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RFID based Ushering and Welcoming System

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Abstract **-This paper proposes an RFID Based Ushering and Welcoming System which provides a laudable welcome for guests in an event. The system comprises individual intelligent identification cards, a terminal and a high-end server. An RFID card (tag) attached to each guest's identity card is used to identify and recognize the individual or bearer. The terminal is an all-in-one standalone machine integrating a card reader, a display and a network system. The high-end server is a wired or wireless connectivity connected to an SQL database.**

Index Terms – RFID, Ushering, Welcoming, Tag, and Reader

I. INTRODUCTION

Officials (ushers) face difficulties in identifying all guests in an event. Some guests frown at improper or incomplete acknowledgement of their presence. Other top attendees would want an ovation at their entrance. Some important functions require that each guest be issued an invitation card, before he/she is legible to attend such events. This could pose a problem since there are no sure ways to reduce impersonation and forgery or falsification of information. To eliminate the problem, an automated approach will be implemented through RFID technology.

This system "**RFID BASED USHERING AND WELCOMING SYSTEM**" offers an automatic identification for guests, displays a laudable welcome message for each registered guest identified at the entrance. The system also ensures that only registered or invited persons are allowed.

RFID stands for **Radio-Frequency IDentification**. The acronym refers to small electronic devices that comprise a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less [1, 2]. Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by electromagnetic induction from magnetic fields produced near the reader. Some types collect energy from the interrogating radio waves and act as a passive transponder. Other types have a local power source such as a battery and may operate at hundreds of meters from the reader.

Unlike a barcode, the tag does not necessarily need to be within line of sight of the reader and may be embedded in the tracked object [3]. In fact, RFID technology came with numerous advantages over the barcode technology as it can be embedded in an item rather than the physical exposure requirement of barcodes and may be detected by radio frequency (RF) signal [4]. Radio frequency identification (RFID) is a wireless Automatic Identification and Data Capture (AIDC) technology for identifying a product, animal or person by using radio signals [15, 24]. Radio frequency identification (RFID) has become and will continue to be very important in the area of automated identification [10].

RFID based access control system allows only authorized or registered persons to attend the events. In [11, 15, 20, 18, 13, 4], an RFID system comprises two main components: the tag (also called a transponder) and the reader (also called an interrogator). The tag which carries information in a microchip is usually attached to the objects to be identified while the reader on the other hand detects tags that are within its frequency range and writes to or reads from the tags.

There are three types of RFID system. These are [15]: Passive (using no battery), Active (with an on-board battery), and Battery assisted passive "BAP" (with a small battery on board that is activated when in the presence of an RFID reader). In this our proposed work, passive RFID tags will be used because they are economical with reasonable range. Of course, in most of the applications tags are passive. The aim of this is to extend their life span and also to reduce the overall cost of the system [5]. The passive communication technology often used in RFID was first presented in Henry Stockman's seminal paper "Communication by Means of Reflected Power" in 1948 [16].

RFID can be classified based on their frequency ranges. Some of the most commonly used RFID kits are low-frequency (30-500 kHz), mid-frequency (900 kHz- 1500 MHz), and high-frequency (2.4-2.5GHz) [1, 8]. Low-frequency RFID systems (30-500 kHz) involve short transmission ranges (less than 180 cm) whereas High-frequency RFID systems (850-950 MHz and 2.4-2.5 GHz) offer longer transmission ranges (more than 3m). Generally, the higher the frequency of the RFID system the more expensive the system [3].

RFID is one of the host of technologies that fall under the Automatic Identification (auto-ID) umbrella. These include bar codes, magnetic inks, smart cards, voice recognition, biometrics, optical character recognition (OCR), touch memory etc [6]. The notions of RFID were first presented in the mid to late 1940's [7, 18, 19, 9] following on from technical developments in radio communications in the 1930's and the development of radar during World War II. This brought the conclusion that Radio Frequency Identification (RFID) emanated since World War II [12, 14, 16, 17, 10, 21] when it was mandatory to determine whether combatants were "Friend or Foe". The system facilitates automatic identification through tags and readers. So, one of the first applications of a radio frequency

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identification system was in "Identify Friend or Foe" (IFF) systems deployed by the British Royal Air Force during World War II. IFF allowed radar operators and pilots to automatically differentiate friendly aircraft from enemies via RF signals. IFF systems helped prevent "friendly fire" incidents and aided in intercepting enemy aircraft [16].

The major drivers of RFID implementation are retailers such as Wal-Mart and the United States (U.S.) Department of Defense. Because of the excellent potential benefits of RFID systems, in June 2003 Wal-Mart announced they would require their top 100 suppliers to tag all pallets and cases they shipped to Wal-Mart distribution centres by January 2005. The U.S. Department of Defense (DOD) requires its 43,000 suppliers to put RFID tags on pallets, cases and on any single item with a cost of more than $5,000 beginning January 1, 2005. Additionally, the US Food and Drug Administration (FDA) has called for the implementation of RFID technology to track the distribution of prescription drugs in order to protect the medical supply chain from counterfeit drugs. Companies in the health care industry will have to tag pallets and cases by 2007 to meet the FDAs' goal. Other early retail adopters of RFID technology include The Gap, Woolworth's, Prada, Benetton, and Marks & Spencer [9].

