



A Study on the Components used in RFID System and its Challenges

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Abstract

The Radio Frequency Identification (RFID) system is an essential wireless technique of identification of physically placed objects in certain state spaces. The RFID system is the most emerging technology these days which is becoming the alternate for the barcode. Hence this technology is receiving a lot of attention comparatively over the past few years. The RFID system technology is used to automatically identify any item or a package. The automatic identification can be done with the help of the RFID Tags and the RFID Reader units. The RFID tag contains a transponder that can transmit wireless information over a short distance. The information is then received by the device called the RFID Reader and is further processed through middleware infrastructure. Lots of the RFID system applications are being used in various fields like Hospitals (Healthcare centers), Engineering, and Livestock's for traceability purposes. Acquaintance with the advantages and the risk of the RFID system. The gumshoe of this technology has made a gigantic impact on our daily lives.

Keywords: Antenna, Middleware, Traceability, RFID system, RFID tags, RFID readers, microcontroller, Personal Computer (PC).

INTRODUCTION

RFID technology has been using for several years. The groundwork of this method was laid in the 1940s and was deployed by a British Army to help in identifying an enemy aircraft ^[1]. Further, in 1945 Leon Theremin designed a surveillance tool for the Soviet Union that help in transmitting radio waves that contain audio information. This tool has a diaphragm, which is vibrated due to sound waves, which alter the shape of the resonator. However, this device was not an identification tag but was a sneaky listening device, and therefore it was considered as a prototype of the RFID technology because the device was acting as a passive device that was energized by Electro-Magnetic waves (EM) generated by an external source ^[2]. Likewise, in 1915, Identification-of-Friend-or-Foe (IFF) transponder was designed to help in identifying the Aircraft in World War II. Further, in 1948, Harry Stockman explored the RFID technology in his paper titled "Communication employing Reflected Power". In the late 1960s, the nuclear material safety and security issue cause the further development of RFID, like the invention of the compact disc, which was visualized in the 1960s but did not get enough popularity until the 1980s. In 1973, Mario Cardullo claimed that his passive radio transponder with memory was the first true predecessor of today's RFID system ^[3]. Further, in 1973 the first demonstration of the RFID tags was done at the Los Alamos Scientific Laboratory ^[4]. The major progress in RFID tracking was done in the 1980s and 1990s. The Compaq computer started using the RFID to track components through production assembly in the 1980s. The developments in the compactness of chips and improvement in the computer speed with complex topologies of computer networks have broadly contributed to the increasing momentum of the RFID system. Most significantly, the standards are benchmarked during this development epoch to ensure that users can enjoy the ease of function and compatibility of this technology ^[5]. The awaiting storms of potentially distracting technology have found ways to bring comfort in our lives using the evolution of technology in different ways. Smart tags are interchangeable monikers for this technology. This modern technology is what we refer to as RFID technology. The RFID tag is usually contained within or fixed on a person or product for the identification, detection, and traceability purpose using radio waves. The RFID reader can read the data that is stored in the Radio RFID tags. Our privacy can be achieved by the use of this modern technology that marks an impact on our personal lives nowadays. The RFID technology is an emergent technology that is used in a wide range of applications, it is a member of the family of Automatic Identification and Data Capture which is referred to as (AIDC) technologies. This is the fastest and reliable means or method of identifying an object or thing. The RFID consists of two main components the interrogator, which is referred to as the RFID reader, and the transponder

