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DESIGN AND CONSTRUCTION OF A LOW COST LUGGAGE DETECTOR USING RADIO FREQUENCY IDENTIFICATION (RFID)

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Abstract:- *Luggage detector RFID based system relates an RFID signalover a distance by acting as the bridge between the RFID tag and reader specifically using 125KHzfrequency. The project concerns mainly on the security of passenger luggage. The system is comprised of the RFID passive tag and a reader module, SIM 900A, LCD, PIC16F877A microcontroller. The RFID reader reads the tag data and transmits it serially to microcontroller which in turn transmit the unique tag ID to the LCD display, it also sends the tag details to the administrator and an sms to the passenger about the luggage position*
General Terms*:RFID, Luggage Tracker*

Keywords*:Microcontroller, SIM900a (GSM module), EM 18 (RFID reader module), MYSQL, Visual Basic*

1. INTRODUCTION

The airline needs to maintain high levels of flexibility to face new challenges from competitors around the world, and to identify and create new services to improve customer satisfaction and reduce costs. The increase in passenger and baggage volumes, plus the development of global alliances and dual transfer flights, all create big challenges for airlines and airports. This is especially true for an airline handling over 2 billion passengers per year.This puts an extra load on the existing baggage handling system, which relies on an aging Barcode system. The airline, therefore, requires a highly efficient method to handle the increasing passengers and baggage volumes, and RFID technology has drawn the attention of the airline. RFID (Radio Frequency Identification) is a means of identifying a person or object using a radio frequency transmission. Communication takes place between a reader (interrogator) and a transponder (silicon chip connected to an antenna). This technology is used to identify, track, sort, or detect a wide variety of objects. RFID technology has received considerable
attention and is considered to be the next wave of the IT revolution. RFID can allow any tagged item to be mobile and intelligent and to communicate with an organization's overall information infrastructure. As a result in the increase in number of airline users, many initiatives have been undertaken to enhance service delivery and customers' satisfaction. One of them is implementation of RFID luggage identification and tracking system in airports. The system is still facing some challenges as it does not involve the passenger in the luggage tracking. Consequently, an efficient luggage handling system is required. The currently used luggage handling system causes a large number of mishandled bags. Mishandled luggage generates losses to the passenger and to the airline. RFID implementation in airports becomes very useful since it enhances the ability of luggage tracking, and increases customer's satisfaction. This technology replaces the traditional barcode system as it overcomes certain limitations found in barcode applications. Because it is not an optical technology like bar coding, no inherent line of sight is required between the reader and the tagged RFID objects. In addition, RFID transmits data wirelessly and is a read/write technology, so it can update or change the data encoded in the tag during the tracking cycle. This project seeks to develop an intelligent RFID luggage tracking system that will interactively involve the customer in the tracking process thus making baggage handling easier and faster as it would reduce the passenger waiting time when a mishandling
error occurs. It will also involve the customer in the tracking process.

1.1 Statement of Problem

Recent trend in engineering shows that the world is gradually moving from analogue system to digital/automated system. These digital systems make way for more complicated design. These achievements are sustained by simultaneous development of electronic approach to processes that were purely mechanical, despite this development and advancement, it was obvious that in Nigeria, the advancement has not been properly appreciated. Due to this reason it then explains why an undergraduate in engineering is concerned with the current trend of luggage tracking in Nigeria and its limitations. In Nigeria, there are lot of complaints to the administrators concerning loss and large number of mishandled luggage. The mishandling and loss could be omissions in the system that can be human error, malfunctioning in the automated systems as luggage moves from check in to the aircraft and they increase on daily basis. Connecting flights with short connection time and numerous flight being involvedin the process can lead to luggage loss [1]. However, theluggage tracking system based on RFID technology is proposed concerning the Nigerian airports,

improving luggage handling, reducing luggage loss and enhancing customer satisfaction. This RFID system can keep tracks of luggage's as they move from point to point they by reduce loss to Nigerian airline companies and enhance customer satisfaction.

1.2 Objective of the Paper

The objective of this paper is to design and develop RFID based luggage detector system which utilizes the usage of RFID technology to replace the bar code system in order to improve the mishandling of luggage and losses in our Nigerian airports, and as well involve customers (passengers) in the tracking process to improve customer satisfaction.

1.3 Scope of Paper

This paper is aimed at design, simulation and construction of an RFID reader and Tag which is the hardware part of the work. The reader should be able to read the tag and send information to the administrator concerning the luggage. Little database of the customer luggage is needed. The RFID reader and tag are the input devices, while the control system using PIC16F877A microcontroller, a GSM module and the 2x16 LCD display is chosen as output.