Currently, RFID technology is being adopted in a wide variety of areas, including manufacturing, logistics, supply chain, agriculture, transportation, defense, homeland security, and retail [24]. The technology is being employed not only for tracking goods in supply chains, but also to reduce the counterfeiting of pharmaceuticals and other high-end products, track baggage in airports and monitor medical supplies in hospitals, as well as in payment systems. Finally, almost every company on Earth will be required to utilize RFID in one way or the other, in order to remain competitive in the global market.

The rest of the paper is structured as follows. Section 2 talks about the rationale of the study, while Section 3 provides related works. RFID principles is described in Section 4. How RFID system works is described in section 5. Description of the components of an RFID system is detailed in section 6. Proposed methodology is explained in section 7. We have the current RFID applications in section 8. Finally, we conclude the paper in Section 9.

II. RATIONALE OF THE STUDY

Radio-frequency identification (RFID) is a form of wireless communication that utilizes radio waves to identify and track objects and persons. Being the most flexible auto-identification (auto-ID) technology, RFID is used to track and monitor the physical world automatically and with accuracy. It takes the barcoding concept and digitizes it for the modern world providing the ability to: uniquely identify an individual item beyond its product type, identify items without direct line-of-sight, identify many items (up to 1000s) simultaneously, and identify items within a vicinity of between a few centimetres to several meters.

However, the main rationale behind the study (work) is to: increase efficiency, improve layouts of the show floor in an event, reduce data entry errors, eliminate registration lines at entrances (reduce human intervention), better time management, real-time information and serialization (unique identification).

III. LITERATURE REVIEW

Impact of RFID Technology on Supply Chain Efficiency [30], improves and increases operating efficiencies in the supply chain which results in company's increased product visibility, reduce out-of-stock items, trim warehouse costs, eliminate stock errors, reduce theft and shrinkage and allow companies to regularly update their logistics and inventory databases. The challenges that interrupt the successful implementation of RFID to accelerate the performance of supply chain are also examined.

Impact of RFID Technologies on the Hospital Supply Chain [25] tackles the problem of supply costs expenditure in hospitals by reducing the costs, improving patient safety, and improving supply chain management effectiveness by increasing the ability to track and locate equipment, as well as monitoring theft prevention, distribution management, and patient billing.

A rules based RFID-enabled supply chain process monitoring system [26], a supply chain management system monitors the performance and ensure that the material flow from material suppliers to customers is delivered at the right time, right place and right quantity.

RFID Based Exam Hall Maintenance System [15] overcomes the challenge students are facing in searching for their exam halls and seating arrangement during examination. The card reader will be provided at the entrance of the building. When the students swipe their tags in front of the reader their exam halls and seat numbers would be displayed on the LCD.

Radio frequency identification (RFID) is an emerging technology that has been increasingly used in logistics and supply chain management (SCM) in recent years as it can identify, categorize, and manage the flow of goods and information throughout a supply chain. It also offers the potential to improve supply chain performance because of its ability to provide rich and timely information that increases visibility and control over the supply chain. Due to these benefits of the technology in the supply chain most of the authors focused their attentions of RFID on the supply chain management with a few on other areas.

In contrast, this study discusses RFID based ushering and welcoming system which offers an automatic identification for guests, displays a laudable welcome message for each registered guest identified at the entrance since none of the authors never tried to develop a system aiding layouts of the show floor in an event.

IV. RFID PRINCIPLES

There are many types of RFID, but at its most simple, RFID devices can be divided into two classes [35]: Active and Passive.

Active RFID tags – Unlike passive RFID tags, active RFID tags possess their own internal power source that is used to power the integrated circuits and to broadcast the response signal to the reader. Communications from active tags to readers is typically much more reliable (i.e fewer errors) than those from passive tags because of the ability of active tags to conduct a "session" with a reader [32]. One

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typical example of an active tag is the transponder attached to an aircraft that identifies its national origin [35].

Passive RFID systems - Passive RFID tags have no internal energy source. Instead of built-in battery, they are powered by the electric field radiated from the reader. Generally, the minimum power to be delivered to a passive RFID tag is – UHF 10dBm (100 μW) [23]. The passive RFID tag has advantages of lightweight, cheap, and long life cycle but with several shortcomings such as shorter read distance which made them to work with high power reader. All read–only tags belong to this category which usually have a 32-128 bits ID code [14].

To transfer power from the reader to the tag, there are two different RFID design approaches [35]: magnetic induction and electromagnetic (EM) wave capture. These two designs utilize advantage of the EM properties associated with an RF antenna—the *near field* and the *far field*. The two can transfer enough power to a remote tag to sustain its operation—typically between 10μW and 1 mW, depending on the type of tag. (For comparison, the nominal power an Intel XScale processor consumes is approximately 500 mW, and an Intel Pentium 4 consumes up to 50 W). With different modulation methods, *near*- and *far-field*-based signals can also transmit and receive data [35].