which is referred to as the RFID tag. The Interrogator, which is the RFID Reader, usually transmits and receives the signal while the Transponder the RFID tag is attached to the object. In the RFID system, an RFID reader interrogates the RFID tags. This tag reader generates a radio frequency interrogation, which communicates with the tags been registered in the system. This reader likewise has a receiver that captures a reply signal generated from the tags and decodes the signal. This reply signal from the tags reflects the tag's information content. An RFID tag usually consists of an antenna and a tiny microchip [6]. The RFID alone has various applications but when it is combined with an Arduino it limitations magnifies more. The developments in RFID technology continue to produce larger memory capacities, faster processing, and wider reading ranges. They are a high tendency that the technology can replace barcode even with the expected reduction in raw materials together with economies of scale; the integrated circuit (IC) in a radio frequency (RF) tag can never be as expensive as a bar code label. Nevertheless, RFID will continue to rise in its recognized places where the barcode or other optical technologies are less effective. Attendance or daily register of employees or students in an institution organization, or places of work has turned into a vivacious assessment viewpoint in the current scheme in both institutions, organizations, schools, and universities. The unoriginal attendance-monitoring scheme has a few obstructions with the development of the latest technology gap. For example, giving out the everyday attendance sheet to a gigantic amount of employees, students in a class or an organization, industries, and places of work is extremely risky and it hinders the consideration of the students or people in that particular class or organization [7]. This is considered a waste of time and energy as well as students or individuals can intentionally register individuals who are not present in the class or places of work in the attendance sheet. If the lecturer or organization mistakenly loses these documents, all the important attendance records will be lost without hesitation. , the RFID novelty has a great chore to carry out in the completion of the vision of connecting objects around us to the internet. These items extend from huge structures, planes, modern plants, vehicles, any sort of merchandise, and explicit pieces of a bigger framework to people, animals, plants, and even obvious body portions of them. The idea driving all this is called the Internet of Things (IoT) [8].

COMPONENTS USED IN THE IMPLEMENTATION OF THE RFID SYSTEM

Radio Frequency Identification (RFID) System: RFID operates by transferring and receiving a signal using Antenna and Integrated Circuit (IC). It has mainly two parts namely, the RFID Tag and the RFID Reader. The RFID tags contain an integrated circuit (IC) and an antenna, which is used to transmit data to the RFID reader also known as an interrogator. This reader then converts the radio waves to a more usable form of information. The data collected from the RFID tags is then transferred through a communications interface to a host computer system, where the information can be stored in a database and analyzed later. The figure below illustrates the information.

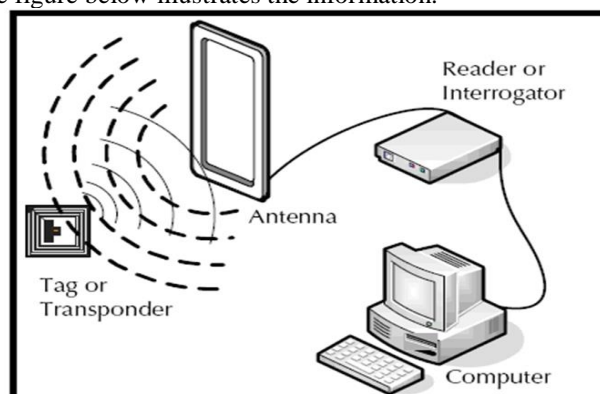


Fig-1: Shows the working operation of the Radio frequency identification (RFID) system

Radio Frequency Identification (RFID) Tag: The RFID tags called the transponder unit could be passive or active RFID depending on the asset type and its use. The active RFID tags usually contain a battery, a beacon to be charge periodically. Depending on the type and power of the antenna and noise in the surrounding environment, the RFID tags could be read remotely from a distance of several hundred feet. In the case of Passive RFID tags, they derive their power while they are inside the signal range of the Reader. Since they are substantially less expensive than the active RFID tags, they have noticeably less read rangeability. The RFID tag is an electronic tag that exchanges data with an RFID reader through radio waves. Almost all the RFID tags have mainly two parts namely, the Antenna and Integrated Circuit (IC). The antenna is used to receive radio frequency waves and the integrated circuit (IC) is used in the processing and store of information. The microchip on the RFID tags is written with whatever information the user wants it. These RFID tags can operate in three different ways

