A STUDY ON RFID BASED APPLICATIONS

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ABSTRACT-This paper contains description of Radio Frequency Identification (RFID) and its Application in various fields. Various research papers discussed in this paper describe different perspective of how RFID Technology is used. RFID is a wireless technology used basically for tracking assets. It is receiving considerable worldwide attention and is widely used in many applications. Based on the success of RFID applications in various fields as discussed below, it shows that its application is endless.

Index Terms: RFID, Security, Applications

I. INTRODUCTION

Wireless communication has been around for many years and is a growing field with improvements being continuously made. Most of the wireless technologies use air as a medium of communication. Wireless tracking is the use of wireless technology to locate objects within certain range accurately. A successful technology would have to provide accuracy, reliability and adaptability.

RFID is a new technology used for tracking objects. It is a wireless automatic identification that allows an object, place or person to be automatically identified without direct line of sight using an electromagnetic challenge/response exchange. This was originally designed in World War II and is gaining popularity due to ease of operation and low implementation cost. RFID is a simple system based on two objects called Tags and Readers. It operates on a various different frequencies. The tags can either be passive (they only produce a signal when near a reader and rely on the signal produced by the reader to power them) or active (the tags have their own battery life and produce a signal on their own). The readers are base stations that record the tags that are present within its range. The reader reads unique ID of tags and calculates the signal strength. The Returned Signal Strength Indicator is the heart of RFID Technology. It is used to calculate the distance of the tag from the reader. Some tags can be read several meters away and beyond line of sight.

There are various advantages of this technology. It provides real-time data transfer, easy to use software, reliability and adaptability. It has low implementation cost, greater accuracy and wide range of applications. This technology is used in monitoring, tracking assets, human identification, product identification and security systems. It has various applications such as Health care, Libraries, Tool Inventory, Positioning systems etc. There are many wireless technologies but RFID is contactless, convenient, efficient and reliable thus possibly falling under the scope of a new technology. This paper presents some of the important research papers that describe the application of RFID technology.

II. LITERATURE SURVEY:

Wen Yao et. al.[4] discuss the **a**ctive RFID tags along with barcodes which are used to track infusion pumps, beds, and wheelchairs. RFID tags are fitted on medicine bottles to detect fake drugs that move through the supply chain and to avoid misuse of medication. It is used to track a blood tracking system which can continuously report the blood temperature, track the blood bag's location, and confirm if it reached the particular patient. Misidentification is a medical error, which can be reduced by using RFID. Positive patient identifications (PPI) applications include using a smart patient wristband which is used for tracking vulnerable patients (elderly with chronic diseases, tuberculosis and dementia patients), during emergency, for identity confirmation of new born babies, identification of disaster victim. They also reveal patient information such as name, date of birth, admitting orders, insurance information, surgical site etc. A new specimen labelling system that used RFID reduced error in the pathology laboratory. RFID tag-labelled endotracheal tubes are used for accurate bedside monitoring to reduce health risk. In hospital, temperature sensing makes it very convenient to track tainted blood to aid in protecting a hospital's blood supply and chemical sensing can support advanced medical monitoring. An indoor navigational system for blind or visually impaired people using RFID can be used in finding pathway for patients by adding a map information system installed on a white cane. By capturing data automatically, error in data collection in hospitals can be solved. If equipment fails, RFID can accurately identify and discard it from service. It can also help in creating an audit trail as to which piece of equipment has been used with which patient. In [7], the LibBest RFID EAS Gates are discussed which are used to prevent theft in Library RFID Management System using the same RFID tags embedded in the library items. They are equipped with EAS (Electronic Article Surveillance).Each gate not only tracks items (of about 1 meter), but also triggers the alarm system and lights will flash when an un-borrowed item passes through it. It has option to trigger a Camera to record patrons who trigger the alarm. Theft detection is an important and an integral feature of the chip which is within the tag. It operates independently of the library database and hence it is a stand-alone technology. This Single technology is sufficient for both inventory and theft management of the library. Thus Library staff is alerted immediately when un-borrowed items pass through the theft detection gates. Matthias et. al. [8] discusses the use of RFIDs for Tool Inventory. In Smart Tool Box, RFID tags are attached to all tools and the boxes are equipped with RFID readers and