A. Near-field RFID

The basis of near-field coupling between a reader and tag is found from faraday's principle of magnetic induction where a reader passes an alternating current through a reading coil which results in an alternating magnetic field within its vicinity. If a tag that incorporates a small coil (see figure 1) is being placed in this field, an alternating voltage will appear across it. If this voltage is rectified and coupled to a capacitor, a reservoir of charge accumulates, which one can use to power the tag chip. Also tags use *near-field* coupling send data back to the reader using load modulaton [35].

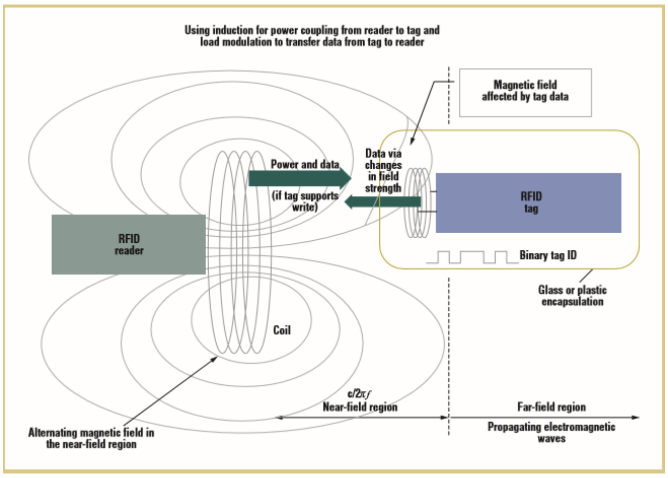

Figure 1. Near-field power/communication mechanism for RFID tags operating at less than 100 MHz [35]

Near-field coupling being the first approach taken and resulted in many subsequent standards like ISO 15693 and 14443, and a variety of proprietary solutions can be considered as the most straightforward approach for implementing a passive RFID system. However, it has some shortcomings.

The range at which magnetic induction can be used approximates to c/2πf, where c is a constant (the speed of light) and f is the frequency. Therefore, as the frequency of operation increases, the distance over which near-field coupling can operate decreases. Another limitation is the energy available for induction as a function of distance from the reader coil. The magnetic field drops off at a factor of 1/r3, where r is the separation of the tag and reader, along a center line perpendicular to the coil's plane [35].

B. Far-field RFID

RFID tags based on far-field emissions capture EM waves propagating from a dipole antenna attached to the reader. A smaller dipole antenna in the tag receives this energy as an alternating potential difference that comes across the arms of the dipole. A diode will rectify this potential and link it to a capacitor, which then results in an accumulation of energy to power its electronics. Unlike the inductive designs, the tags are beyond the range of the reader's near field, and information can't be transmitted back to the reader using load modulation [35].

Backscattering is the technique designers use for commercial far-field RFID tags (see figure 2). If an antenna of precise dimensions is designed by them, it can be tuned to a particular frequency and absorb most of the energy that reaches it at that frequency. But if an impedance mismatch occurs at this frequency, some of the energy will be reflected back as tiny waves by the antenna toward the reader, which will then detect the energy using a sensitive radio receiver. If the antenna's impedance is changed over time, the tag will reflect back more or less of the incoming signal in a pattern that the tag's ID will be encoded. In a nutshell, in far-field propagation, the reader sends a signal to a tag and the tag backscatters (i.e reflects) a response back to the reader [5, 31].

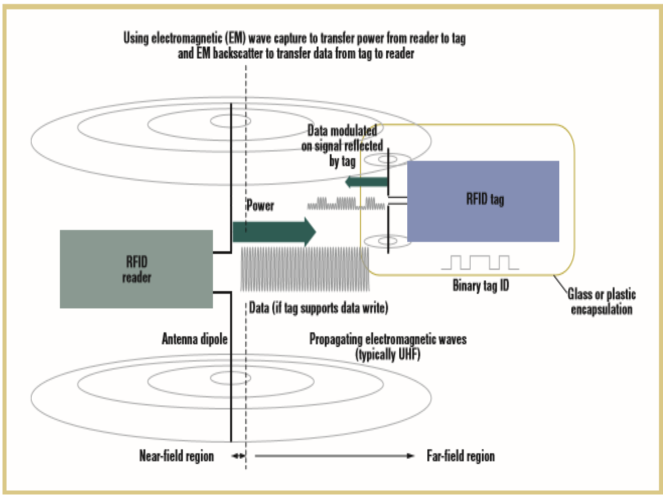

Figure 2. Far-field power/communication mechanism for RFID tags operating at greater than 100 MHz [35].

The range of the far-field system is limited by the amount of energy that comes to the tag from the reader and the sensitivity of the reader's radio receiver to the reflected signal. The actual returned signal is very small, because it's the result of two attenuations, each based on an inverse square law—the first attenuation comes up as EM waves

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radiate from the reader to the tag, and the second occurs as the reflected waves travel back from the tag to the reader. Therefore, the returning energy is 1/r4 (again, r is the separation of the tag and reader).

Tags can successfully be interrogated by a typical far-field reader at a distance of 3m away. In fact, some RFID companies assert their products have read ranges of up to 6 m. As a rough design guide, tags that use far-field principles operate at a frequency greater than 100MHz typically in the ultra high-frequency (UHF) band (such as 2.45 GHz); below this frequency is the domain of RFID based on near-field coupling [35].