- (1) The Frequency that operates within the range of 100 kHz to 500 kHz is known as Low Radio Frequency (LRF) tag.
- (2) The Frequency that operates within the range of 10 MHz to 15 MHz and 850 MHz to 950 MHz is referred to as the High Radio Frequency (HRF) tag.
- (3) The Frequency that operates within the range of 2.4 GHz to 5.8 GHz is known as Ultra High Radio Frequency (UHRF) tag. Low Radio Frequency (LRF) tags are usually economical and have slow speed as compared to High Radio Frequency (HRF) tags, Low Radio Frequency (LRF) tags are usually used for the applications where the data transfer over a short distance is required. The High Radio Frequency (HRF) tags can be used for medium-range applications

having faster speed and can be used to transfer the data over a long distance. The Ultra High Radio Frequency (UHRF) tags are fastest than both the Low Radio Frequency and High Radio Frequency tags.



Fig. 2: Radio frequency identification (RFID) tags

Radio Frequency Identification (RFID) Reader: The RFID reader is the brain of the RFID system and is necessary for any system to function. The Readers also called the interrogators are devices that transmit and receive radio waves to communicate with the RFID tags. The RFID reader is a device, which is used to gather information from the Radio RFID system. The RFID system uses radio waves to transfer the data from the RFID tag to the RFID reader.



Fig- 3: Radio frequency identification (RFID) reader

Microcontroller: A microcontroller is an extremely combined device, which includes one chip, all, or most of the parts needed to perform an application control function. The PIC (peripheral interface controller) is an integrated circuit (IC) that was established to control peripheral devices, improving load from the central processing unit (CPU). It also has a low memory capacity; it is also used in performing calculations and is controlled by software just like the central processing unit (CPU). It is used in the designs where a local resolution needs to be taken. It helps in the programming of the whole circuit. Below is the image of the microcontroller.

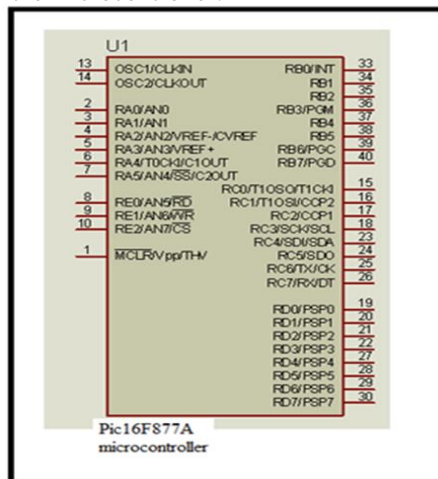


Fig-4: microcontroller

How the Radio Frequency Identification System (RFID) Antenna Works: A RFID system consists of three parts: a scanning antenna, an RFID tag that comprises all of the data about a product, and a reader which normally decodes and interprets the information on the RFID tag. These three pieces fit into a process where the information is first stored in the RFID tag in either a read-only or read-write format. The RFID tag is either battery-powered or passive. When the RFID tag comes within the range of the scanning antenna, an electromagnetic (EM) energy will trigger the RFID tag to start sending information in the form of radio waves. These radio waves are then picked up by the antenna and will then send to the reader which will then decodes the waves as digital information.

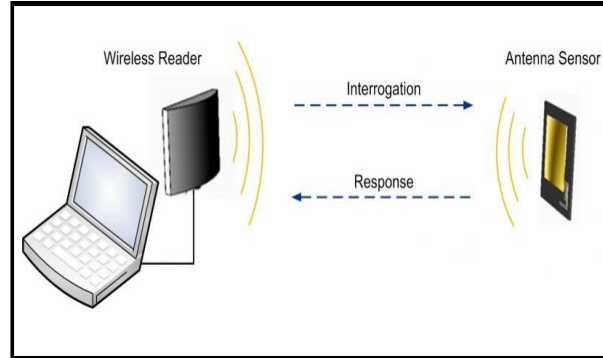


Fig-5: How the Radio Frequency Identification Antenna Works

Radio Frequency Identification (RFID) Middleware: This is the RFID software, which sits between the readers and the enterprise, business applications. The middleware software has numerous purposes and plays a major role in RFID system management and operation. The middleware software does not merely manage the RFID printers, readers, and connects between these devices and the business applications but likewise, filters, manages, aggregates, and makes sense of the information coming from the RFID tags.