1.4 Significance of the Paper

This paper targets to eliminate all or most of the problems associated with mishandling and loss of luggage in the Nigerian
airport to improve confidence and convenience of the airline administrators. It is significant in the Nigerian airport today as it seek to reduce the passenger waiting time when a mishandling error occurs. Minimizes big losses generated by airline companies from mishandled and loss luggage's and very useful since it increases customer's satisfaction

II. LITERATURE REVIEW

RFID stands for Radio Frequency Identification. Quite simply it describes the method by which a subject can identify itself, on request, by the transmission of identification information through the medium of radio waves [8]. The subject can be either Animate: such as Humans, Dogs or farm animals etc., OR Inanimate: packaged foods, cars, or consumer goods

2.1 History of RFID and Adoption

RFID was first discovered and used in the Second World War to allow the British to differentiate between friendly and enemy airplanes [9]. The British warplanes were fitted with a transponder that woke up when a British Radar signal was detected and then transmitted a friendly signal back towards the source, indicating that the plane was friendly. Though invented in wartime, in more peaceful times RFID research and development has been driven forward by the promises of significant cost reduction and a multitude of exciting value added services [9]. In its early commercial manifestations each item to be tagged had a small electronic assembly (a transponder) fitted to it that would respond with a burst of radio frequency (RF) carrier modulated identification data when interrogated by a RF signal (on a different frequency) from either a hand-held scanner/reader, or one mounted, say, in a doorway. This burst of identifying data was intercepted by the scanner, decoded and used to both identify the tagged item and for it to be counted. The early RFID tagging means were battery powered (so called active devices). These were not only costly, but also relatively bulky. Since then RFID use, and potential, has greatly increased in large part due to the unit cost, size and power needs, of the essential 'tag' having decreased by many orders [12].

2.1.1 RFID Technology Advantages over Barcode.

In many applications RFID tags replace barcodes, which have proven excellent for tracking products through checkpoints for more than forty years (i.e. at the point of sale on the way out of the supermarket for instance) [5]. Curtin J. et al (2007) said compared to barcode inventory control systems RFID technology has significant advantages, many of which are outside of product manufacture and distribution chain applications. Some of these include [3]

- Not requiring line of sight access to be read.
- The tag can trigger security alarm systems if removed from its correct location.
- Scanner/reader and RFID tag are not (so) orientation sensitive.
- Automatic scanning and data logging is possible without Operator intervention.
- Each tag can hold more than just a unique product code.
- Each item can be individually 'labelled'.
- Tag data can be comprehensive, unique in parts/common in parts, and is compatible with data processing.
- With the right technology a plurality of tags can be concurrently read
- It can be read only or read-write.
- There is a very high level of data integrity (character check sum encoding).
- Provides a high degree of security and product authentication; a tag is more difficult to counterfeit than a barcode.
- The supporting data infrastructure can allow data retrieval and product tracking anywhere provided the scanner/reader is close enough to the tag.
- Combined with its authentication is the ability to monitor shelf life, a societal advantage in the pharmaceutical and food industry.
- Since each tag can be unique they can act as a security feature if lost or stolen e.g. a stolen smart travel card can be cancelled.

- The technology is rugged and can be used in hostile environments such as down oil wells (heat and pressure) to carry data to remote equipment.
- The technology lends itself to being updated, for example, as a car goes through its life its service record can be electronically logged with the car.
- The technology could be adapted to a range of circumstances for instance, a chip could be inserted within a suit so that when it is sent to the cleaners it automatically gets the right cleaning procedure applied to it.
- The technology can be used to increase security for instance monitoring if a child leaves a school in an unauthorized manner.

2.1.2 Applications.

The applications for RFID tags are numerous and some of the most innovative and successful may yet to be identified. However, initially the applications fall into the following sub divisions [6].

- Manufacturing
- Supply Chain Management
- Security Access & Control
- Asset Tracking
- Payment

2.1.2.1 Manufacturing.

Within the manufacturing environment RFID tags have been used for the past decade to greatly improve operating efficiencies. Individual parts can be monitored as they pass through the process and throughput times calculated. In this way bottlenecks can be discovered and inventory buildupsidentified. RFID also allows for easier tracking of parts usage and re-ordering of components can be timed to minimise the costs of holding unnecessary inventory. Therefore providing support for manufacturing processes. Supply Chain Management a bid to boost efficiencies and reduce costs, companies are seeking to employ RFID to further streamline their operations. The large supermarket chains, such as Walmart, are at the forefront of this development. The reasoning is that a deeper knowledge of where exactly products are in the supply chain should help the company to identify areas where unnecessary costs or inefficiencies are occurring that could impact the companies costs and thereby their profit margins. For example, real-time knowledge of which products are selling well on the shop floor can easily be linked to the companies ordering system placing up-to-the minute demand data in the hands of the supplier.

2.1.2.2 Security Access & Control.

RFID tags have been used for some time to replace swipe cards in gaining access to restricted access areas of buildings i.e. entry doors to a commercially
sensitive area of an R &D company for example. However, more recently RFID has been touted as a possible replacement to the information contained in paper passports. Electronic passports could carry personal data about the individual such as fingerprints and other biometric data as well as any convictions that person may have received.