V. HOW RFID SYSTEM WORKS

An RFID system comprises four elements, as shown in Figure 3. The RFID tag comprises an antenna integrated with a microchip. The RFID reader and antenna transmit an electromagnetic RF signal which is received by the tag via its antenna. Power is then provided to the tag by the energy in the received signal which allows the microchip to operate. This is referred to as a "passive" tag [21].

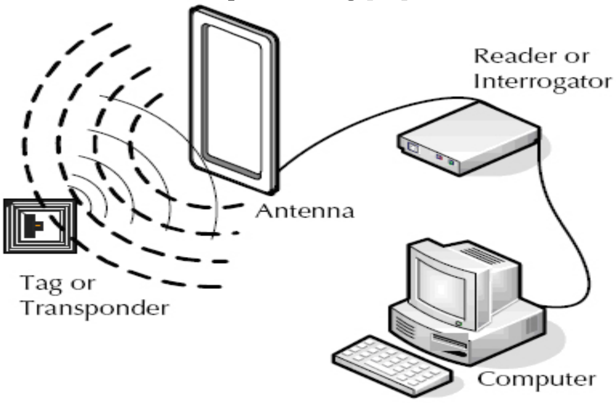

Figure 3. Components of a Passive RFID System [36]

An RF signal that contains the data from the microchip is "reflected" by the tag back to the reader via the reader antenna and this process is referred to as passive backscatter. The reader then receives this signal from the tag, extract the tag's code from the signal, and return it to its digital form. This returned code is then sent to a host computer [21]. The purposes of the system include identification, monitoring, authentication, and alerting through this exchange of data between the tag and the reader. Also, the process is automatic and both the tag and the reader do not need to be in plain sight [12].

The communication process between the reader and tag is managed by some protocols which include (ISO 15693 and ISO 18000-3 for HF or the ISO 18000-6, and EPC for UHF). These protocols begin the identification process when the reader is switched on. The selected frequency bands in which these protocols can work are (860 – 915 MHz for UHF or 13.56 MHz for HF). Once the reader is on and the tag comes in proximity to the reader fields, it automatically wakes-up and decodes the signal and replies to the reader by modulating the reader's field [22, 37].

For passive tags, readers energize the tags with energy, receive the results and frequently handle the low-level anti-collision algorithms that allow readers to read more than one tag at a time [21]. As a result, all the tags within the reader range may reply at the same time, but in this case the reader must detect signal collision (indication of multiple tags). The problem of signal collision is resolved by applying anti-collision algorithm that enables the reader to sort tags and select/handle each tag based on the frequency range (between 50 tags and 200 tags) and the protocol used. In this connection, the reader can perform certain operations on the tags such as reading the tag's identifier number and writing data into a tag [22].

VI. COMPONENTS OF AN RFID SYSTEM

An RFID system comprises different components which are integrated in a manner that allows the system to deduct the object's tag and perform different operations on it [22]. The RFID system, as any information system comprises software and hardware components. Therefore, their main specification lies in the hardware components which include the tags and readers as well as the techniques of energy exchange they use to communicate. Tags and readers are core hardware components of an RFID system [18, 19].

A. Tags

An RFID tag consists of two parts – an antenna for transmitting and receiving signals, and an RFID chip (or integrated circuit) which stores the tag's ID and other information. Tags are attached to all objects to be identified in an RFID system. Often tags carry no on-board power source and must passively harvest all energy from an RF signal [16]. There are three types of RFID tags depending on built-in battery or not [14, 22, 16, 11, 27, 28, 29, 5, 32, 33, 34, 3]: passive, semi-passive, and active tag.

Due to the low cost, passive RFID tag is the most popular and has been deployed in many applications such as supply chain management, animal tracking, passports, hospital, building access, transporters, and libraries [27]. But due to the onboard energy source of active RFID tags, they can transmit at a higher power level than passive tags, allowing them to be of more effective in RF challenged environments such as water, metal or at longer distances [11]. Semi-passive tags have a combination of active and passive tags characteristics. Therefore, mainly two types of tags (active and passive) are being used by industry and most of the RFID system [22]. Systems operating at Low Frequency (LF) and High Frequency (HF) bands are passive systems whereas systems operating at Ultra-High Frequency (UHF) and microwave frequency bands can be passive or active systems [19].

Table 1: Comparison of passive and active RFID tags [19]

	Passive RFID	Active RFID
Tag Battery	No	Yes
Tag Power Source	Energy transferred from the reader	Internal to tag
Availability of Tag Power	Only within the field of an activated reader	Continuous
Required Signal Strength from Reader to Tag	High (must power the tag)	Low (only to carry information)
Available Signal Strength from Tag to Reader	Low	High
Communication Range	Short or very short range (3m or less)	Long range (100m or more)
Tag lifetime	Very long	Limited to battery life (depends on energy saving strategy)
Typical tag size	Small	Large
Multi-Tag Collection	- Collects hundreds of tags within 3 meters from a single reader - Collects 20 tags moving at 8 Km/h or slower	- Collects 1000s of tags over a 28 000 m² region from a single reader - Collects 20 tags moving at more than 160 km/h
Sensor Capability	Ability to read and transfer sensor values only when tag is powered by reader; no date/time stamp	Ability to continuously monitor and record sensor input; data/time stamp for sensor events
Data Storage	Small read/write data storage (Bytes)	Large read/write data storage (KBytes) with sophisticated data search and access capabilities available
Typical applications	Rigid business process, constrained asset movement, basic security and sensing. Simple cargo security (one time tamper event detection), substantial business process impact. Individual item tagging, luggage, boxes, cartons, pallet, printed labels	Dynamic business process, unconstrained asset movement, security/sensing, data storage/logging Intermodal container, rail car Area monitoring, high speed multi-tag portals, sophisticated cargo security applications (continuous tamper detection, date/time stamp), electronic manifest
Cost	Low (below 0.5 EUR)	High (above 5 EUR, up to hundreds)

