS Components and Egoman. The hardware is the same across all manufacturers.

All Raspberry Pis include the same Video Core IV GPU, and either a single-core ARMv6compatible CPU or a newer ARMv7-compatible quad-core one (in Pi 2); and 1 GB of RAM (in Pi 2), 512 MB, or 256 MB (in older models A and A+). They have Secure Digital (SD) (models A and B) or MicroSD (models A+ and B+) sockets for boot media and persistent storage

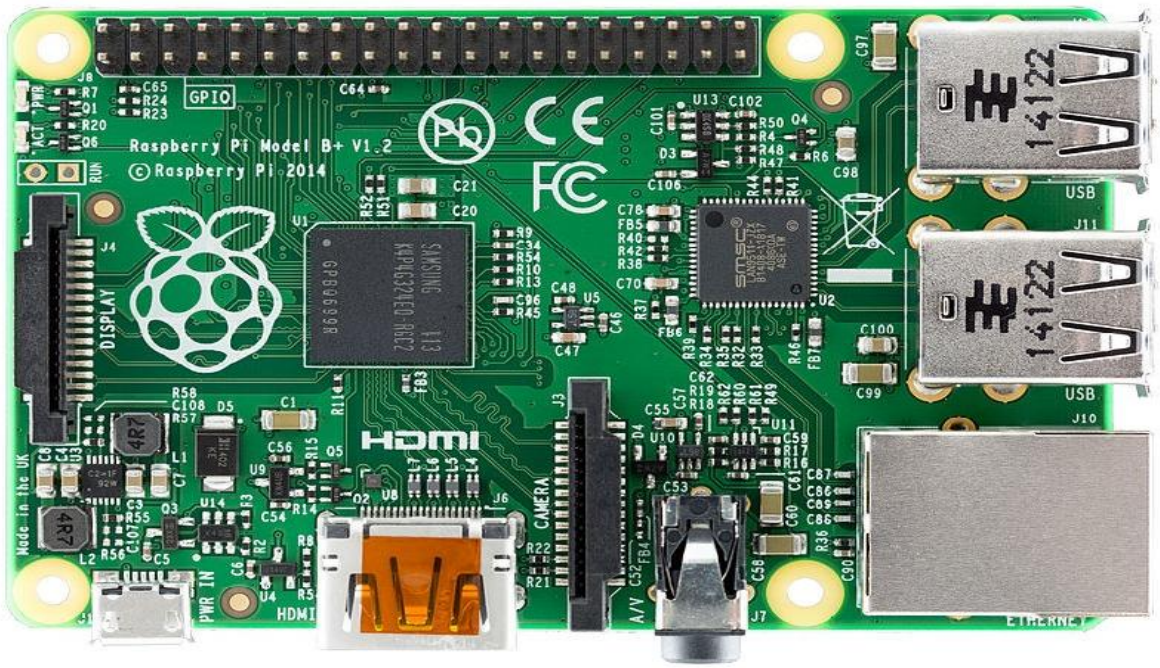


Figure 5: Outer view of Raspberry Pi

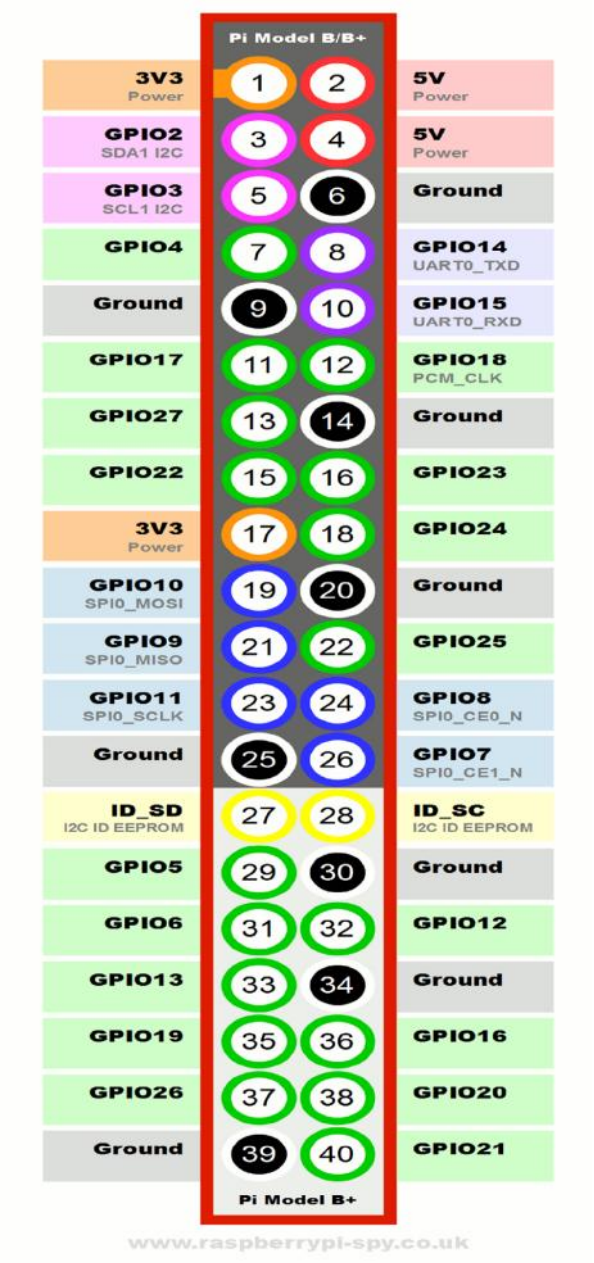


Figure 6: Pin configuration of Raspberry Pi

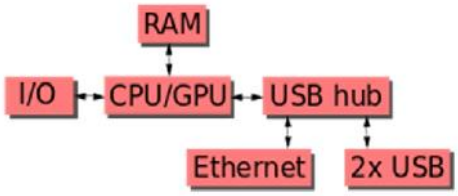
1.2.1 Physical Characteristics

- 4 USB ports, Ethernet connector, and power jack extending beyond the former dimension
- Four screw holes allow the board to be attached to a surface or case
- Reset button to reset the sketch and any attached shields
- Nicer push-push micro SD card socket.

1.2.2 Specifications

Chip	Broadcom BCM2835 SoC
Core architecture	ARM11
CPU	700 MHz Low Power ARM1176JZFS Applications Processor
GPU	Dual Core VideoCore IV® Multimedia Co-Processor Provides Open GL ES 2.0, hardware-accelerated OpenVG, and 1080p30 H.264 high-profile decode Capable of 1Gpixel/s, 1.5Gtexel/s or 24GFLOPs with texture filtering and DMA infrastructure
Memory	512MB SDRAM
Operating System	Boots from Micro SD card, running a version of the Linux operating system
Dimensions	85 x 56 x 17mm
Power	Micro USB socket 5V, 2A

1.2.3 Connectors



Ethernet	10/100 BaseT Ethernet socket
Video Output	HDMI (rev 1.3 & 1.4) Composite RCA (PAL and NTSC)
Audio Output	3.5mm jack, HDMI
USB	4 x USB 2.0 Connector
GPIO Connector	40-pin 2.54 mm (100 mil) expansion header: 2x20 strip Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines
Camera Connector	15-pin MIPI Camera Serial Interface (CSI-2)
JTAG	Not populated
Display Connector	Display Serial Interface (DSI) 15 way flat flex cable connector with two data lanes and a clock lane
Memory Card Slot	SDIO

1.2.4 Description of Key Components

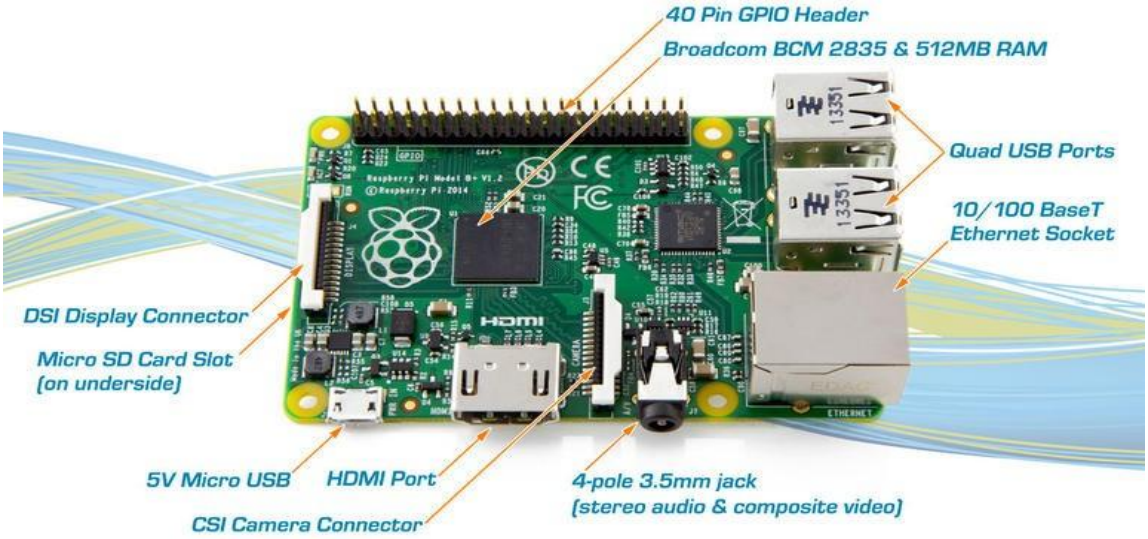


Figure 7: Detailed View of Board

1.3 PROBLEM STATEMENT

As per a research report published in the British daily The Telegraph, 'The average adult wastes a five hours and 35 minutes queuing each month, with standing in line at the supermarket taking up the biggest amount of time'. This is the equivalent of five months, two weeks and five days. In the current scenario where no one wants to wait and time is much more than money so to find out we spend six months of our life doing just that is quite shocking. One such public point where a lot of time is wasted in cities and metropolitans are the billing counters at supermarkets where after completing shopping the common people have to wait in long queues so as to get their shopped items billed.

Apart from this people today generally want a system that is highly reliable, secure, easily manageable and fast & simple to use when it comes to money based transactions at various commercial sites.

Figure 8: People waste lots of time at billing queues

With the people getting educated and more and more aware of the benefits of modern payment methods people have begun to prefer the cashless medium over the traditional cash payment method as it is hassle free, more secure and transparent.