2.1.2.3 Asset Tracking.

RFID tags can be used to track the location of all kinds of physical assets from cars to library books. The principle purpose behind this application is the desire to know the whereabouts of an asset whenever the information is required. In a library for instance a misplaced book could be lost indefinitely causing lost revenue in rentals and perhaps even unnecessary replacement. As a proportion of revenue, this can cost Libraries a small fortune. However, with the advent of low cost RFID tags in books a systematic sweep of the library with a suitable reader should determine the exact locations of all of the
books and those that were misplaced could be easily identified. Likewise, RFID tags can be deployed to track stolen goods suchas cars [4].

2.1.2.4 Payment Systems.

There are many areas where the time taken to receive payment for goods or services can be a major bottleneck in the process and cause major delays and queuing. Two examples of this would be road toll payments and at the supermarket checkout. In these areas RFID can offer significant reductions in the bottleneck, reducing queuing times andthereby improving efficiency. RFID tags in cars allow the driverto drive straight through the toll crossing without slowing down, knowing that the payment with be automatically deducted. At the supermarket if all the items in the basket have RFID tags
the user can simply push the trolley through a reader, which will scan the goods, calculate the price and deduct the money from the customer's bank account by way of the RFID chip in his/her wallet.

2.1.3 The Baggage Handling Industry.

In the aviation industry, major airports have been looking for opportunities in the baggage handling area since 1999. Many pilot tests of RFID were
done at numerous airports. In various tests, RFID tags were far more accurate than bar codes when applied to baggage handling operations [2]. Airport baggage handling is now the fastest growing RFID application. Furthermore, the business case demonstrates how RFID can add significant value across the baggage handling process in reduced luggage loss and improved customer service (i.e. reduced transit times, luggage segregation etc.). The major airlines stand to benefit a great deal from the cost savings involved in an improved baggage handling system. The first installation of an RFID baggage handling system was a trial coordinated by the delta airline and the Transportation Security Administration. The paper piloted an RFID baggage handling system installed at Jacksonville International Airport in

Florida for one month. FKI Logistex was contracted to design, produce and install the system. FKI chose Matrics to supply the RFID hardware for this paper [9]. While the trial only lasted for one month, Jacksonville has a permanent RFID system that is only used to track selected baggage. The RFID hardware for this system was provided by SCS corp. of San Diego [10]. Nath et al. [13] advocate
embedding RFID tags in luggage labels, as it could eliminate the need for manual inspection and routing by baggage handlers. A network of readers placed along conveyor belts could read the tags' routing information and provide feedback to a system that could then direct the bags onto the correct path. Automatic routing could reduce the number of mishandled baggage, lowering costs and improving customer satisfaction [7]. Al-Ali et al. [10] described the design and implementation of a prototype system for baggage handling in airports to enhance the management and tracking of passengers' luggage while, as a side effect, improving airport security. Sample et al. [11] focused on the use of RFID technology in the US department of Transportation's (DOT) international airport security initiative in Nigeria. One of the uses of RFID baggage tags, in conjunction with RF handheld
readers and boarding pass readers, is to verify passenger boarding versus luggage loading for positive passenger baggage matching on flights departing for the U.S. and other international locations [11]. The growing number of crime and luggage mishandling over the years, requires many companies to encourage the design and production for automated luggage trackers. Luggage trackers are intended to look at luggage's as they move from point to point and on conveyor belts in the airports they by reducing luggage mishandling and loses hence, improving customer satisfaction. The airline industry is struggling to provide passengers with access to real time information for tracking improperly handled luggage. The airlines try to be more proactive with improperly handled luggage claims at the airport and allow passengers to self-process the claims for delayed luggage. According to "air transport industry report" (2014), in 2013 3.13 billion passengers have used the air transport (increasing by 5.1% from 2.98 billion compared to 2012), if which have been 21.8 million cases of improperly handled luggage [14].

2.1.4 How the Baggage Tracking System Works.

The RFID 'tag' is essentially a memory device with a means of revealing and communicating its memory contents, when prompted (scanned) to do so. The memory consists of a plurality of binary (two state) digits, also known as bits, and the communication comprises RF reception and transmission means. The binary data (bits) are formed into binary words comprising typically 8, or 16 or 32 bits that can make up letters and numbers in the same manner as in computing, the Internet and 'texting' on a mobile phone. There are two broad categories of RFID tag systems: Active, and Passive. Active RFID tags contain a power source (normally a battery or are solar powered) and are able to transmit a radio frequency wave with the identification information contained in the tag's microchip. If there is sufficient memory available, the microchip might contain additional information (such as the washing/ care instructions should the tag be from an item of clothing). In contrast, passive RFID tags do not contain a power source. These tags are designed such that they are able to draw a small amount of energy from an incoming Radio Wave, which awakens the Microchip and pings back its unique identification signal onto the reflected wave, which is emitted from the antenna. Passive tags simply consist of a single transponder, antenna coil, and capacitors and are preferred over the others because they do not require a significant scanning range and relatively have a small size. The range over which they operate is quite small (0.05-10m). When the tag is subject to this RF field, it draws power used to get and transmit the stored information in the memory. In this way, the tag sends the passengers information to the reader. The reader then converts the reflected waves sent by the tag into digital
data for computer processing. Once the data is processed, the database system sends appropriate messages to the passengers. The passive tags operate below 100 MHz frequencies and their