RFID tag selection is, perhaps, the most critical component of a successful RFID system, and hundreds of tag variations are available in the market today. An RFID tag could be the perfect size and shape for your application, but be the wrong type for mounting on metal. Metal-mount RFID tags are specially designed to read well when mounted on a metallic surface, whereas RFID wet inlays or RFID labels are not readable if applied to metal surfaces [36]. RFID does not require a direct line of sight for reading. This means that tags can be read through fluids, fabric, plastic, cardboard, or other materials that are transparent to the operating frequency [17].

Primary points of consideration when selecting an RFID tag [36]:

- What type of surface will you be tagging? On metal, plastic, wood, etc.?
- What read range do you desire?
- Size limitations (i.e. the tag can be no larger than x by y by z inches)?
- Any excessive environmental conditions to consider? Excessive heat, cold, moisture, impact, etc.?
- Method of attachment? Adhesive, epoxy, rivets/screws, cable ties, etc.?

a) Tag memory capability

Tags can be chip-based or chipless. Chip-based tags comprise a microchip that stores data and an antenna used to communicate via radio frequency communication while a chipless tag does not contain an integrated electronic chip. Chipless tags can be used as anti-counterfeiting and anti-theft devices. Chip-based tags are of three types [9]: (1) read-only; (2) write once/read many times; and (3) read-write. Data on read-only tags cannot be changed unless the chip is electronically reprogrammed and they are often used to track assets that have a unique ID over their lifetime while data on read-write tag can be changed and they are used to track items through the supply chain.

b) Tag Frequencies

The RFID tag's range depends on its frequency which evaluates the resistance to interference and other performance attributes. The use/selection of RFID tag depends on the application; different frequencies are used for different RFID tags [22]. Presently, there are four categories of RFID frequencies [17]: Low Frequency (LF), High Frequency (HF), Ultra High Frequency (UHF) and Microwave frequency. But many RFID applications operate on Low Frequency (LF), High Frequency (HF), and Ultra High Frequency (UHF) ranges such as 125kHz, 13.56MHz, and 868MHz respectively [38]. Radio waves behave differently at different frequencies, so it's important to choose the right frequency for the right application. LF tags are less affected by the presence of fluids or metals when compared to the HF tags [28]. The chart in figure 4 outlines the three primary frequency ranges used in RFID:

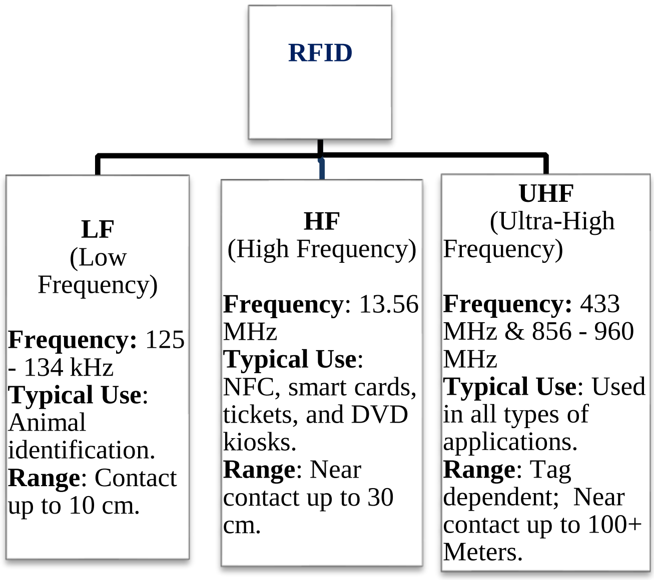

Figure 4. RFID frequency ranges [36].

Within the UHF Frequency range of 856 – 960 MHz, there are two primary subsets:

1) The FCC (US) standard frequency range of 902-928 MHz
2) The ETSI (EU) standard frequency range of 865-868 MHz

The FCC standard is used throughout North America as well as the majority of the Caribbean and much of South America. The ETSI standard is used throughout the European Union and most countries adhering to EU standards. Various other subsets within the above ranges are used throughout the world [36].

RFID systems operate at Low Frequency (LF), High Frequency (HF), Ultra High Frequency (UHF), and Microwave frequency ranges. As some radio communications systems operate at licensed frequencies (such as mobile telephony or television), RFID systems operate at specific unlicensed frequencies that are not fully harmonised internationally, particularly in the UHF and

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Vol. 11 Issue 02, Februay-2022

microwave ranges. Different frequencies for RFID in different regions can be challenging for those who advocate the deployment of global RFID applications, although technical solutions can cope with a certain level of divergence of frequencies (See Table 2) [19].