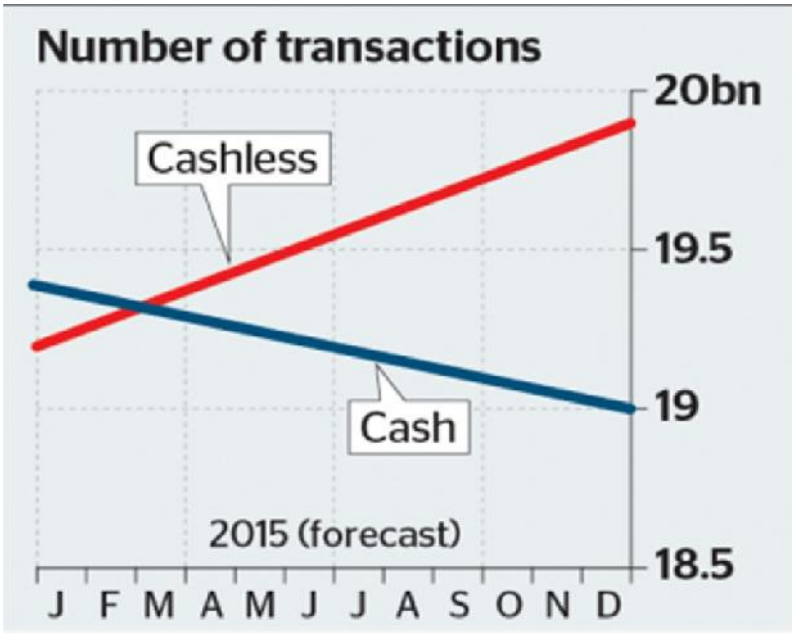


Figure 9: Graph: Cashless vs Cash based transaction trends

Moreover, in today's world everyone is busy and has no time to waste in queuing areas at key payment areas such as Bars and Food outlets. The bent towards technology has risen tremendously in the past decade and the current generation is more technology savvy, so they want to use technology wherever it can make their life comfortable and tension free. The scope of our problem is to provide a simple point of sale system which would provide the customers with a hassle free cashless payment system which would be secure and allow the customer to keep a track of all their expenses using our system and also save the time wasted in standing in queues at billing counters. At the same time it would also take care of the shopkeepers by providing them with an efficient method to keep track of all the sales and their analysis acting both as a cash register and sales manager.

1.4 OBJECTIVES

The objectives of our project work are as follows:

- Design an innovative system that saves the customers the trouble of standing in long queues for billing by providing a system embedded in shopping carts.
- Providing a secure, transparent, feasible and practical system for point of sale system.
- Providing a system that caters to the needs of both customers and shopkeepers
- A system that provides customers with the facilities like billing, expenditure analysis and record maintenance.
- A system that provides shopkeepers with facilities like inventory tracking and management, sales analysis, and order tracking.

CHAPTER 2: LITERATURE REVIEW

2.1 Title: Internet of Things in Electronic commerce

Although RFID has been around for more than a half century, it is only in recent years that this technology has been gaining significant momentum due to the convergence of lower cost and increased capabilities of RFID tags. Currently, RFID is emerging as an important technology for revolutionizing a wide range of applications, including supply chain management, retail, aircraft maintenance, anti-counterfeiting, baggage handling, and healthcare. It also heralds the emergence of inexpensive and highly effective pervasive computers that will have dramatic impacts on individuals, organizations, and societies. Many organizations are planning or have already exploited RFID in their main operations to take advantage of the potential of more automation, efficient business processes, and inventory visibility. For example, recent news shows that Wal-Mart has reduced out-of-stocks by 30 percent on average after launching its RFID program. Many predictions agree that RFID will be worth billions of dollars in new investments. According to IDTechEx, a leading market research and advisory firm, the RFID market will rocket from $2.71 billion in 2006 to $26.23 billion in 2016.

The realization of IOT has **many applications in Electronic Commerce (EC)**, and gives impetus to operation management of EC enterprises and customers' shopping. IOT codes every package with EPC code rule, and embeds this code into every package. The information of EPC code can be read by RFID technology in the logistics process, and this information can be transferred to the professing centre for enterprises and customers to inquire. Therefore, enterprises or customers can track their packages in real time, and they can discover the problem during the logistics in time so that the quality of logistics service can be improved effectively. From the beginning of manufacturing products (even raw materials are manufactured), the EPC tab is embedded into the products, and the whole procedure of production and circulation can be recorded. Customers can find the whole procedure from raw material to products, and from products to goods based on the EPC tag provided by the seller when they do shopping on Internet, and according to this information, they can decided if they buy this goods. This method can solve the problem that the information is provided only by the sellers, and customers can get the product information actively while this information cannot be changed according to the sellers' desire.

With IOT enterprises can supervise their every product in real time, and manage their logistics architecture. They not only supervise the circulation in supply chain and share information, but also analyse the information generated from every procedure and forecast. By forecasting the information from the current procedure of their products, the future trend or the probability that accident happens is estimated, remedy measures can be adopted or the warning can be given ahead. This can improve enterprises' ability of responding to the market.

Figure 10: IoT & E-Commerce

IOT can affect the whole supply chain. Firstly it can optimize the supply chain management; secondly it can make sources to be used effectively; thirdly it can make the whole supply chain to be visible so that it can improve the information of supply chain transparency; fourthly the supply chain can be managed in real time; the lastly it can make the supply chain high agility and complete integration. IOT affects the supply chain management in manufacturing link, warehousing link, transportation link and selling link. It makes enterprises even all the whole

supply change response to the varied market quickly so that the adaptability of the supply chain to market verification changes is improved.

In the manufacturing link, the automation of production line can be implemented, and the identification and tracking of materials and products can be realized, thus the cost of man discrimination can be cut greatly. After EPC technology is employed, raw materials and spares can be found out correctly through electronic tags, thus it can provide the great convenience to the manufacturing industries.

EPC technology can help managers to give out the order of replenishing the stock, and the balance of streamline and stable manufacturing can be realized. At the same time, the quality of products can be controlled and tracked. In the warehousing link, the space can be optimized. The readers at the entrance can read tags automatically when the goods are transported into the warehouse centre, and the inventory can be finished. The information of goods can be transferred, and the information of goods can be transferred into the database on the host computer. The place where goods are placed can be arranged automatically, so that the utilization ration of space can be enhanced greatly. The storage level can be checked quickly and correctly.

2.2 Title: Secure Smart Environment Using IOT based on RFID

We propose the use of IOT which uses intelligent bar codes (RFID) that can talk to a networked system to track every product that you put in your shopping cart. IOT with RFIDs can be used in shopping malls. These RFID tags will communicate with an electronic reader that will detect every item in the cart. The reader will be connected to a large network that will send information on your products to the retailer and product manufacturers. Your bank will then be notified and the amount of the bill will be deducted from your account.

- At the grocery store, you buy a carton of milk. The milk containers will have an RFID tag that stores the milk's expiration date and price. When you lift the milk from the shelf, the shelf may display the milk's specific expiration date, or the information could be wirelessly sent to your personal digital assistant or cell phone.
- As you exit the store, you pass through doors with an embedded tag reader. This reader tabulates the cost of all the items in your shopping cart and sends the grocery bill to your bank,

which deducts the amount from your account. Product manufacturers know that you've bought their product, and the store's computers know exactly how many of each product need to be reordered.

- Once you get home, you put your milk in the refrigerator, which is also equipped with a tag reader. This smart refrigerator is capable of tracking all of the groceries stored in it. It can track the foods you use and how often you restock your refrigerator, and can let you know when that milk and other foods spoil.
- Products are also tracked when they are thrown into a trash can or recycle bin. At this point, your refrigerator could add milk to your grocery list, or you could program the fridge to order these items automatically.
- Based on the products you buy, your grocery store gets to know your unique preferences. Instead of receiving generic newsletters with weekly grocery specials, you might receive one created just for you.

In order for this system to work, each product will be given a unique product number. MIT's Auto-ID Centre is working on an Electronic Product Code (EPC) identifier that could replace the UPC. Every smart label could contain 96 bits of information, including the product manufacturer, product name and a 40-bit serial number. Using this system, a smart label would communicate with a network called the Object Naming Service. This database would retrieve information about a product and then direct information to the manufacturer's computers.

PROTECTING OBECT INFORMATION SENT FROM TAG

1. Killing the Tag

The manufacturer of the items can embed C1G2 UHF Tags with a Kill Password as per the EPC global C1G2 UHF RFID Protocol standard. The tag is permanently unusable and unreadable whenever an RFID reader sends this kill password to the tag. Therefore, once a tagged item is purchased by customer, the cashier (point-of-sale) can obtain the tag's kill password from the store's EPC Information system and kill the tag permanently.

2. Locking the Tag

The manufacturer of the items can also embed C1G2 UHF Tags with a unique 32-bit value Access Password as per the EPCglobal C1G2 UHF RFID Protocol standard [3] .The tag verifies the access password sent by the RFID reader to check if it is the same as the one embedded within itself. If the access passwords tally, the tag allows the reader to perform Read, Write, and Lock operation on it. A tag's chip has four memory banks: Reserved, EPC, TID, and User.

The Reserved memory bank is used to store the kill password and access password. The reserved memory bank is permanently locked by the manufacturer; as a result the access password can neither be read nor modified by any reader. As mentioned above, most of the tags contain only its unique EPC number and all the data associated with that EPC number is stored with the EPCInformation system (EPC-IS). Access to the EPC-IS is secure, and restricted to only authorize supply chain stakeholders. Generally, the EPC memory bank is never locked, because the EPC number is used to retrieve the data associated with that item and also to retrieve its corresponding access password (from EPC-IS). Based on the above-mentioned access password and locking features available with C1G2 UHF tags, we propose the following approach, where the tag need not be killed permanently in order to protect consumer privacy. Once a tagged item is purchased by customer, the clerk at the point-of-sale can retrieve the tag's access password from the store's EPC-IS and using this access password, the clerk can lock all the memory banks of the tag including the EPC memory bank. The customer can download and store the EPC numbers and their corresponding access passwords into her mobile/smart phone. This can be made possible via the mobile RFID enabled mobile/smart phone communicating with the mobile RFID-module at the point-of-sale. With this proposed approach, the intruder can no longer get any information (including the EPC number) from the RFID tags that are in customer's possession, as all the memory banks of the tags are locked and intruder does not have the access passwords.

After purchasing the RFID tagged items from the store, the retailer terminal allows the shop manager to download and store the EPC numbers and their corresponding access passwords into the mobile RFID-enabled mobile/smart phone. Shop manager uses the Smartphone's 3G/4G/WiFi network to establish an HTTPS (Hypertext Transfer Protocol Secure) connection with the shop server, in order to send the EPC numbers and their access passwords.

Based on the EPC numbers, the shop server identifies the appropriate EPC-IS and uses the access passwords as proof of purchase, downloads the related information (product description, size, weight, manufacturing date, expiry date, directions to use, ingredients, warranty certificate, etc.)

associated with the EPC numbers. The EPC-IS must provide only the information, which is relevant to the consumer who purchased the items. Therefore, by the time shop manager has purchased tagged items, the shop server is ready with all the information about the items. After obtaining the EPC numbers from Shop managers mobile RFID-device, the shop server now needs to contact the appropriate EPC-IS to download the related information associated with the EPC numbers. As per the EPCglobal Architecture Specification, there exists an Object Naming Service (ONS), which can assist the shop server in locating the EPC-IS. The retailer at the pointof-sale gives away the access passwords to only those consumers who purchased the tagged items. The EPC-IS already has the list of EPC numbers and their corresponding access passwords therefore when the shop server sends the access passwords to the EPC-IS it proves that shop manager/shop server indeed purchased the tagged items.