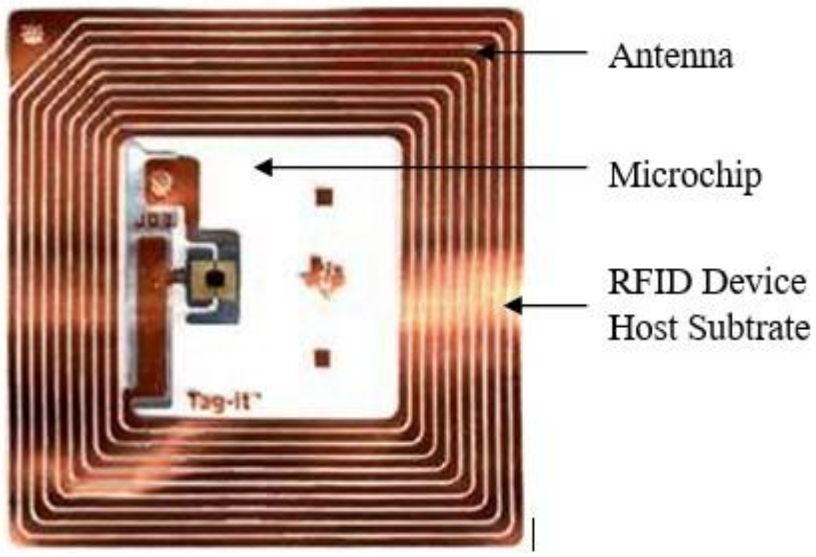

Fig. 1. An RFID passive tag

transferred energy is carried by magnetic field. This tag generates voltage in the coil which is used as power supply also as data signal.

III. DESIGN

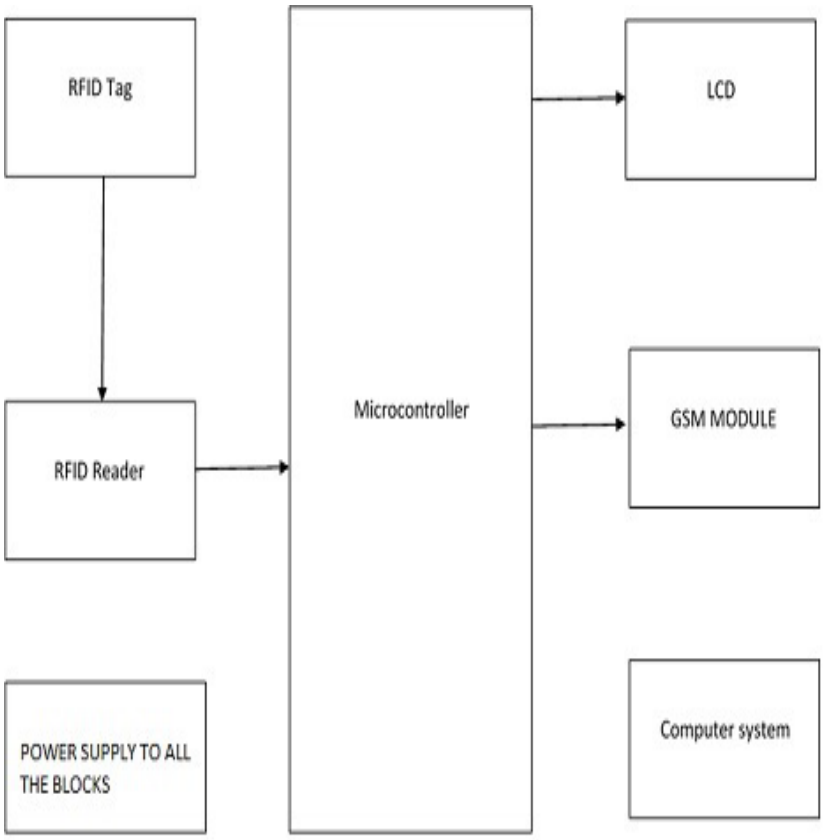

Fig. 2.: Block Diagram of RFID Based Luggage Tracker/Detector

The circuit is energized by a 5V supply, when all components are initialized, the RFID reader searches for tags by radiating electromagnetic
waves. For the tag detection response, a mini buzzer is used. This is driven by a PNP transistor connected at the Buzz Pin of the reader. When a card is detected, this buzz pin goes low making the transistor conduct. The LED will glow along with the Buzzer sound. The tag has a 10-digit decimal number.
When a correct tag is brought into the read distance of the RFID reader, the reader converts the10-digit decimal number to HEX value and output at the TX pin which is received by the microcontroller, the microcontroller through LCD displays the unique tag ID. It then sends the tag details to the administrator were the tag details is being compared with the TAG number on the data base. If data corresponds to that on the databases, the microcontroller prompts the SIM900a GSM module to send an SMS to the assigned phone number telling customer the location of the baggage. When the data doesn't match the data base, the process continues.