Table 2. Frequencies and regions [19].

Low Frequency (LF) 30-300 kHz	125 – 134 kHz in Canada, Europe, Japan, and the US
High Frequency (HF) 3-30 MHz	13.56 MHz in Canada, Europe, Japan, and the US
Ultra-High Frequency (UHF) 300 MHz-3GHz	433.05 – 434.79 MHz in most of Europe, US, and under consideration in Japan 865 – 868 MHz in Europe 866 – 869 and 923 – 925 MHz in South Korea 902 – 928 MHz in the US 918- 926MHz in Australia 952 – 954 MHz in Japan, for passive tags starting in 2005
Microwaves 2-30 GHz	2400 – 2500 and 5.725 – 5.875 GHz in Canada, Europe, Japan and the US

- **Low Frequency** tags operate in the 120-140 kHz range. They are passively powered through induction and because of that, they typically have very short read ranges of 10-20 cm. LF tags are used in rugged environments and can operate in proximity to metal, liquid, or dirt. This makes them to be useful as implantable pet identification tags or laundry management tags. One disadvantage of LF tags is that, they have a very low data read rate compared to other operating frequencies. LF tags are commonly used in car immobilization and access control systems. In such systems, a car will only start if a LF tag, typically attached to the ignition key, is in proximity to the ignition. This takes advantage of LF's short read range and uses it as a security feature. In 2006, LF passive tags may be purchased in bulk for US$1 per tag or less. Two major manufacturers of LF tags are Texas Instruments and Phillips Semiconductor. The ISO 18000-2 standard offers specifications for LF RFID tags [16].
- **High Frequency** tags operate at 13.56 MHz frequency. They are always packaged in a foil inlay or credit card form factor and this makes them useful for building access control, contactless credit cards, and ID badges. HF tags are also used in many asset-tracking applications. Libraries and book stores often use HF foil inlays to track books. Some airports have started using HF RFID luggage tags for baggage handling applications. HF tags offer a higher data read rate than LF tags, but do not perform as well as LF tags in proximity to metals or liquids. However, HF tags do offer better performance near metals or liquids than UHF tags do. In 2006, HF passive tags may be purchased for US$0.50 or less per tag in quantity. Texas Instruments and Phillips both offer HF tag lines, although there are many smaller and specialized manufacturers or integrators in the HF space. International Standards Organization (ISO) specifications for HF RFID tags are specified by the ISO 18000-3 standard. Related specifications for HF contactless smart cards and proximity cards appear in ISO standards 14443 and 15693.
- **Ultra High Frequency** tags operate in the 868-928 MHz range. European tags typically operate within 868-870 MHz range. The United States and Canada operate at 902-928 MHz. Since UHF tags offer a longer read range and are cheaper to manufacture in bulk than LF or HF tags, they are used for item tracking and supply-chain management applications. The first generation of EPC tags operate at UHF frequencies. In 2006, UHF tags can be purchased in quantities for under US$0.15 per passive tag. Specifications for RFID tags operating at UHF frequencies are established by both the ISO 18000-6 standard and the EPC global standard [16].
- **Microwave** tags operate at either 2.45 or 5.8 GHz. Microwave tags used are typically semi- passive or active, but can also come in passive form. Semi-passive microwave tags are commonly used in fleet identification and electronic toll applications. There are various problems associated with microwave tags. One is that, they consume more energy than their lower-frequency counterparts. Microwave tags are typically more expensive than UHF tags. It also has good reader rate even faster than UHF tags. In 2006, commercially available active tags cost as much as $25 per tag. The ISO 18000-4 and the rejected ISO 18000-5 standards offer respective specifications for 2.45 and 5.8 GHz RFID tags [16, 22].

B RFID Reader

An RFID reader is the brain of the RFID system and necessary for any system to function. Readers, also called interrogators, are devices that transmit and receive radio waves in order to communicate with RFID tags [36]. An RFID reader: a device that communicate between the antennas and host PC, enabling the PC to capture or write information stored in the tag [14]. An RFID reader is also a device that is used to interrogate an RFID tag. It has an antenna that emits radio waves which the tag responds by sending back its data [8]. RFID readers communicate with tags through an RF channel to obtain identifying information. This communication could be a simple ping or could be a more complex multi-round protocol depending on the tag type. In situations where there are many tags, a reader may have to perform an anti-collision protocol in order to ensure that communication conflicts do not occur. Anti-collision protocols permit readers to rapidly communicate with many tags in serial order.

Readers power passive tags through their RF communication channel. These types of tags carry no on-board power and rely solely on a reader to operate. As these tags are so limited, they may subsequently rely on a reader to perform computation as well [16]. Readers come in different forms and sizes. The sizes of the Readers depend on various factors and vary from the size of a coin to that of a personal assistant or personal computer (See Figure 5). Readers can embed GPS capabilities and connectivity to information

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systems and networks. The cost varies from USD 100 to USD 1 000 for readers of passive tags to USD 1 000 to USD 3 000 or more for readers that communicate with active tags over long distances. We have different types of readers as shown in figure 5: Handgun type reader (left), computer style reader (centre) and ultra small RFID reader (12 mm x 12 mm x 2 mm) (right) [19].