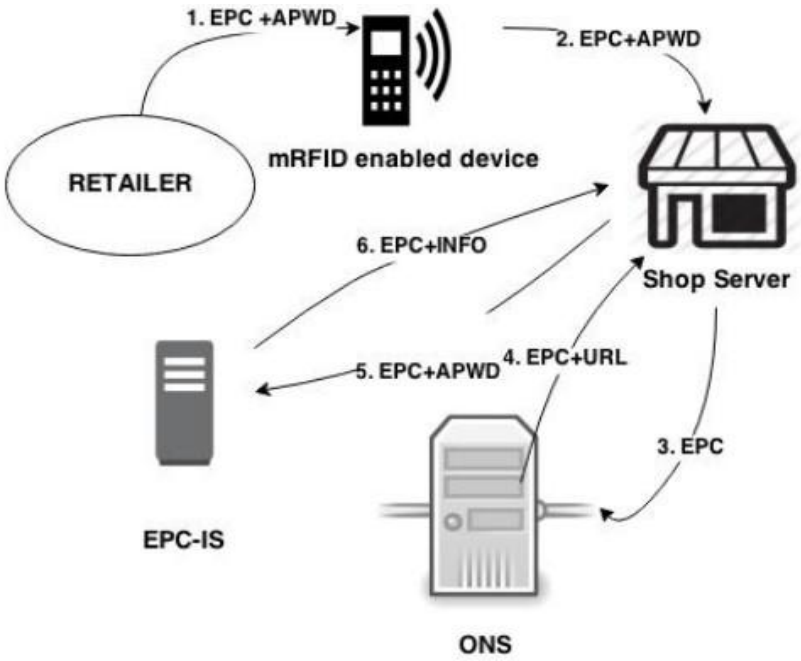


Figure 11: Secure Communication between mobile- RFID device, shop server and EPC-IS

The RFID reader in the Shop does not get any EPC numbers from the newly added items in the shop as their memory banks are all locked. In such a situation, the RFID reader communicates with the shop server and requests all the RFID tag access passwords that have been downloaded by the server (from EPC-IS) but not yet activated in the smart shop. The shop server then sends all those access to the RFID reader in the shop and the reader checks each of these passwords with every locked tag until a particular tag responds with its EPC number. With this approach a tag can

be unlocked without knowing its EPC number initially. This approach can be easily understood by looking at the Figure 4.

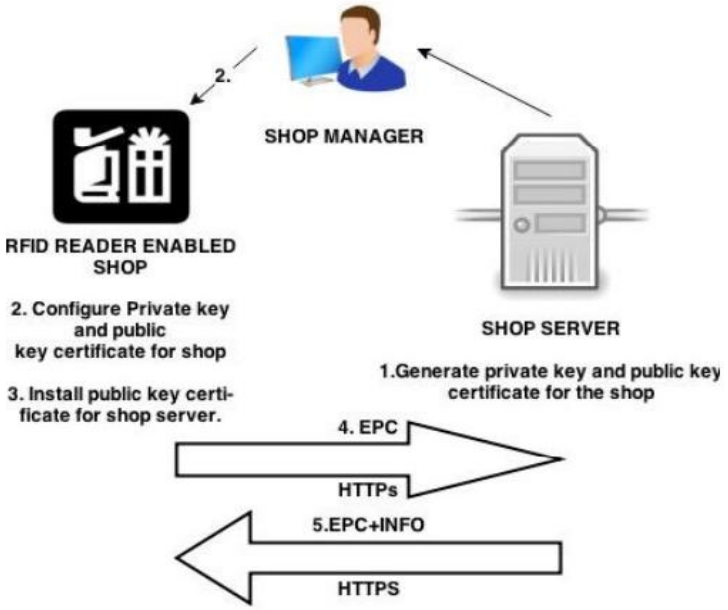


Figure 12: Secure Communication between the Shop objects and shop server.

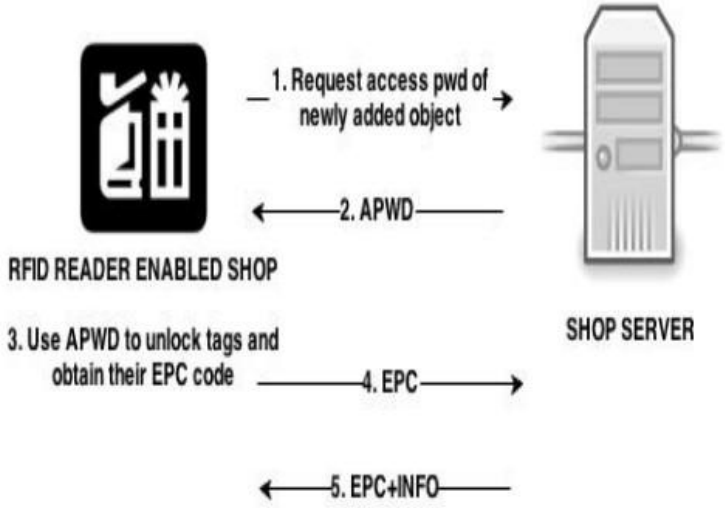


Figure 13: Unlocking RFID tags using an RFID Reader enabled Device

2.2 Title: RFID based automatic billing system

Now days purchasing and shopping at big malls is becoming a daily activity in metro cities. We can see huge rush at malls on holidays and weekends. The rush is even more when there are special offers and discount. People purchase different items and put them in trolley. After total purchase one needs to go to billing counter for payments. At the billing counter the cashier prepare the bill using bar code reader which is a time consuming process and results in long queues at billing counters. Our aim is to develop a system that can be used in shopping malls to solve the above mentioned challenge. The system will be placed in all the trolleys. It will consist of a RFID reader. All the products in the mall will be equipped with RFID tags. When a person puts any products in the trolley, its code will be detected and the price of those products will be stored in memory. As we put the products, the costs will get added to total bill. Thus the billing will be done in the trolley itself. Item name and its cost will be displayed on LCD. Also the products name and its cost can be announced using headset. At the billing Counter the total bill data will be transferred to PC by wireless RF modules.

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CHAPTER 3: SYSTEM DEVELOPMENT

3.1 Project Design

- RFID reader/writer module interfaced with the Raspberry Pi board is attached to the shopping cart.
- The system is constantly connected to shop's local network which enables the system to make entries and store and retrieve data into the database server and can be viewed directly on the web portal.
- Each product has a unique RFID tag attached with it which helps identifying the product as soon as it is put into the shopping cart.
- The cart therefore functions also as a billing counter because as soon as the product is placed into the cart an entry is made into the server with respective Cart ID into the temporary database.
- The smartphone of the customers would function as the display for the system and can be docked onto the cart.
- Once shopping is complete payment can be easily made through one-click using third party e-payment service.

Figure 14: Proposed Model

- For shopkeepers facilities like inventory monitoring, sales-analysis and sales record maintenance are a few primary features available.
- Cash invoices would be automatically sent to email of the customers email for backup.

Figure 15: System Architecture

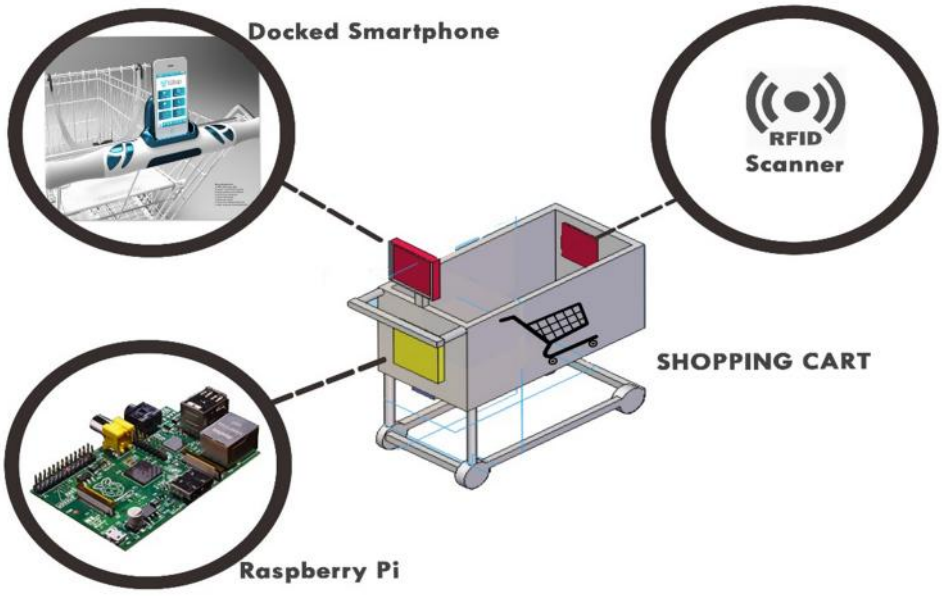

Figure 16: Cart Model Design

3.2 Hardware Requirements

The major hardware requirements required for the project are:

I. Raspberry Pi B+ V1.2
II. RFID Reader/Writer module - MFRC522
III. RFID Key Tags and Card
IV. Monitors
V. HDMI Cable
VI. HDMI to VGA converter

Sensor that we are going to use in our project is: **RFID Reader/Writer module - MFRC522**

RFID RC522

RFID is an automatic identification technology whereby digital data that is encoded in an RFID tag or "smart label" is captured by a reader using radio waves. RFID is similar to bar code technology but it uses radio waves to capture data from tags, rather than optically scanning the bar codes on a label. RFID does not require the tag or label to be seen to read its stored data which is a key factor of an RFID system. MiFare is one of the four 13.56MHz card 'protocols' (FeliCa is another well-known one)

RFID tags are integrated circuits

The tags consist of an integrated circuit (IC) attached to an antenna, usually a small coil of wires, plus some protective packaging; such as, a plastic card that is determined by the application.

EEPROM Memory

Mifare Classic cards have either 1K or 4K of EEPROM memory. Each memory block can be configured with different access conditions, with two seperate authentication keys present in each block.

Mifare Classic cards are divided into section called sectors and blocks. Each "sector" has individual access rights, and contains a fixed number of "blocks" that are controlled by these access rights. Each block contains 16 bytes, and sectors contains either 4 blocks (1K/4K cards) for a total of 64 bytes per sector, or 16 blocks (4K cards only) for a total of 256 bytes per sector. The card types are organized as follows:

- 1K Cards - 16 sectors of 4 blocks each (sectors 0..15)
- 4K Cards - 32 sectors of 4 blocks each (sectors 0..31) and 8 sectors of 16 blocks each (sectors 32..39) requirements.