Due to the complete volume of information coming from the RFID tags if fore instant thousands of RFID tags read at almost the same time thousands of times, RFID systems need a new kind of middleware, as well as unadventurous addition middleware. Orthodox middleware is used mainly to link distinct applications, both externally and internally, and to the enterprise for:

Decoding information into different formats

Web services

Routing data using different transport protocols

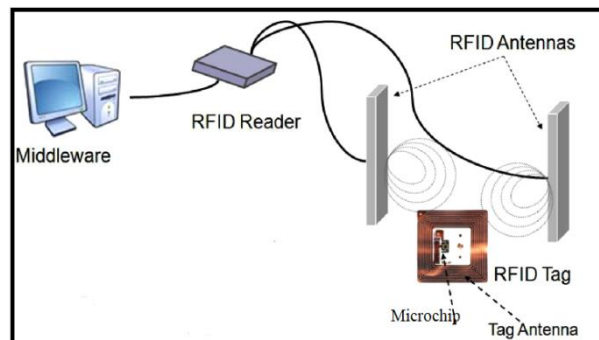


Fig. 6: How the Radio Frequency Identification Middleware

RELATED WORKS

Designed and implementation of a wireless fingerprint-based attendance system to obtain and record the attendance information using fingerprints known as biometric [9]. Designing time management and access monitoring system using a microprocessor card to monitor students and staff's movement with the data that are kept in the database for administrator reference in campus, office, or a certain area. Headmasters, Teachers, and parents could access all the information captured by this system by fully utilizing Mykad features via the Internet and intranet facilities [10]. A system that was capable to record student's attendance using interactive input, viewing students' and lecturer profiles, generating reports, and providing students timetable the system records the attendance using a barcode scanner is design [11]. In another spectrum, an RFID technology for checking in and checking out at parking areas without the need to stop the cars and it avoids traffic jams during the parking hours. This type of system is usually used in identifying vehicles through internet facilities by comparing the previous data in the database [12]. A system called the RFID Based Automatic Attendance system was developed. The attendance system software is developed using visual basic VB.net and database (Microsoft Access). Each of the employees or students has an RFID tag attached with the identification (ID) card. There is a serial connection between the computer and the RFID reader and the computer system. The RFID reader is placed at