IV SIMULATION AND MEASUREMENTS

The simulation process of this work was carried out using advanced circuit design software, PROTUES 8.4 Professional. It is a computer aided design (CAD) software. It comprises of advanced simulation facilities such as digital oscilloscope, DC/AD Voltmeter, DC/AD ammeter and other measurement tools. The

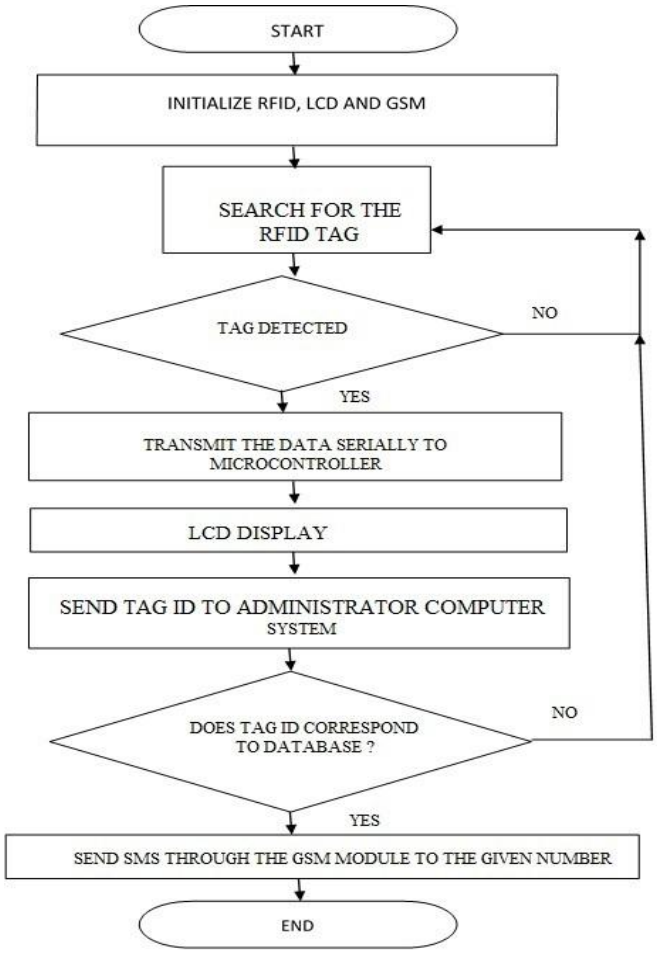

Fig. 3.: flowchart of RFID Based Luggage Tracker/Detector

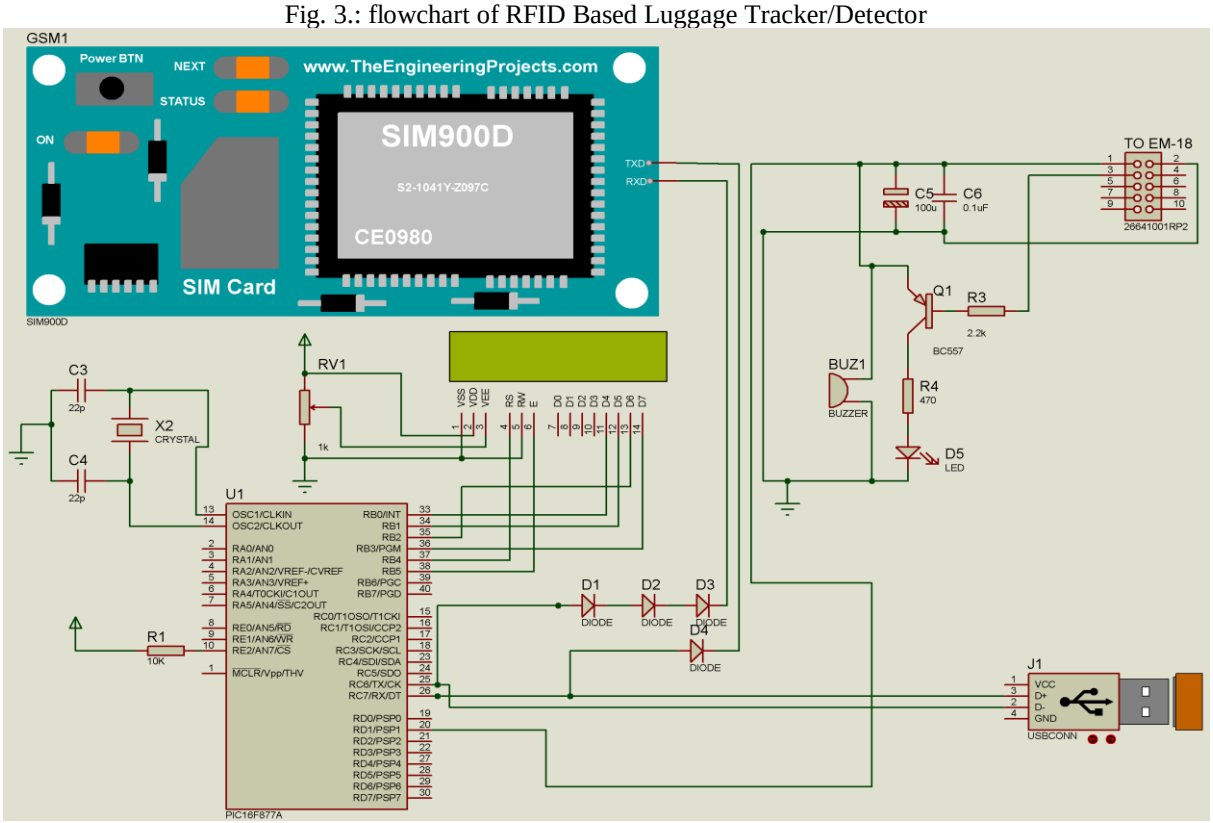

Fig. 4. Circuit Diagram of RFID Based Luggage Tracker/Detector.

circuit development from the most essential (i.e microcontroller) to the common components (e.g resistor, capacitor, e.t.c) are all found in the component library under different subdivision and classes according to the model and chip