Example of a New Mifare Classic 1K Card

The follow memory dump illustrates the structure of a 1K Mifare Classic Card, where the data and Sector Trailer blocks can be clearly seen:

```
[------------------------Start of Memory Dump-------------------------]
------------------------Sector 0-------------------------
Block 0  8E 02 6F 66 85 08 04 00 62 63 64 65 66 67 68 69  ?.of?...bcdefghi
Block 1  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 2  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 3  00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
------------------------Sector 1-------------------------
Block 4  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 5  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 6  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 7  00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
------------------------Sector 2-------------------------
Block 8  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 9  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 10 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 11 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
------------------------Sector 3-------------------------
Block 12 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 13 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 14 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 15 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
------------------------Sector 4-------------------------
Block 16 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 17 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 19 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
------------------------Sector 5-------------------------
Block 20 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 21 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 22 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 23 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
```

```
-----------------------Sector 6-------------------------
Block 24 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 25 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 26 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 27 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 7-------------------------
Block 28 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 29 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 30 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 31 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 8-------------------------
Block 32 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 33 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 34 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 35 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 9-------------------------
Block 36 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 37 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 38 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 39 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 10------------------------
Block 40 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 41 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 42 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 43 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 11------------------------
Block 44 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 45 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 46 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 47 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 12------------------------
Block 48 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 49 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 51 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 13------------------------
Block 52 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 53 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 54 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 55 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 14------------------------
Block 56 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 57 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 58 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 59 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
-----------------------Sector 15------------------------
Block 60 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 61 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 62 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
Block 63 00 00 00 00 00 00 FF 07 80 69 FF FF FF FF FF FF  ......ÿ.?iÿÿÿÿÿÿ
[-------------------------End of Memory Dump-------------------------]
```

Figure 17: RFID Tag data dump

An RFID reader is a radio frequency transmitter

An RFID **reader** is basically a radio frequency (RF) transmitter and receiver, controlled by a microprocessor or digital signal processor. The reader, using an attached antenna, captures data from tags then passes the data to a computer for processing.

As with tags, readers come in a wide range of sizes and offer different features. Readers can be affixed in a stationary position; for example, beside a conveyor belt in a factory or dock doors in a warehouse, portable (integrated into a mobile computer that also might be used for scanning bar codes), or even embedded in electronic equipment such as print-on-demand label printers.

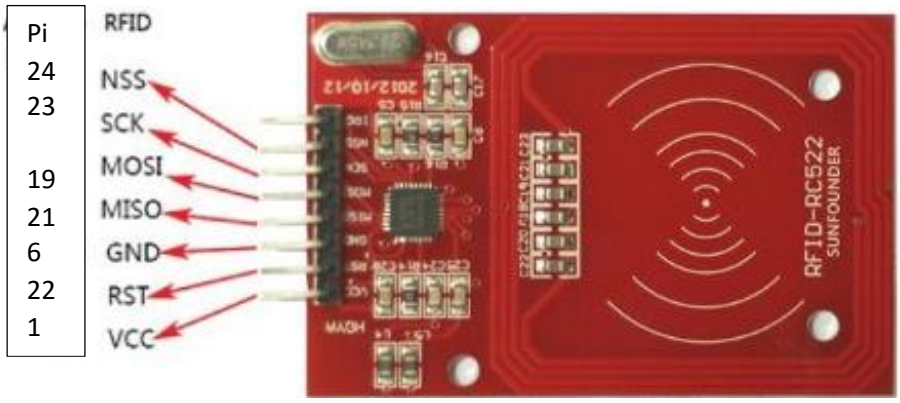

Figure 18: MFRC522 RFID

How RFID Functions

Information is sent to and read from RFID tags by a reader using radio waves. In passive systems, which are the most common, an RFID reader transmits an energy field that "wakes up" the tag and provides the power for the tag to operate.

With active systems, a battery in the tag is used to boost the effective operating range of the tag and to offer additional features over passive tags; such as, temperature sensing. All of the data is collected from tags and then passed through familiar communication interfaces (cable or wireless) to host computer systems in the same manner that data scanned from bar code labels is captured and passed to computer systems for interpretation, storage, and action.

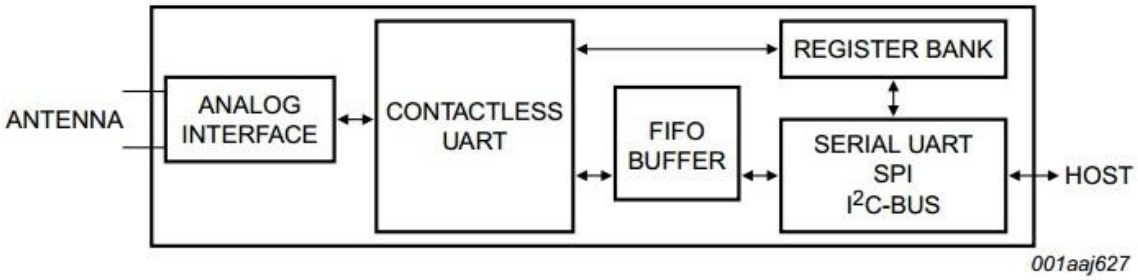

Figure 19: RFID RC22 Block Diagram

Accessing EEPROM Memory

To access the EEPROM on the cards, you need to perform the following steps:

- You must retrieve the 4-byte NUID of the card (this can sometimes be 7-bytes long as well, though rarely for Mifare Classic cards). This is required for the subsequent authentication process.
- You must authenticate the sector you wish to access according to the access rules defined in the Sector Trailer block for that sector, by passing in the appropriate 6 byte Authentication Key (ex. 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF for new cards).
- Once authentication has succeeded, and depending on the sector permissions, you can then read/write/increment/decrement the contents of the specific block. Note that you need to re-authenticate for each sector that you access, since each sector can have it's own distinct access keys and rights!

Features

- RFID systems can provide error-free, wireless data transmissions that are both battery-free and maintenance-free.
- They do not require line-of-site scanners for operations.
- The stored data can be altered during sorting or they can capture the workflow or process information.
- RFID systems can usually work effectively even in harsh environments with excessive dirt, dust, moisture, and extremes of temperatures.

- One of the components of RFID consists of tags that are electronically programmed with unique information.
- Each paper-thin tag contains an etched antenna and a microchip with a capacity of at least 64 bits.
- Tags are available in one of three types: **read-only**; **write-once, read-many** (WORM); and **read-write**.
- Tags are **read-only** if the identification is encoded at the time of manufacture and not rewritable.
- This type of tag contains nothing more than item identification.
- It can be used for items acquired after the initial implementation of RFID.
- The **WORM** tag's main advantage over a read-only tag is that information in addition to the identification number can be added; however, this information must be something that won't need to be changed.
- An example would be a library that includes information about an author or item title if the tag has enough capacity, but not a library location or circulation status.
- **Read-write** tags, are chosen by most libraries and can have information changed or added.
- For example, a library might add an identification code for each branch and that information could be changed if the holding location were subsequently changed to another branch of the library.
- In library RFID, usually part of the read-write tag is secured againave placed RFID tags on staff and patron identification cards.
- The tags can be inserted in the items by a library, a book jobber, or the publisher when the book, etc. is completed.
- Most libraries that have implemented RFID technology have done their own tagging.
- Book jobbers that provide processing services are willing to insert RFID tags at additional cost, but publishers will not do it unless there are enough bookstores and libraries are willing to pay more for books with embedded tags.
- Almost all libraries using RFID have tagged only library materials, but libraries can also tag small pieces of equipment. One academic library has dramatically reduced losses by protecting everything that is not fastened down.

- A few libraries have placed RFID tags on staff and patron identification cards. Not only does that application identify patrons for charging and discharging of library materials, but also for access to restricted areas.

Applications

- **Logistics & Supply Chain Visibility:** Winning in the supply chain means increasing efficiency, reducing errors, and improving quality. In chaotic manufacturing, shipping, and distribution environments, real-time data on the status of individual items provides insights that turn into actionable measures. With the visibility provided by RFID, you'll be on your way to Six Sigma Master Black Belt status in no time

- **Item level inventory tracking**: Tracking assets on the item level is beneficial across a broad cross-section of industries, but the retail sector has one of the highest ceilings in terms of opportunity from the use of RFID. As mentioned above, tracking items through the supply chain is wonderful, but now think about tracking items through the supply chain all the way to the point of sale. With a well-designed inventory system sharing data across all business units, you'll have a treasure trove of actionable data. One last added benefit — store employees can count inventory in a matter of minutes with a handheld RFID reader

- **Race timing**: Timing marathons and races are one of the most popular uses of RFID, but often race participants never realize they're being timed using RFID technology, and that's a testament to RFID's ability to provide a seamless consumer experience

- **Attendee Tracking**: If you've ever managed a large conference before, you'll know that it's key to keep the flow of traffic moving at a steady pace, especially in and out of seminars. With an RFID attendee solution, eliminate the need for registration lines at entrances
- **Materials Management**: In construction and other related industries, materials are often the largest project expenditure. On large job sites, simply finding materials can be problematic. RFID solutions like Jovix take the guess work out of the equation.

- **Access Control**: Certain areas require an expected level of security and access. From doors to parking lots, RFID access control tags restrict access to only those preapproved.

- **IT Asset Tracking**: IT assets such as server blades, laptops, tablets, and other peripherals are costly investments for any company, not to mention that information stored on those items could prove detrimental in the wrong hands. IT asset tags give your IT team the ability to quickly do an inventory count and make sure everything is in place.

- **Kiosks**: Many kiosks use RFID to either manage resources or interact with users. DVD rental kiosks use RFID DVD tags to make sure customers receive their selected movie rental. Other examples of RFID kiosks include interactive media displays where an embedded RFID reader interrogates badges or cards.

- **Library Systems**: An RFID library solution improves the efficiency of circulation operations. While barcodes require line of sight, RFID tags can be read from multiple angles which means the checkout and check-in process is significantly faster. Also, as noted above in the retail section, taking inventory of books on the shelf is dramatically faster

- **Laundry Management**: Large companies like casinos often manage thousands of employee uniforms. With an RFID laundry management system, operations can track which uniforms were assigned to specific employees, the age of uniforms, the number of times washed, and identify missing uniforms. RFID laundry tags provide a new level of visibility for laundry management.

- **Interactive Marketing**: RFID in marketing brings a certain level of interaction to campaigns. Whereas traditional advertising campaigns push a message onto the consumer, interactive campaigns invite the consumer to engage with the brand. Here's a list of RFID & NFC marketing examples.