the lecture hall door or entrance door of the organization. Whenever students or employees enter the lecture hall or organization, the RFID reader reads the RFID tags and it stores all data (Entry time, Name, etc.) of the employee or students into the database via a serial connection and maintains the system. Here the admin of this system can view all the documents using the software interface by retrieving the data from the database without any hitches, not like the traditional system of writing names on the attendance sheet or piece of paper ^[13]. Design and implemented an attendance system with the combination of RFID and a Web-Based system. This system uses the RFID tag and the RFID reader for getting the student's attendance and read the particulars of the students. Then this reader connects with Arduino which serves as the brain of the whole research because all instruction is given from there, which then passes the RFID reader response to the web server by the use of Arduino shield, finally, the attendance of students can be stored in web server by using PHP and MySQL. The admin of the implemented system can now view all the student's documents by login into this particular web-based application and can view all the student's details registered or stored using liquid crystal display (LCD) ^[14]. A system that, the RFID and Pose Invariant Face Verification for an automatic attendance system. The system works under two-factor verifications. In the first step, the students need to use the RFID tag that is read by the RFID reader. If the first step is succeeded then it moves to the second step of verification, if not, the student becomes under the unrecognized category. The second step is Face verification, if the face match with the particular registered in the RFID tag then it marks the student attendance that is in the database. Missing the above readings, the system will automatically identify the fraud students. This two-factor automatic system reduces the misuse of identity theft for getting attendance because they are not registered in the system database ^[15]. A Student Attendance Management System Based on RFID and Fingerprint Reader. The system also works as a two-factor verification system. In the system, the RFID reader is linked with the computer and the computer has specific software that is used to measure the automatic attendance of the students which is developed by Microsoft Visual basic studio and SQL. In the first place, the entire student must register his or her RFID tag and Fingerprints and it is stored in the database of the system. Once the students enter the classroom they need to use the RFID tag and this will be read by the RFID reader which will then check the database of the system to check if the tag is registered, if it is registered or correct then he moves to the next verification step. In the second step, the fingerprint of the student is then verified. If it matched the information of the students registered he or her then the attendance of the student will be stored on the server. Besides, the lecturers or teachers have authentication to use the system, they can also act as admin of the entire system ^[16]. An SD card module with an RFID tag, which carries different voice codes, is used in the system development. The tag identification card and the code of the voice greeting are stored in the SD card module. When the student enters the classroom door, his or her RFID tag is being read. If the identification card of the student tag matched with the stored data in the SD card then the particulars of the student or person need to use the voice greeting, if it matches then the door will be open and the attendance of the student will be store in the excel sheet. The Student can view their attendance detail using the liquid crystal display (LCD) use in the research. In the research, the Arduino connects the liquid crystal display, the RFID reader, the SD card module, and the rest components use in the research. Likewise, the system has very simple schematics than another system because of the very simple components use and the design of the whole system. Also, you can we get fast response and accurate results ^[17]. A model system called the Microcontroller Based Attendance System Using the RFID system and Global System for Mobile (GSM) was designed. The system consists of three atMega16microcontroller placed in between the RFID reader, Global System for Mobile modem, and the computer. Each of the microcontrollers uses has its purpose. The system will starts whenever a lecturer or teacher used his or her RFID tag to enter the lecture room or classroom then the students will enter the classroom also by swapping their RFID tags within five minutes. The RFID reader reads the RFID tag, sends the signal to the first microcontroller, which will analyze the signal of the RFID reader, and opens the classroom door using infrared rays (IR) signal, which is influence by a motor. This signal is temporarily stored in the microcontroller, when the lecturer or teacher finishes his or her class he or she must swap the RFID tag again to the RFID reader and the system will decide automatically that the class is finished. Therefore, the microcontroller will pass the temporarily stored signal to the computer database as the attendance. In case if a student is absent, the signal will pass it to the global system for mobile, modem and it will send this message to the parents of the students who were not present during the lectures or lesson in the lecture room or the classroom. If any of the students go out before the lecturer or teacher, the system will not count the student present in the lecture room or classroom. The system itself is an added advantage and a reliable security system. Thus, the students cannot cheat the administration and their parents ^[18]. A system that will work with the RFID technology and global system for mobile. In their research, they used a microcontroller as a midway among global systems for mobile modules and RFID technology. Whenever the students enter the lecture room or classroom, they need to make use of their tag, which is read by the RFID reader, and it sends it to the global system for the mobile module. If the identification card of the student or individual tag does not match with the stored information of the database he or she is considered as an unapproved person. If it accepts the tag, then the global system for the mobile module will send a message to the administration and their parents that the students attended lectures or lessons ^[19]. A system that uses web-based attendance using four-tier architecture by the use of RFID and Biometrics. In their system, the students, lecturers, or teachers' RFID has a unique code, which will be store in the database of the institution or school. The RFID reader and the fingerprint device are placed at the entrance door of the lecture room or classroom. Whenever the students want to enter the classroom, they need to use the RFID tag which will be read by an RFID reader and validates the identity of the students by comparing it with the information store in the