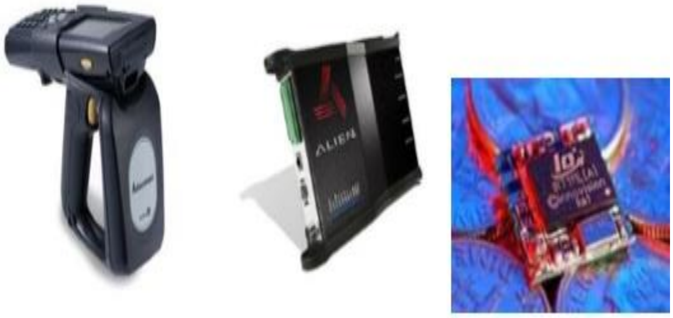

Figure 5. RFID readers [19]

Primary points of consideration when selecting an RFID reader [36]:

- How much read range do you require for your application?
- Any excessive environmental conditions to consider? Excessive heat, cold, moisture, impact, etc.?
- Will you be adding the reader to a network?
- Where will the reader be placed? Fixed location? Vehicle? Does the reader need to be mobile?
- How many read points/read zones will you need?
- How many tags might need to be read at one time?
- How quickly will the tags be moving through the read zone? For example, is this a slow moving conveyor belt or a fast moving race?

VII. PROPOSED METHODOLOGY

This system will be designed and constructed using a Mi-fire long range RFID reader (4-5m) and tags, a mini-PC, a 22''LCD TV to serve as the screen. An SQL server for the database and guest data storage. A wooden stand to hold the application system, the screen and other electronic devices. A computer program (GUI) will be written in C# (pronounced “C-sharp”) to control the whole system. Data capture, database communication, welcome screen will all be controlled through the GUI. The system consists of individual intelligent identification cards, a terminal, and a high-end server.

a) Terminal Unit

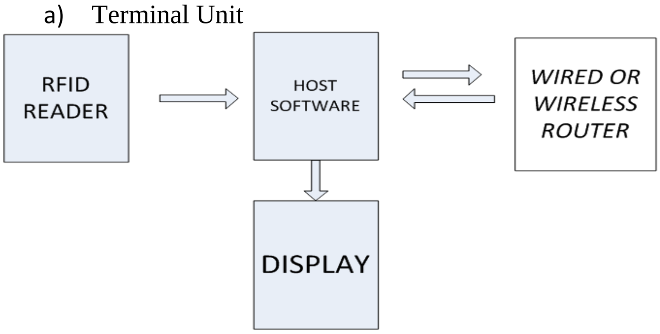

Figure 6. Terminal Unit

The terminal is an all-in-one machine integrating a card reader, a display and a network system.

b) High End Server

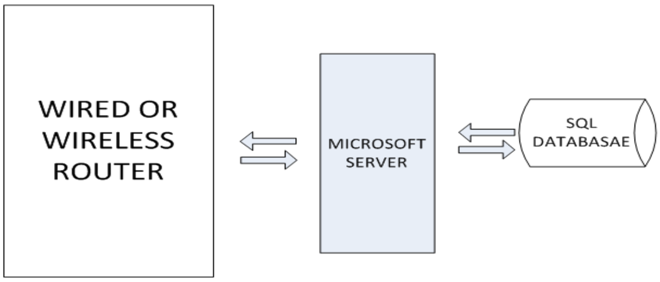

Figure 7. High End Server

The high-end server is a wired or wireless connectivity. It comprises a database system and a management system. The database system will be used for storing attendee’s information. The management system will be used for managing a database.

c) Block Diagram

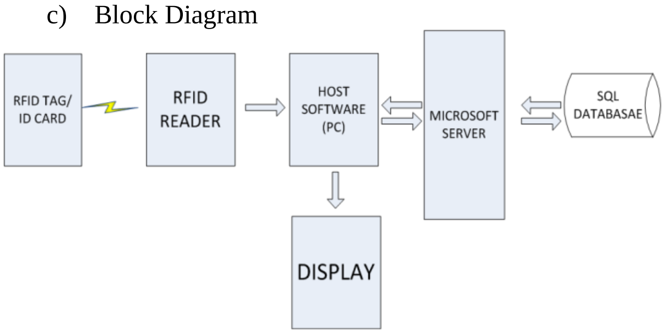

Figure 8. Block Diagram

d) Block Diagram Explanation

The block diagram of an RFID Based Ushering and Welcoming System is shown in figure.8. This system consists of various parts such as RFID tag, RFID reader, host software, server, data base and LCD display.

- The RFID Tag/ID card:

An RFID cards (tags) attached to each guest’s Identity card is used to identify and recognize the individual or bearer. As said earlier, a passive RFID tag will be used in this work, since no user data will be stored on the card.

- The RFID Reader:

The reader reads Card ID from each identity card displayed by the terminal, the information is transmitted to the high-end server which searches for effective information in the data base by utilizing the received information as the index and transmits the information to the display unit.