3.3 Software Requirements

This project needs:

- Python 2.7.2
- Java 8
- Mechanize 0.2.5 – A python library
- Tkinter – Python based GUI library
- J2EE(JSP, JDBC)
- Apache Tomcat V7.0
- Eclipse Indigo IDE
- Bootstrap
- Raspbian OS

3.3.1 Mechanize 0.2.5

Mechanize is a very useful python module for navigating through web forms
Features include: ftp:, http: and file: URL schemes, browser history, hyperlink and HTML form support, HTTP cookies, HTTP-EQUIV and Refresh, Referer header, robots.txt, redirections, proxies, and Basic and Digest HTTP authentication.

3.3.2 Raspbian OS

Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, precompiled software bundled in a nice format for easy installation on Raspberry Pi.

3.3.2.1 Installing the Raspbian OS

The Raspberry Pi primarily uses Linux-kernel-based operating systems. The ARM11 chip at the heart of the Pi (first generation models) is based on version 6 of the ARM. The current

release of Ubuntu supports the Raspberry Pi 2, while Ubuntu, and several popular versions of Linux, do not support the older Raspberry Pi 1 that runs on the ARM11. Raspberry Pi 2 can also run the Windows 10 IoT Core operating system, while no version of the Pi can run traditional Windows. The Raspberry Pi 2 currently also supports Raspbian, OpenELEC and RISC OS. The install manager for the Raspberry Pi is NOOBS. The operating systems included with NOOBS are:

- Arch Linux ARM
- OpenELEC
- OSMC (formerly Raspbmc) and the Kodi open source digital media centre
- Pidora (Fedora Remix)
- Puppy Linux
- RISC OS – is the operating system of the first ARM-based computer.
- Raspbian (recommended for Raspberry Pi 1)– is maintained independently of the Foundation; based on the Debian ARM hard-float (armhf) architecture port originally designed for ARMv7 and later processors (with Jazelle RCT/ThumbEE and VFPv3), compiled for the more limited ARMv6 instruction set of the Raspberry Pi 1. A minimum size of 4 GB SD card is required for the Raspbian images provided by the Raspberry Pi Foundation. There is a Pi Store for exchanging programs.
- The Raspbian Server Edition is a stripped version with fewer software packages bundled as compared to the usual desktop computer oriented Raspbian.
- The Wayland display server protocol enables efficient use of the GPU for hardware accelerated GUI drawing functions. On 16 April 2014, a GUI shell for Weston called Maynard was released.
- PiBang Linux – is derived from Raspbian.
- Raspbian for Robots – is a fork of Raspbian for robotics projects with Lego, Grove, and Arduino.
- Other operating systems
- Q4os
- Xbian – using the Kodi (formerly XBMC) open source digital media center
- openSUSE

- Raspberry Pi Fedora Remix
- Slackware ARM – version 13.37 and later runs on the Raspberry Pi without modification. The 128–496 MB of available memory on the Raspberry Pi is at least twice the minimum requirement of 64 MB needed to run Slackware Linux on an ARM or i386 system. (Whereas the majority of Linux systems boot into a graphical user interface, Slackware's default user environment is the textual shell / command line interface.) The Fluxbox window manager running under the X Window System requires an additional 48 MB of RAM.

- FreeBSD and NetBSD are general operating systems.
- Plan 9 from Bell Labs and Inferno (in beta)
- Moebius – is a light ARM HF distribution based on Debian. It uses Raspbian repository, but it fits in a 128 MB SD card. It has just minimal services and its memory usage is optimized to keep a small footprint.
- OpenWrt – is primarily used on embedded devices to route network traffic.
- Kali Linux – is a Debian-derived distro designed for digital forensics and penetration testing.
- Pardus ARM – is a Debian-based operating system which is the light version of the Pardus (operating system).
- Instant WebKiosk – is an operating system for digital signage purposes (web and media views).
- Ark OS – is designed for website and email self-hosting.
- MinePeon – is a dedicated operating system for mining crypto currency.
- Kano OS
- Nard SDK – is a software development kit (SDK) for industrial embedded systems.
- Sailfish OS with Raspberry Pi 2 (due to use ARM Cortex-A7 CPU; Raspberry Pi 1 uses different ARMv6 architecture and Sailfish requires ARMv7.)
- Tiny Core Linux – a minimal Linux operating system focused on providing a base system using BusyBox and FLTK. Designed to run primarily in RAM.
- "Windows 10 IoT Core" – Microsoft offers a free edition of Windows 10, known as Windows 10 IoT Core that runs natively on the Raspberry Pi 2.

- WTware for Raspberry Pi 2 – is a free operating system for creating Windows thin client from Pi 2.
- IPFire – is a dedicated firewall/router distribution for the protection of a SOHO LAN; runs only on a Raspberry Pi 1; porting to the Raspberry Pi 2 is not planned for now.
- xv6 – is a modern reimplementation of Sixth Edition Unix OS for teaching purposes; it is ported to Raspberry Pi from MIT xv6; this xv6 port can boot from NOOBS.
- Planned operating systems
- Haiku – This open source BeOS clone has been targeted for the Raspberry Pi and several other ARM boards. Work began in 2011 on model 1, but only the model 2 will be supported.

Installation Instruction for NOOBS OS

To get started with Raspberry Pi you need an operating system. NOOBS (New Out Of the Box Software) is an easy operating system install manager for the Raspberry Pi.

Download

- Using a computer with an SD card reader, visit http://www.raspberrypi.org/downloads/.
- Click on the Download ZIP button under 'NOOBS (offline and network install)', and select a folder to save it to.
- Extract the files from the zip.

Format Your SD Card

It is best to format your SD card before copying the NOOBS files onto it. To do this:

- Visit the SD Association's website (http://www.sdcard.org/) and download SD Formatter 4.0 for either Windows or Mac.
- Follow the instructions to install the software.

- Insert your SD card into the computer or laptop's SD card reader and make a note of the drive letter allocated to it, e.g. G:/
- In SD Formatter, select the drive letter for your SD card and format it.

Drag and Drop Noobs Files

- Once your SD card has been formatted, drag all the files in the extracted NOOBS folder and drop them onto the SD card drive.
- The necessary files will then be transferred to your SD card.
- When this process has finished, safely remove the SD card and insert it into your Raspberry Pi.

First Boot

- Plug in your keyboard, mouse and monitor cables.
- Now plug in the USB power cable to your Pi.
- Your Raspberry Pi will boot, and a window will appear with a list of different operating systems that you can install. We recommend that you use Raspbian – tick the box next to Raspbian and click on Install.
- Raspbian will then run through its installation process. Note this can take a while.
- When the install process has completed, the Raspberry Pi configuration menu (raspi-config) will load. Here you are able to set the time and date for your region and enable a Raspberry Pi camera board, or even create users. You can exit this menu by using Tab on your keyboard to move to Finish.

Logging In and Accessing the Graphical User Interface

The default login for Raspbian is username pi with the password raspberry. **Note you will not see any writing appear when you type the password.** This is a security feature in Linux. To load the graphical user interface type startx.

CHAPTER 4: SIMULATION AND WORK DONE

4.1 Interfacing MFRC522 with Raspberry Pi

The base of this project work is RFID Reader/Writer module which needs to be interfaced with the Raspberry Pi B+ v1.2 board. The RFID module can be interfaced with the Raspberry Pi easily by following a few simple steps which are as follows:

Step 1: The Wiring

First and the foremost step for interfacing is the wiring of RFID with Raspberry Pi GPIO pins. The table below describes the GPIO pin mapping with Pi board.

Table 1: Raspberry Pi & MFRC522 pin mapping

Raspberry Pi B+ v1.2 Board GPIO pin	MFRC522 RFID IO pin	Meaning
1	VCC	3.3 V
6	GND	Ground
19	MOSI	GPIO10
21	MISO	GPIO9
22	RST	GPIO25
23	SCK	GPIO11
24	NSS	GPIO7
-	IRQ	Do not attach

Warning

The Pins from the MFRC522 module need to be soldered. Modules without proper soldering may not work properly or may get short circuited.

Step 2: Installation

Following commands can be run one by one on the Terminal on Raspbian.

```
# apt-get install python-dev
# apt-get install gcc
# git clone https://github.com/lthiery/SPI-Py
# cd SPI-Py
# python setup.py install
# git clone https://github.com/mxgxw/MFRC522-python
# cd MFRC522-python
```

Figure 20: Raspberry Pi interfaced with MFRC522

Step 3: Firmware modification

The latest firmware implements device tree support. That will break things like I2C, SPI, and 1-wire bus. The command `raspi-config` can be used or in Advanced Options disable Device Tree.

This is needed because else the modules cannot be loaded and the Reader would simply never work.

Step 4: Enable SPI-Device

Enable SPI device by editing file `/etc/modprobe.d/raspi-blacklist.conf` and comment the line `blacklist spi-bcm2708` so it will read as follows:

```
# blacklist spi and i2c by default (many users don’t need them)
# blacklist spi-bcm2708
blacklist i2c-bcm2708
```

Step 5: Try to fetch Data

Finally to test the work following command can be used

```
# sudo python Read.py
# sudo python Dump.py
```

Output:

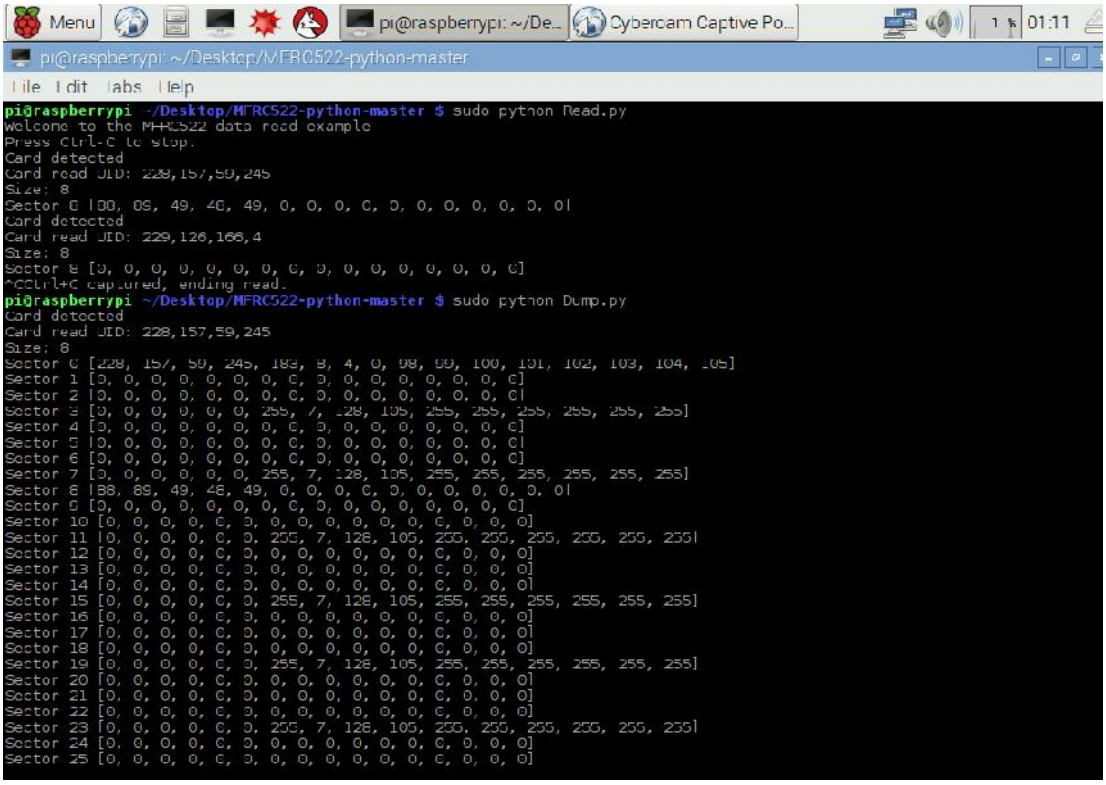

Figure 21: RFID Tag data dump

4.2 Sending data to the server

```
import  mechanize,sys
import urllib, urllib2
def sender(cartid,page):
```

```
br = mechanize.Browser()
#page ='http://192.168.137.1:8082/Test/hidden.html'
try:
    br.open(page)
    forms = br.forms()
    print 'Forms:'

    for form in forms:
        print 'form', form
# Force try using the expected form
        br.select_form(name="biller")
        br["pid"] = "XY123"
        br["name"] = "Joey"
        br["price"] = "136.76"
        br["cartid"] = cartid
        response = br.submit()
        content = response.get_data()
        br.close()

except urllib2.HTTPError, e:
    sys.exit("%d: %s" % (e.code, e.msg))
except IOError, e:
    print e
except:
    pass
```

The above python code has been used to send data collected from RFID Tags attached to the products placed in the shopping cart through the Raspberry Pi onto the database server through the network to which the board is connected. The above code uses functionalities from a python library Mechanize which is used to communicate with websites on the network. A hidden web page has been added in the web portal system which is being accessed through the above code. On this hidden web page `hidden.html` a form named ‘biller’ is being accessed and data from the RFID tags is placed into the form fields and the form is submitted. This invokes the backend system and adds the product data into the database.

4.3 Database Schema Design

1. BILLSMART_USERS: Database table that stores the credentials of all the system users.

Column Name	Data Type	Nullable	Default	Primary Key
EMAIL	VARCHAR2(4000)	No	-	1
NAME	VARCHAR2(4000)	Yes	-	-
UNAME	VARCHAR2(4000)	Yes	-	-
C_TYPE	VARCHAR2(4000)	Yes	-	-
PASSWORD	VARCHAR2(4000)	No	-	-
LASTLOG	VARCHAR2(4000)	No	-	-

Figure 22: Database Schema: BILLSMART_USERS

2. TRANSACTION: Database table that stores transaction data for analysis.

Column Name	Data Type	Nullable	Default	Primary Key
PRODUCT_ID	VARCHAR2(4000)	Yes	-	-
CUSTOMER_EMAIL	VARCHAR2(4000)	Yes	-	-
SHOPKEEPER_EMAIL	VARCHAR2(4000)	Yes	-	-
PRODUCT_DETAILS	VARCHAR2(4000)	Yes	-	-
QUANTITY	NUMBER	Yes	-	-
PRICE	NUMBER	Yes	-	-
DATEOFTRANSACTION	TIMESTAMP(6)	Yes	-	-

Figure 23: Database Schema: TRANSACTION

3. RECORDS: Backup database table for keeping track of all transactions and bills.

Column Name	Data Type	Nullable	Default	Primary Key
PID	VARCHAR2(4000)	No	-	1
NAME	VARCHAR2(4000)	Yes	-	-
PRICE	NUMBER	Yes	-	-
PURCHASE_DATE	VARCHAR2(4000)	No	-	-
EMAIL	VARCHAR2(4000)	No	-	-

Figure 24: Database Schema: RECORDS

4. PSEUDO: Live transaction database for managing incoming and outgoing records while the system is carrying out transactions.

Column Name	Data Type	Nullable	Default	Primary Key
PID	VARCHAR2(4000)	Yes	-	-
NAME	VARCHAR2(4000)	Yes	-	-
PRICE	NUMBER	Yes	-	-
CART_ID	VARCHAR2(4000)	Yes	-	-