database whether the tag matches or not. The second stage of verification will be allowed if and only if the first stage of verification is succeeded. The Verification with the fingerprint is the second stage of the system and if the student's fingerprint matches with the data in the database then the attendance will be marked and stored into the database, but if he or her record does not store or capture in the database then they will be no attendance for that student. The fingerprint verification is merely acting in ten minutes including five minutes before the schedule and after the schedule of class starting time. If anyone is late then it will deny providing attendance to that particular student that is late but the students can stay at the lectures and learn but will not have attendance for that class. Lastly, a short message service (SMS) will be sent to the students' parents if the students are present or not in the lecture room or classroom ^[20]. Prototype of the attendance management system with the placement of a bigger number of RFID readers placed in the room and there is a server application maintains through a laptop. The radio frequency identification reader and the laptop or personal computer (PC) are connected with the help of a wireless router or LAN connection. Whenever a student or person enters the classroom or lecture room, he or she needs to use the RFID tag which is read by the RFID reader and passes the student's attendance to the server through wireless or LAN connection. Since many of the RFID readers are placed, more than one person can get the attendance simultaneously and get the higher efficiency than the traditional method or using the single radio frequency identification reader ^[21]. In addition, proposed a system that is working with the RFID technology and Telegram Messenger Application. In their system, the students need to meet their lecturers or teachers for the tapping of their RFID tags. If the tags match with tag information stored in the database, then it will send the attendance to the management of the institution or principal in the form of an excel sheet as well as sends a message to the specific student's parent via Telegram messenger. Meanwhile, facial verification cost is comparably average to other biometric verification. It also could be considered for a better system for developing an automatic attendance system. The RFID technology with a fingerprint system is very comparable to the RFID with the facial system. Each characteristic of the table is providing similar ideas except for their cost. Fingerprint biometric systems provide a very lower cost compare to Retina and Iris. Meanwhile, software, which makes use of visual studio and SQL, are costs in a great measure. Eventually, the system is considered a high-cost system with a higher eminence ^[22]. Low-Cost Portable Smart Card Based Attendance System. Is the combination of RFID with fingerprint biometric technology to enhance the safety level and integrity of the records. This design system does not merely make the system design simpler but likewise improves the efficiency of the institution both in terms of manpower and time. This system does not merely abridge the method of taking attendance but decreases the rate of errors and permits for faster verification of student attendance, all with minimal human interaction ^[23]. Smart Attendance Monitoring System (SAMS) A Face Recognition based Attendance System for Classroom Environment. This system is developed by the integration of omnipresent components to make a portable device for managing the student's attendance using Face Recognition technology ^[24]. A Radio Frequency Identification Based Attendance System with Short Message Service (SMS) Backup ^[25]. This project seeks to address means of automatically registering the students recording attendance, saving students information on the personal computer (PC) as well as backing their information via the global system for mobile communication, and finally making a decision on the worthiness of a student to sit for an examination course or attending the lectures ^[26].

CHALLENGES FACED USING THE RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM

- 1) Loss of the radio frequency identification (RFID) tags: This is just like the traditional locks and keys, you might likely or can forget or misplace your tags, which you are using to open the secure entrance the tags are registered to.
- 2) The radio frequency identification system can be hacked by hackers; the hackers can enter the secure environment and do whatever they feel like doing or even stealing without anyone knowing or aware of their presence.
- 3) Power Shortage Issue: among the major issue or problems the radio frequency identification system is facing is the problem of electric power especially if it is connected or powered by it. The radio frequency identification (RFID) systems may glitch during power outages affecting some lockers to either shut you out or worse leave the lockers open where people may try to steal what is inside.
- 4) More Involved and More Expensive to Setup: the radio frequency identification system requires locks that are being wired to a secured server. The computer that is going to be used is where access is controlled, programmed, and logged.
- 5) If the server computer is not connected to the internet, and you have time-based access restrictions, you will need to manually change the computer's clock twice a year when the time changes.

CONCLUSION

In this paper, I have reviewed many papers related to the radio frequency identification system we have seen their various improvements in the recent technology and the benefit of using the radio frequency identification system over the traditional paper-based attendance system in taking the attendance of the employees or students. Also, the challenges faced using the radio frequency identification system are discussed and its main components used in the implementation of the system.

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