maker. Some of the components used (e.g sim900a GSM module, EM-18 RFID module) could not be found in the libraries of the proteus 8.4 professional and so simulating the circuit was not possible because of this reason. Interconnection and circuit links (i.e wires and connection nodes) are all available minor circuit accessories in the CAD software. The software is user friendly and easy to draw and modify circuits and its properties. The proteus 8.4 software installation and use is as easy as any other regular software in use.

4.1 Creating a New Customer Account

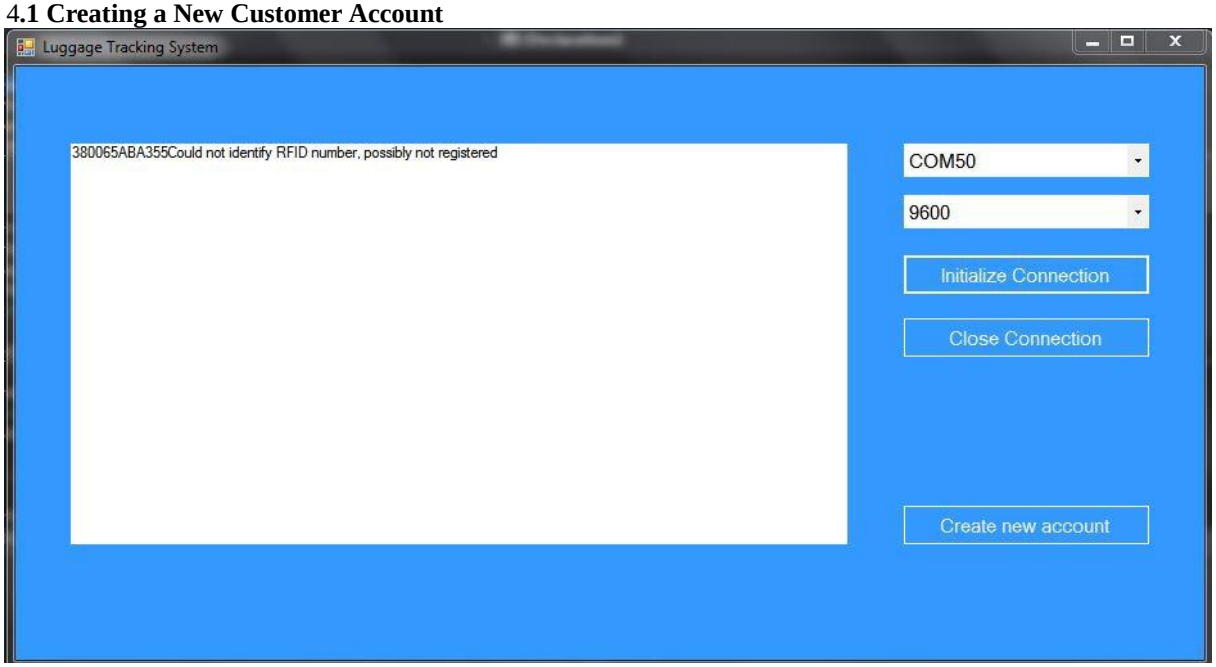

Fig. 5.: Display for First Tag Read

When the reader displays the tag ID as shown in 5, the tag detailsis copied and used to create a new customer account as shown inthe figure below.