Figure 25: Database Schema: PSEUDO

4.4 Web Portal Design and implementation

1. Login.html

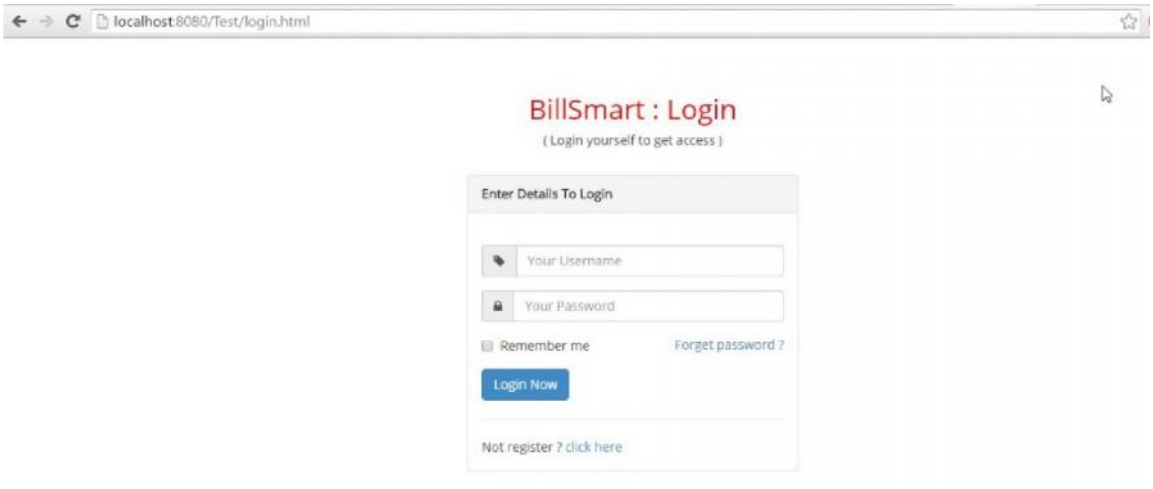

Figure 26: Login.html

2. Index.jsp

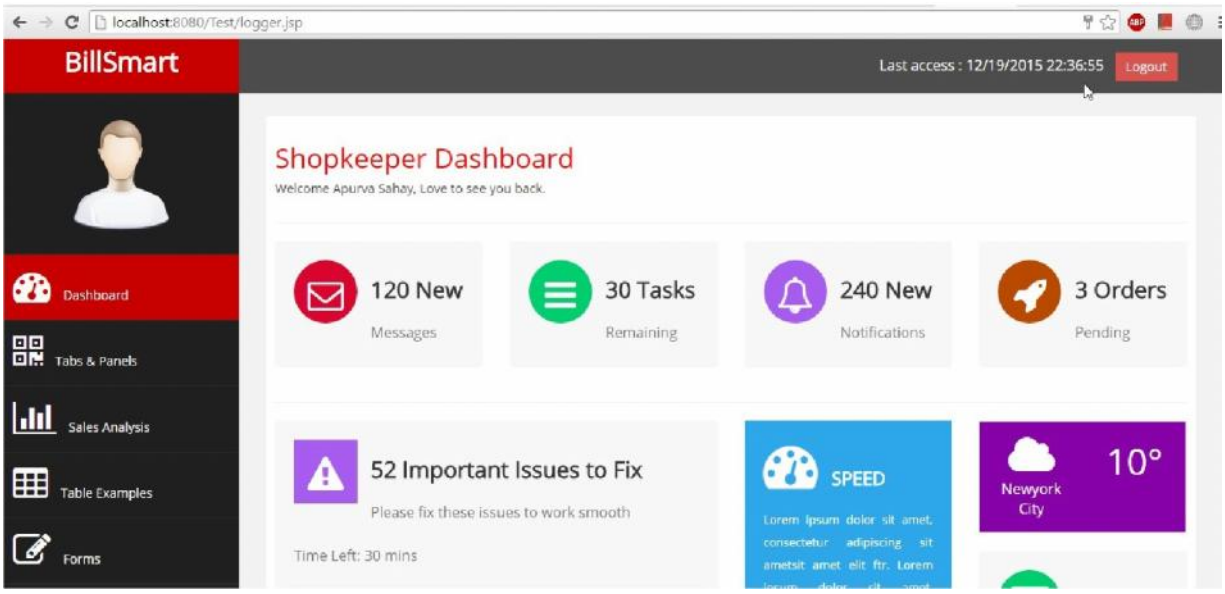

Figure 27: User Dashboard

3. Charts.jsp

Figure 28: Sales Analysis

3. Registration.jsp

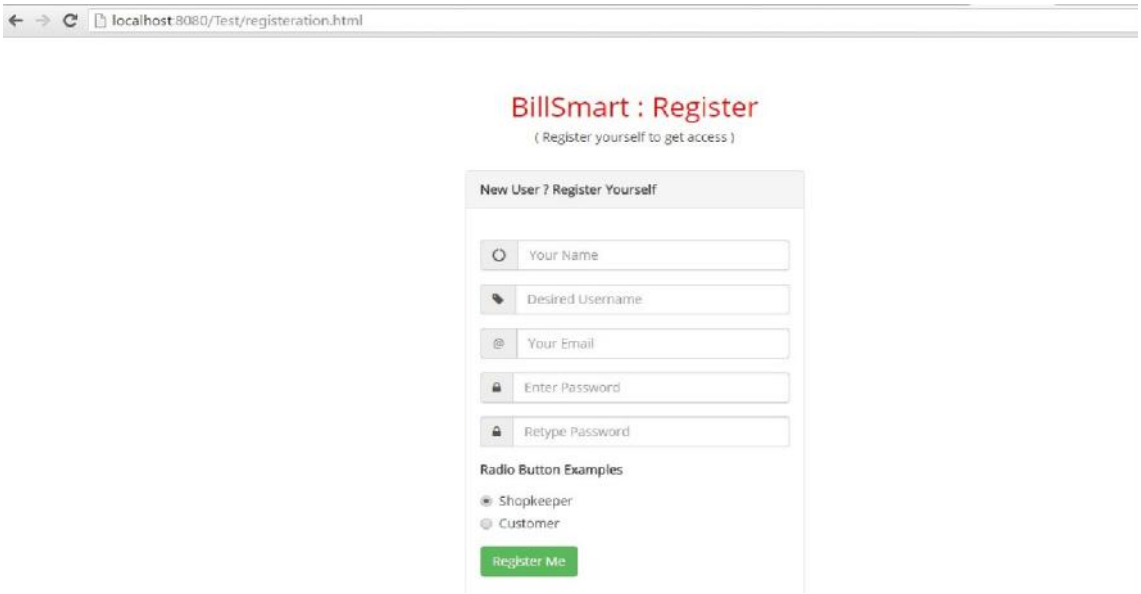

Figure 29: Registration page

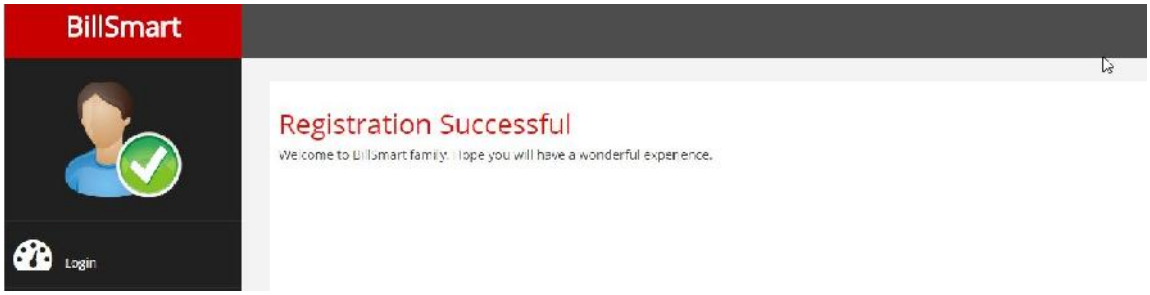

Figure 30: Registration success page

3. Billing.jsp

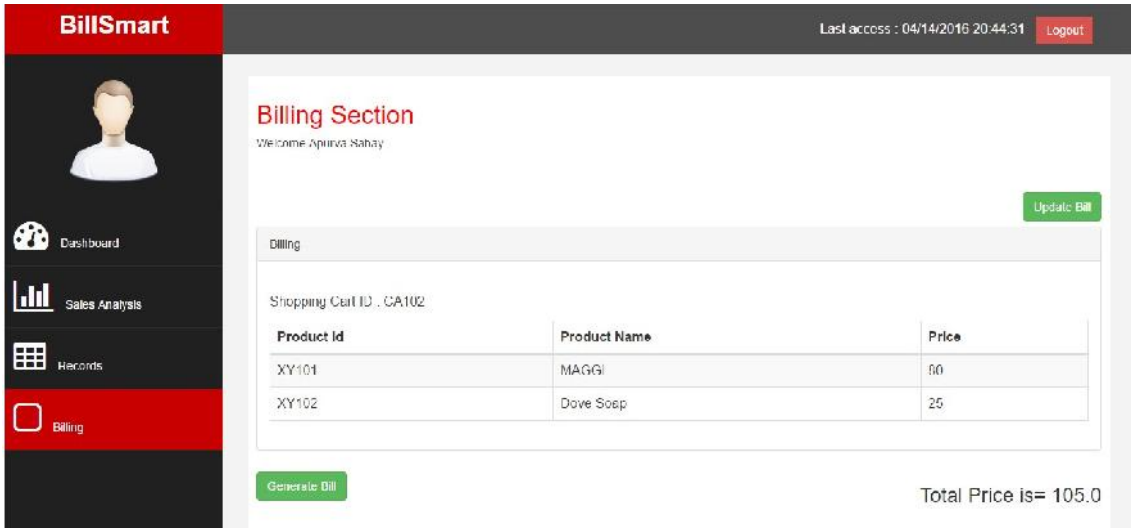

Figure 31: Billing Page

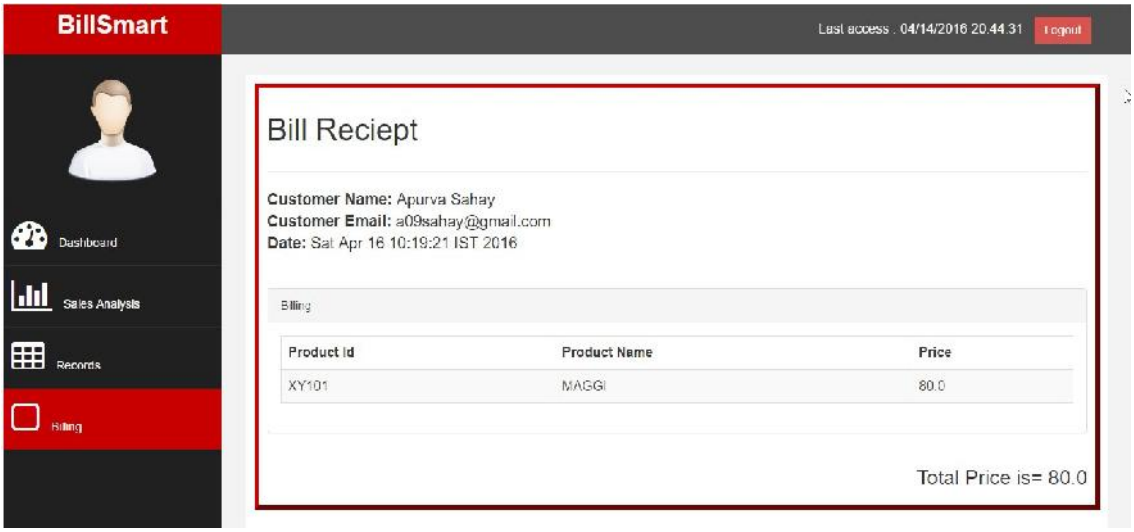

Figure 32: Bill Receipt

4.5 Final Prototype Design & Implementation

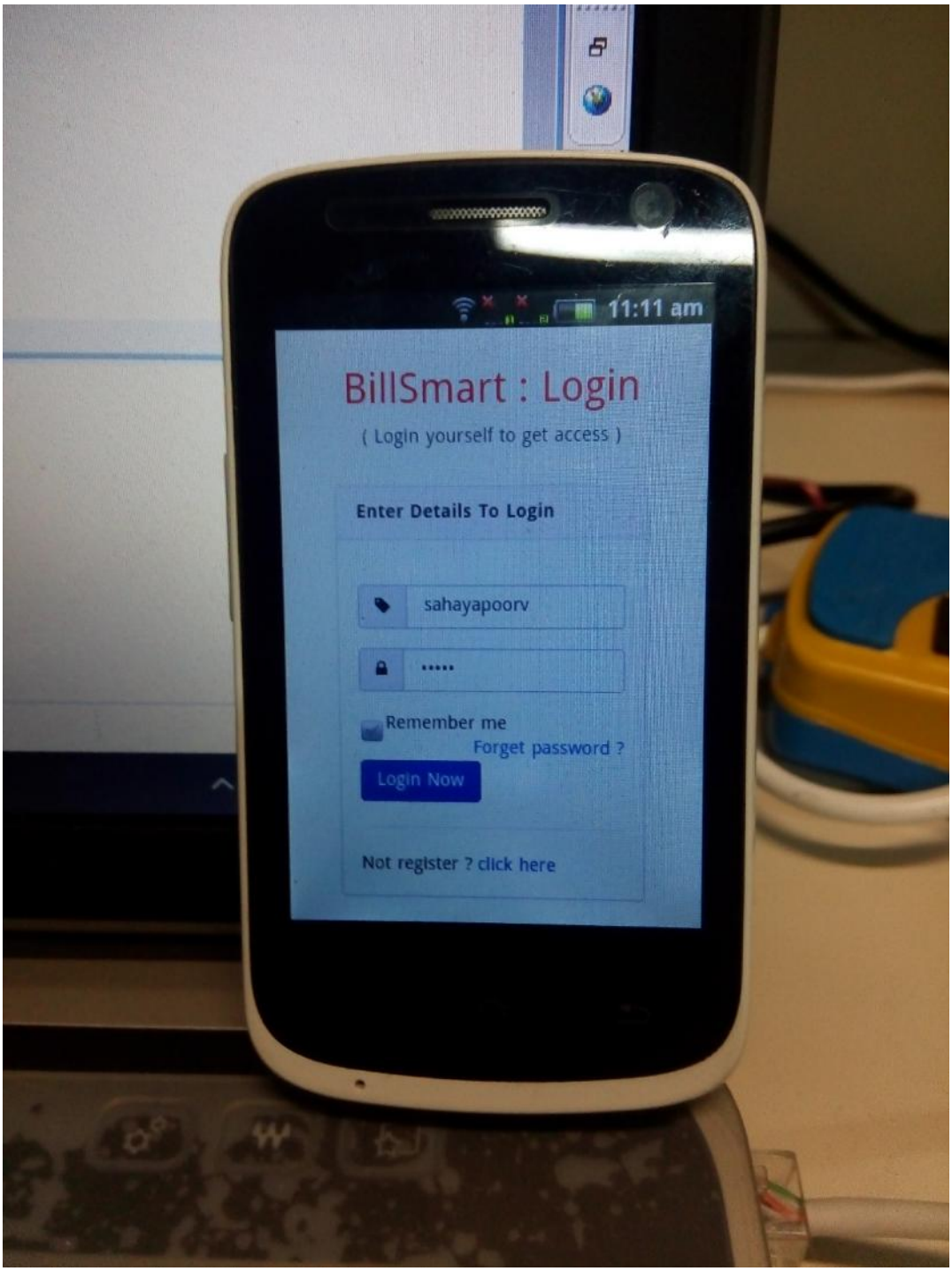

Figure 33: BillSmart System on Smartphone

Figure 34: BillSmart System Prototype – View 1

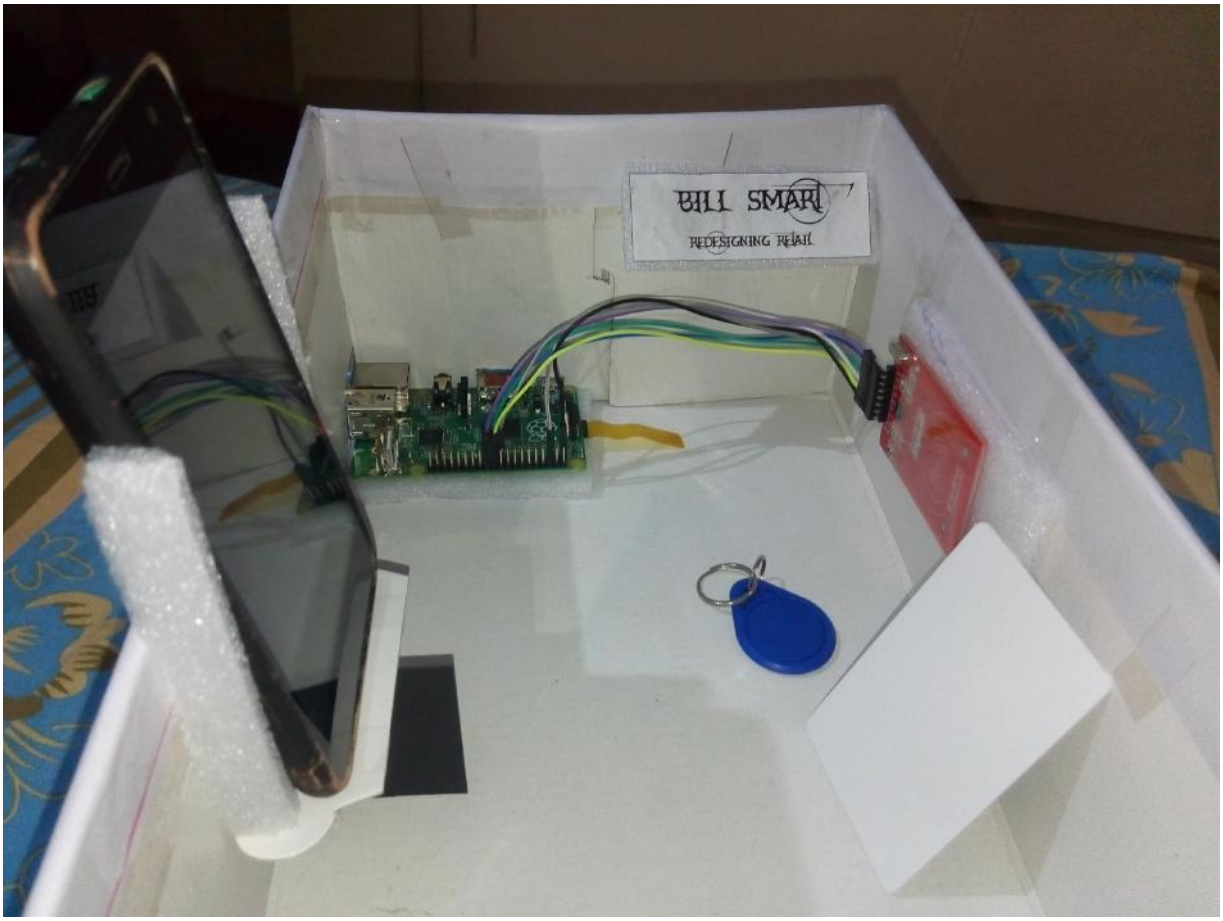

Figure 35: BillSmart System Prototype – View 2

CHAPTER 5: CONCLUSION AND FUTURE WORK

5.1 CONCLUSION

The prototype for the solution we have proposed has been designed and implemented successfully. We have tried to include solutions to each and every problem that has been mentioned in the problem statement. The system prototype is a model of a shopping cart which has a Raspberry Pi B+ v1.2 board interfaced with an MFRC522 RFID Reader/Writer module attached to it enabling the customer to get the items to be purchased directly billed from the shopping cart instead of standing in long queues at billing counters.

The data is directly uploaded to the server and thereby stored into the database as the Raspberry Pi on each cart is connected to the shop network. Since the data is viewable on the website, both the customers and shopkeepers can check records of their e-transactions and also get an analysis of their transactions. The final project is also well equipped with the features like basic sales & inventory management to the shopkeeper and billing record maintenance for the customers (anytime & anywhere). The model is just a prototype so it has been tested for functional flaws and bugs only up to a basic level. We also plan to do an in-house alpha testing and if possible beta testing in real time scenario with a sample set of users.

5.2 FUTURE WORK

The future scope of this smart billing and retail system will be determined by ideas and development that call for the seamless inter-working of mediums. The future of smart retail & billing will be rooted in how marketers and platforms create ways for new and traditional media to play together.

The future scope of our project is as follows:

- Establish a direct relation with the customer by directly interacting with the user by providing personalized offers and deals and by maintaining his/her regular preferences.

- Develop an Android application for the complete system & integrating an expense manager into it.

- Provide customers in store with an interactive mapping of products in the store.

- Display customized ads on customers smart devices based on their previous purchases & interests.

REFERENCES

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[3] Research on Application of Internet of Things in Ecommerce, Guicheng Shen & Bingwu Liu: School of Information, Beijing Wuzi University, Beijing, China, 2010 Third International Symposium on Electronic Commerce and Security.