antennas. The toolbox can uniquely identify all tools that are in the toolbox and automatically perform the routine and base completeness check. This is done by comparing all IDs on the tools with a list of IDs of tools that are belonging to the box. Missing tools are shown by empty spaces and tools that belong to a different toolbox are highlighted with a special indicator. It also identifies the mechanic by detecting his RFID badge. A warning will be displayed to avoid mixing up of tools if he is not the owner of the box. The usage history of the tools is inferred from the time a mechanic takes out a tool and puts it back. It allows optimizing the content by removing tools that are used infrequently from the toolbox and placing them in the tool inventory. RFID tags are attached to all tools in the inventory. Similarly an RFID reader and antenna are attached to checkout counter. No explicit user interaction with the system is needed, since the tools trigger all processes. When a tool is placed on the counter, the tool management system checks the ID.A return process is initiated if the tool is currently checked out and the identified tools are marked as returned. Else a checkout process is initiated, in which the tools are marked as checked out. This allows detailed statistics of tool usage and can lead to an optimized tool inventory. Cecilia et. al. [9] discusses RFID system for remote monitoring and control of overnight living environment. This is based on RFID passive technology to monitor activities at night and generate alarms automatically in case of anomalous behavior. In manual monitoring a person has lack of sleep which may affect his health. Typical remote monitoring systems contain audio/video recording systems and active sensors directly connected to first-aid remote centres. The NIGHTCare platform makes use of miniaturized wearable tags attached to objects and conventional ambient tags dispersed in the environment. A long-range UHF RFID reader processes the electromagnetic signals generated by interaction between the subject and surrounding environment that indicate the presence or absence of the object. A physical layer software engine is present for real-time processing of data and a web based graphical processor with warning modules that alerts the supervisor during accidents. This system makes it easier for the security people to work.

Yuusuke et. al. [14] discusses wireless, automatic and non-contact identification of people visiting the large scale events. It employs EPC (Electronic Product Code) network architecture which is a standard for networked RFID systems. The trials were conducted at Tokyo in an exhibition of Internet technology and networking equipment. RFID systems were used for activities like same day registration processing, recording venue entry, necessary information processing (recording, searching). All the peripheral systems interacted through the network. RFID tags were used as an entry pass by the visitors and also as a business card to provide their contact information. The exhibitors used RFID tags to send electronic version of pamphlets to the visitors who had requested for information. Monitoring of visitors was done through real time monitoring system that made use of video surveillance. There was one problem faced i.e. when visitors carried laptop computers or other non-RFID electronic equipment, readability dropped and created difficulties in reading the tag. Yang et. al. [22] proposes a portable wireless monitoring system for sleep apnea diagnosis. This system is composed of an on-body sensor system and a RFID reader and tag. This system is designed to operate in the 5.8 GHz ISM band, to minimize the physical size of the sensors. A unique resonant frequency is set for each tag and on corresponding sensor device it is labelled. The on-body sensor unit accesses it. The uneasy feeling of the patient during monitoring process is reduced through this system. The MIMO technique is introduced in order to overcome the fading effect due to body movement and reflection etc. Pen-ho et. al. [27] discusses the integration of Radio Frequency Identification and SIP Express Router (SER) to create a VoIP (Voice over Internet Protocol) system for personal mobility, In this system, as soon as the user moves to different locations, the sensors of the doors/locations reads the RFID Tag of the user and the server activates the phone and it registers to the SER immediately. This system will close the phone which the user used before at the same time to avoid multiple registrations. In this system there is no restriction of using a specific phone. To support personal mobility Remote Call Server (RCS) and Remote Call Client (RCC) are used. The phenomenon of call-miss, where someone calls in during the time the user is moving to another place, can be reduced if the user agent can start on as early as possible at the time the user moves to the guard system of the new location. Joshua et. al. [29] discusses detecting human activity using various RFID based techniques. It can be computer vision or active sensor beacons or passive RFID. Active sensor beacons provide accurate object identification but are impractical for long term deployment as they require batteries. But RFID tags have the same object-identification accuracy as active beacons, with an advantage of being battery-free. Two different approaches based on RFID are mentioned here. The iBracelet is a short-range RFID reader that detects object via hand proximity which is wrist worn. The Wireless Identification and Sensing Platform (WISP) is a long-range RFID tag that detects object motion which is augmented with sensors. The combination of approaches is most suitable for real-world applications and especially for human activity detection.

Souvik et. al. [23] proposes an implementation for enhancing museum visiting experience using active RFID technology. Radio Frequency Identification Detection (RFID) technologies are applied in cultural spaces like museums and art galleries to help users to get the correct information about the artifacts. This system rules out the need for traditional guides at these places. An Active RFID based prototype has been used to describe the audio information of the artifact to the visitors in their preferred language through an audio system, via a headphone. RFID has the ability to identify objects in a wireless mode with no contact or a direct sight line. Artifacts have a reader and processor is attached and there will be a handheld device that has active RFID tag, a processor and an audio system along with a headphone. Every visitor entering the museum is supplied with the handheld device during the entry. On the handheld device there are push buttons each corresponding to a particular language. When a visitor wants to get information about a particular artefact, the visitor has to simply stand in front of the artifact and select one of these pushbuttons. The audio descriptions of the artifacts can be heard through the headphone. Koushik et. al. [25] presents a Traffic Congestion Monitoring & Measurement System called Traffic Monitor to monitor and measure the road traffic congestion using a probe vehicle. This system helps to analyse the traffic movement and congestion patterns. Traffic Monitor combines active RFID and GSM technologies. The calculation of vehicular speed and the average waiting time of vehicles at road crossing are important in congestion detection algorithm. Conclusions arrived from this system are period of slowest traffic movement, average lane velocity (i.e. level of congestion and nature of traffic at different hours) and average waiting time. Thus it is possible to measure