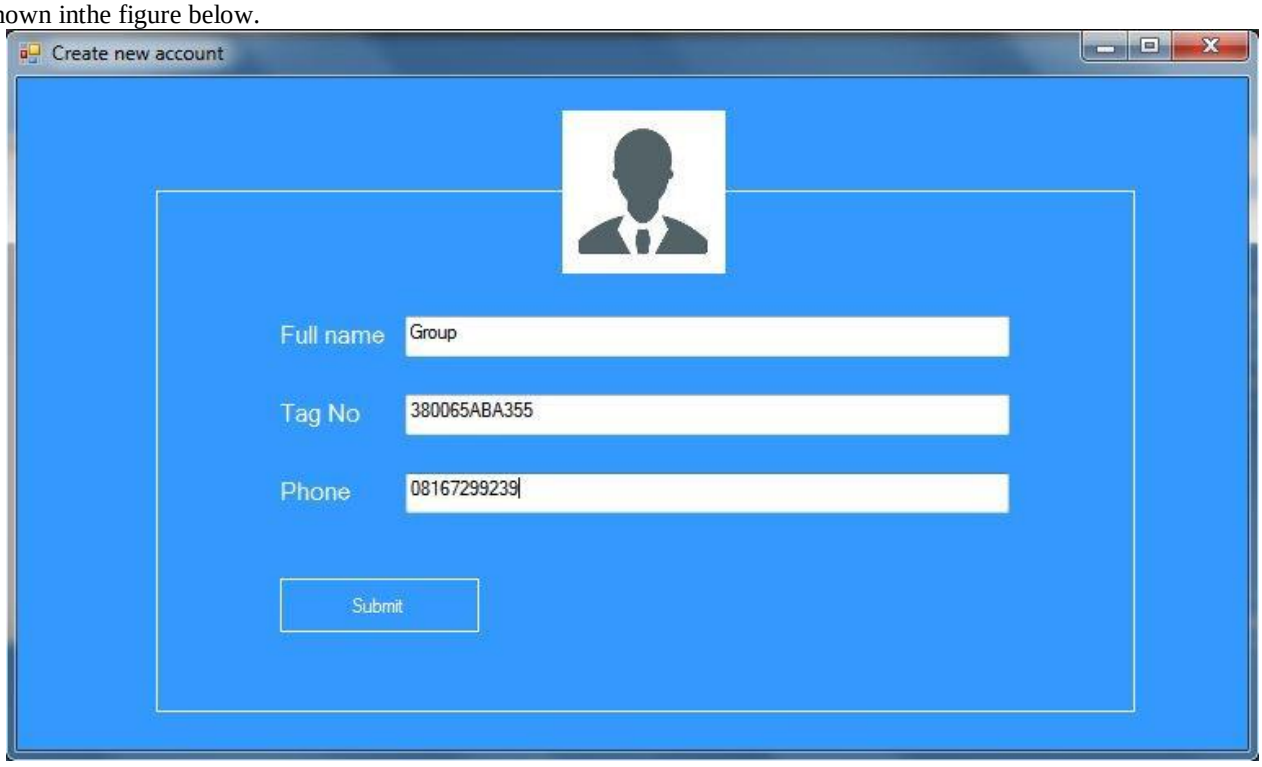

Fig. 6.: Display for Creating New Customer Account

4.2 Sending SMS

When the customer account is created and saved on the database, the RFID reader is used to read the Tag again and this time it brings a different message from that initially displayed in 5. The new displays shows that the system have received the message from the microcontroller compared it on the database and is sending a SMS to the registered details as shown in 7 below.

4.3 Accuracy of Recognition Analysis

Various tests were performed on the luggage detector circuit to investigate its accuracy and to characterize performance. The tests performed include

TAG read accuracy, LCD display, Sending and receiving of information from database