[4] P. Bhatwal and O. Chamoli, "Automated Self-Billing System Using RFID Technology(ISSN 2278-6856)", International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Mumbai, 2015

Web Links:

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[3] https://dl.acm.org
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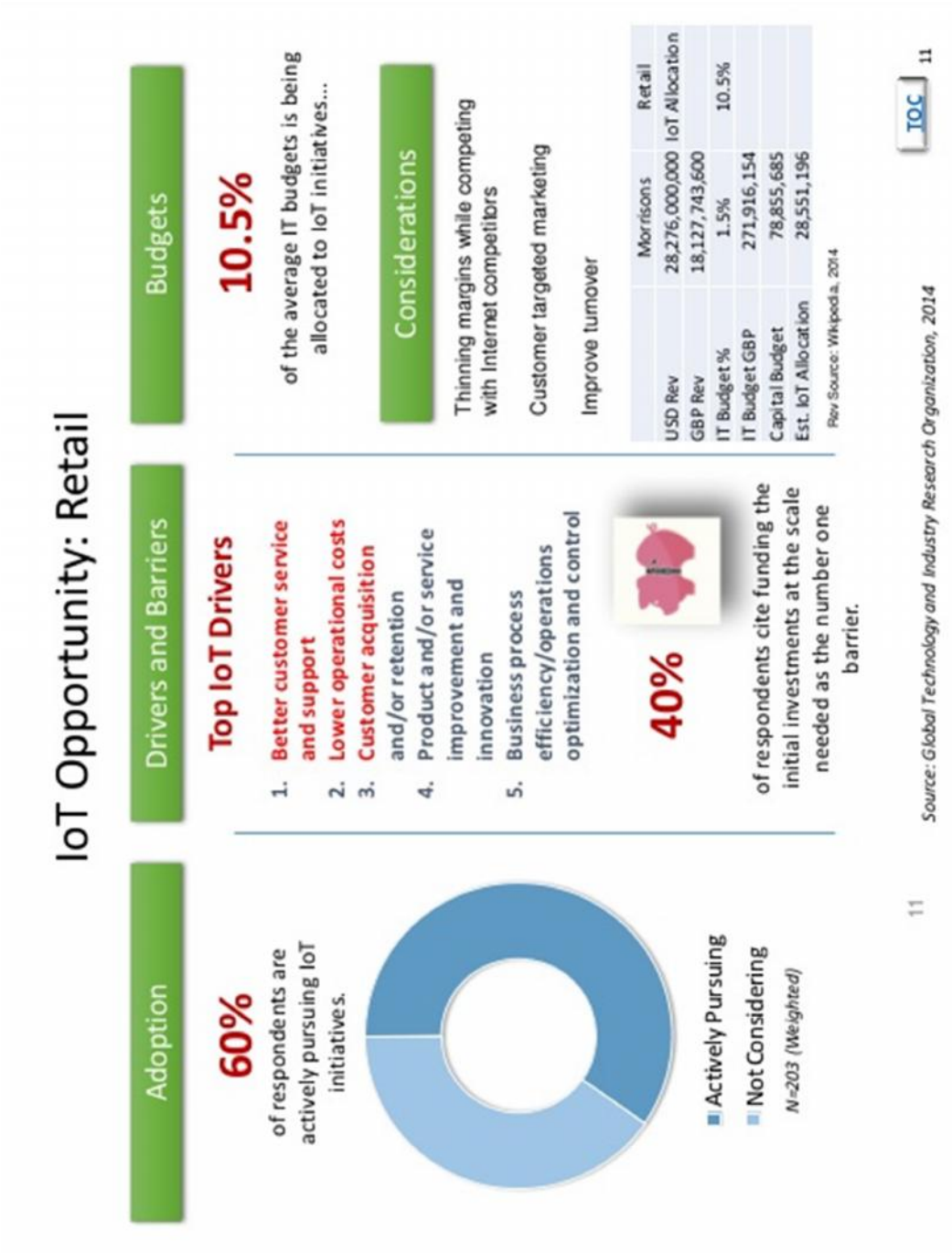
APPENDICES


IoT Opportunity: Retail
Adoption
60%
of respondents are actively pursuing IoT initiatives.
Actively Pursuing
Not Considering
N=203 (Weighted)
Drivers and Barriers
Top IoT Drivers
1. Better customer service and support
2. Lower operational costs
3. Customer acquisition and/or retention
4. Product and/or service improvement and innovation
5. Business process efficiency/operations optimization and control
40%
of respondents cite funding the initial investments at the scale needed as the number one barrier.
Budgets
10.5%
of the average IT budgets is being allocated to IoT initiatives...
Considerations
Thinning margins while competing with Internet competitors
Customer targeted marketing
Improve turnover
Morrisons Retail
USD Rev 28,276,000,000 IoT Allocation
GBP Rev 18,127,743,600
IT Budget % 1.5% 10.5%
IT Budget GBP 271,916,154
Capital Budget 78,855,685
Est. IoT Allocation 28,551,196
Rev Source: Wikipedia, 2014
11
Source: Global Technology and Industry Research Organization, 2014
TOC
11

The Internet of Things IN RETAIL

The opportunity for IoT in retail is huge, and **getting started with a quick, high-value project is easier than you think.**

IoT is more than just the "Things" of connected devices, products or sensors. IoT can connect systems, providing unified visibility, real-time decisions, and deeper insights into customers, competition, product portfolio and performance.

BY THE NUMBERS

56% of smartphone users plan to use their device while shopping
ACCENTURE

85% of shoppers prefer personalized offers reflecting their past shopping behavior
SYNQUERA

54% use or would like to use digital touchscreens in-store
CISCO

61% would visit and do more shopping in a store with beacon marketing campaigns
SWIRL

RETAILER BENEFITS

CARREFOUR'S BEACON-BASED MARKETING
600% new users
400% more time spent in app
+50% conversion rates

URBAN OUTFITTERS IN-STORE PUSH MESSAGING
60–70% engagement rate

KALYPSO + ThingWorx

Quick wins are **easy to find.**
DON'T DO NOTHING

The technology is here now to create an incredible shopping experience for your customer and build huge value for retailers.


MOBILITY IN RETAIL
CONSUMER-LED REVOLUTION
DEVICES AND DATA
RETAILERS' CAPABILITIES
SHOPPING BECOMES AN OMNI-CHANNEL ACTIVITY
The new age consumer shop across channels using the latest technology
94%
BUY
Online
Store
70%
59%
Mobile
RETAILERS GO DIGITAL
59%
of retailers rated mobile optimization of apps as the topmost improvement area in their current enterprise systems
STORES' Top 100
70%
70% of retailers in STORES' Top 100 Retailers list and 47% of brands in the Hot 100 list offer branded mobile apps for customers
Hot 100
47%
IN-STORE CUSTOMER MOBILITY