- Host Software:

This is the computer interface programme designed using Microsoft visual studio. It co-ordinates all the operations of the system including data acquisition, data base transactions, guest welcome screen etc. The computer interface will be written in C#.

- Server:

The primary function of any server is to provide resources to other computers. The Microsoft SQL server that will be used will provide data base resources to the host software and will also serve as its Relational Data Base Management System (RDBMS).

- Database:

This is the storage unit of the system. It will be designed using Microsoft SQL.

- LCD Display:

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. The LCD is used in a wide variety of applications including computer monitors, televisions, instrument, aircraft cockpit displays, and signage. In this work a 22''LED TV will be used for the display of guest's photo and profile on arrival. This will serve as the primary output of the system.

VIII. CURRENT RFID APPLICATIONS

There are several areas in which RFID technology is being applied today. Some of these are summarized in the following sections.

a) Supply Chain

The main application of RFID is in the area of supply chain visibility. RFID technology can be used in closed loop supply chains or to automate parts of the supply chain within a company's control. Since standards emerge, companies are increasingly turning to RFID to track shipments among supply chain partners. Major retailers such as Wal Mart, Best Buy and Albertsons are leading the charge, mandating usage of RFID tags on cases and pallets within the next two years. The U.S. Department of Defense (DoD) has issued similar mandates for its suppliers, also at the case and pallet level. The use of UHF band chips in the EPC global standard has been specified by these retailers and the DoD [13, 21].

b) Animal Tracking

RFID is being used for animal tracking. This can start from livestock management (for animal movement, feeding, health, and market visibility) to pet tracking. Animal tracking is one of the largest implementations of asset management using RFID. Low frequency tags are used for animal tracking [21].

c) Toll collection

For road toll collection, an RFID tag (typically an active or semi-passive tag) is carried by the vehicle and a reader is deployed at each toll collection point. Whenever a tagged vehicle passes through the collection point, it can be detected and identified, and this information is used to levy the appropriate charge for the journey, electronically. The advantages of electronic tolling are clear from the driver's point of view – there is no need to slow down significantly at the toll booths, no need to have the correct change to hand, no queuing. Similarly, costs of collecting tolls are significantly reduced by reducing staffing levels, cash handling and so on [18].

d) Payment Systems

RFID technology can be used for payment systems in order to secure transactions. Safety requirements of tags are very high and the systems can further be characterised by very low read ranges in order to avoid mixing different payment cards [19]. Near Field Communications devices such as Sony's Felica card and Philips ViVOTech (essentially HF RFID with improved data speeds) are used for payment systems. The principle behind this technology is to use a mobile phone enabled with an RFID chip for payments [21].

e) Access Control

One of the common applications of RFID is access control where contactless badges are in use in virtually every office and facility. This style of RFID badge generally has very low read ranges, and tends to work in the LF or HF band. These systems tend to use very proprietary formats, networks and protocols. In general, the tags are packaged in a sealed ID card format. Some ID tags have thin film batteries for encryption and information storage [21].

f) Library systems

RFID technology can be used for material management in a library setting. RFID tags are incorporated into books and other library media. These tags can be applied at the source (at the time of publishing) or after manufacturing by the library staff as items are acquired [18]. Using RFID in libraries saves library staff's time by automating their tasks. An establishment that uses RFID library management saves a book reader, precious time that he would have been spent, waiting for his turn in a queue for borrowing or returning a book. Borrowing and returning of books can be fully automated with the help of self check-in/out systems [33].

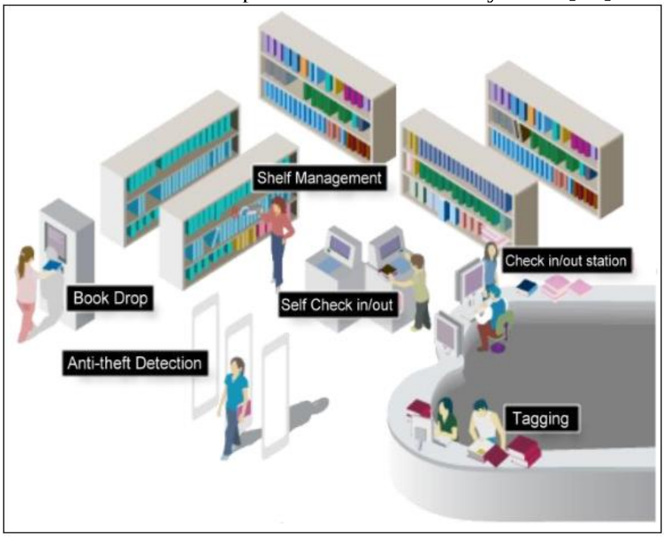

Figure 9. RFID Library Management System [33]

IX. CONCLUSION

Due to the limitations and shortcomings of the other methods of accreditation and ushering systems such as biometrics, barcodes etc, which is basically manual in nature and require human intervention. RFID is a viable alternative and an upgrade on these methods for accreditation. It is anticipated that in order to realise the full potential of item-level tagging, and thus enabling RFID to become more widespread, tags must become much cheaper than the current pricing. Some experts estimate cost-effective tags will enter the market in a couple of years, and will have a major impact on the efficiency and economy of the retail industry.

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