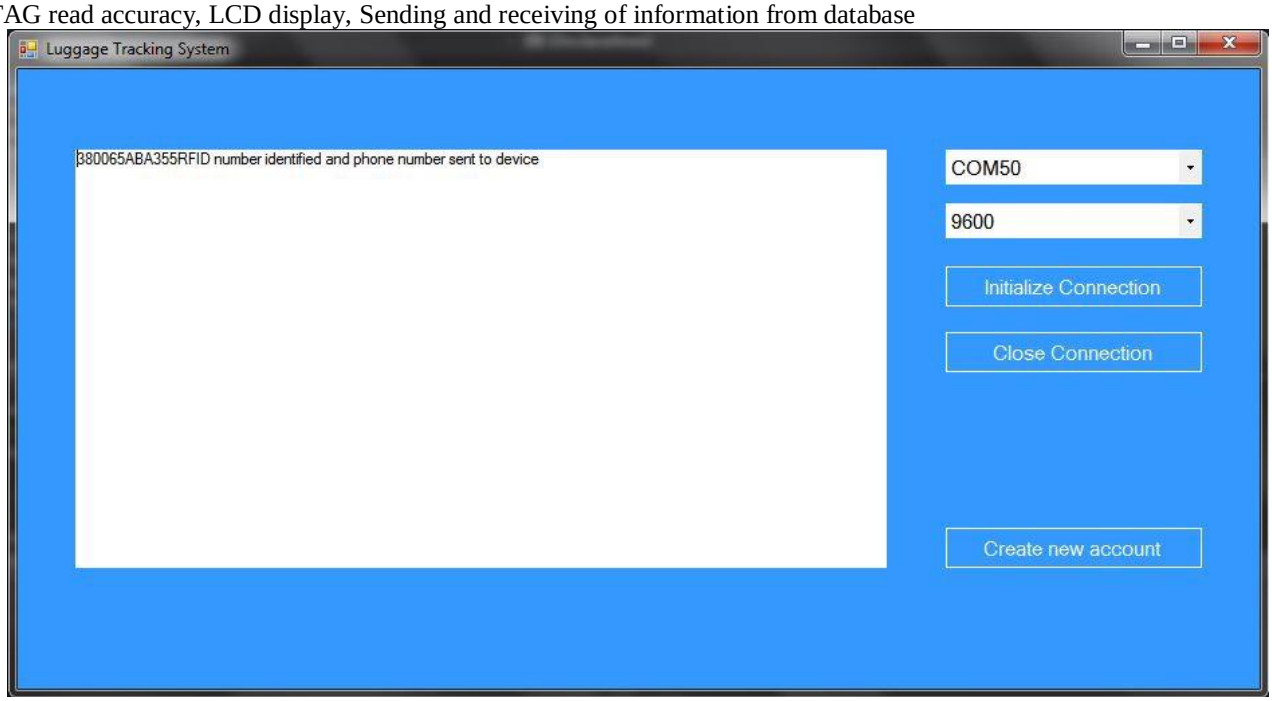

Fig. 7.: Display for sending SMS

Sending SMS to the customer/passenger.

V. SUMMARY

The design and construction of an RFID luggage detector System is achieved through the use of microcontroller, RFID module, LCD module, GSM module and other electronics components as represented in the circuit diagram of 4. The RFID reader module reads the tag number through electromagnetic waves and transmit to the PIC16F877A microcontroller. The microcontroller receives the tag details and displays them on the LCD and sends the tag details to the database stored on the system administrator/computer. The system compares the details sent by the microcontroller to the information on the database. If the tag details are found on the database, the system sends a response to the microcontroller which in turn sends a SMS to the customer through the SIM900a GSM module. When the tag details are not on the database the system repeats the process.

VI. CONCLUSION

The objective of this paper is to design and develop RFID based luggage detector system which utilizes the usage of RFID technology to replace the bar code system in order to improve the mishandling of luggage and losses in our Nigerian airports, and as well involve customers (passengers) in the tracking process to improve customer satisfaction.

VII. REFERENCES

[1] AsmaeBerrada and YassineSalih-Alj. An efficient rfidbasedtracking system for airport luggage, 2015.
[2] Yoon S Chang, Chang H Oh, Yoon S Whang, Jae J Lee, Jang A Kwon, Min S Kang, Ung Y Park, et al. Development of rfid enabled aircraft maintenance system. In Industrial Informatics, 2006 IEEE International Conference on, pages 224–229. IEEE, 2006.
[3] John Curtin, Robert J Kauffman, and Frederick J Riggins. Making the mostout of rfid technology: a research agenda for the study of the adoption, usage and impact of rfid, 2007.
[4] Bala Krishnan, DanieleQuercia, Simon Longbottom, and John Strafford. Market Feasibility Study on RFID and Baggage Handling.
[5] LubicaLesakova. Innovations in small and medium enterprises in slovakia. ActaPolytechnicaHungarica, 6(3):23–34, 2009.
[6] M Liard. The global markets and applications for radio frequency identification and contactless smartcard systems,2003.

[7] Deepti Mishra and Alok Mishra. Improving baggage tracking, security and customer services with rfid in the airline industry. ActaPolytechnicaHungarica, 7(2):139–154, 2010.
[8] Bala Krishnan Daniele Quercia. New technology ventures. 2005.
[9] Mark Roberti. The history ofrfid technology. RFID journal, 16(01), 2005.
[10] A Sagahyroon, A Al-Ali, F Sajwani, A Al-Muhairi, and E Shahenn. Assessing the feasibility of using rfid technology in airports. In RFID Eurasia, 2007 1st Annual, pages 1–5. IEEE, 2007.
[11] Kevin B Sample, David K Taylor, and Ed Rao. High tech aviation security program in africa-a model for technology transfer. In Security Technology, 2004. 38th Annual 2004 International Carnahan Conference on, pages 270– 277. IEEE, 2004.
[12] Shiou-Fen Tzeng,Wun-Hwa Chen, and Fan-Yun Pai. Evaluating the business value of rfid: Evidence from five case studies. International Journal of Production Economics, 112(2):601–613, 2008.
[13] ChuanzhenZang and Yushun Fan. Complex event processing in enterprise information systems based on rfid. Enterprise Information Systems, 1(1):3–23, 2007.
[14] KATO Zoltan et al. Using rfid and gis technologies for advanced luggage tracking. SEA-Practical Application of Science, 2(8):229–234, 2015.6