congestion more accurately and easily from this system. Dawood et. al. [26] presents a new active RFID system based on the low power system on-chip. The main application of this system is for the container identification. An active Tag is mounted on each vehicle. The AUTOCRC error detection is enabled to detect minor errors in the received frames. Using RFID, a large amount of time and cost is saved and a safer transportation method is provided. TDMA protocols have been focused as they help in avoiding collisions. In limited power supply conditions, tags will be in sleep mode. A Tag is only activated by the Reader command. This system is used for vehicle transportation and container tracking at commercial ports.

Cyril Brignone et. al.[3] propose a system for real time asset tracking in a data center. For tracking physical assets in a data centre, each asset is fixed an RFID tag which must pass within close proximity to a reader (typically less than a meter) in order to be detected. But accurate location knowledge is only available occasionally and under limited conditions. The Sentient Data Centre or SDC provides the solution. It consists of the RFID Reader Array (an array of antennas and reader circuit), which is the hardware that performs pinpoint asset detection. Each rack has an array embedded within itself (usually in the front door). Each antenna is customized to detect tags only in the corresponding slots and thus only the corresponding RFID tags are energized. Asset Identity is transmitted by the tag in that slot if it is present, which is decoded by the RFID reader. There is a Rack Sensor Controller (RSC) in each rack connected directly to the RFID Reader Array, a network interface and a Door Position Sensor (DPS). The DPS tells the RSC when the door of the rack is opened or closed. It packages the data extracted from the RFID Reader Array into the SDC message format and sends it over the network to the Forwarder. TCP/IP stack is auto-configured by the SDC using DHCP. Network Time Protocol is used to synchronize the time clock of the RSC, so that SDC messages have a proper timestamp and location history is accurate. Thus the current and past location of each asset is recorded by the database and thus automatically finds the physical location. YanboWu et. al. [6] discusses Networked RFID where software and isolated RFID systems are connected using the internet. They not only ease the integration of distinct RFID systems, but also address the limitations of passive tags and enable traceability such as, discovering the current location of an item. They can also retrieve history, such as previous location, time required to travel between two locations etc. To achieve full potential of traceability, partner nodes in a traceable RFID network must share collected data. EPCglobal Architecture Framework (EAF) is one of the most well-known RFID network architectures with several core services (EPC Network Services). This framework has three modules, namely identity, capture, and exchange. The identity layer standardizes data representation in RFID tags (EPC Tag Data Specification and Tag Data Translation). The capture layer consists of standards for reader management, reader protocols and most importantly, the Application Level Event (ALE) interface. A common interface for accessing processed RFID data is ALE. RFID readers send a collection of raw RFID event data which is controlled by ALE. The aggregation and filtering of RFID data is described by the ALE specification. Exchange is designed as a service-oriented architecture. Data provisioning and discovery are enabled by many services. In this way, a large-scale RFID network can be built by to achieve traceability. Ahmed et. al. [11] discusses the connected coverage for RFID and WSNs. RFID technology is used in monitoring and tracking of objects. The wireless sensor networks are used to sense parameters in the environment. A WSN is defined as a network of a set of sensor nodes connected wirelessly. Sensor Networks are connected to internet through a base station or a gateway. Localized distributed algorithm is used that forms a connected sub network of the set of nodes that preserves coverage. It is based on building a connected dominating set and adding nodes to it to preserve coverage. The algorithm is compared to well-known benchmarks. The first benchmark is minimum spanning tree whereas the second is shortest-path tree. The algorithm considers RFID networks, but it can be easily adapted to WSN and RFID/Sensor networks. Prasanna et. al. [20] proposes a mechanism for vehicle load balancing and tracking using RFID, GPS and GSM. Logistics management is very important aspect in real time applications. In recent years, important developments have emerged in the field of Real-time Location Systems (RTLS). Radio Frequency Identification and Detection (RFID) is rated as one of the most promising and significant RTLS in industries. It can be deployed in different applications and offer various additional functions. The Global Positioning System (GPS) is the most promising technology to acquire the position information in outdoor environments. It allows the real-time location of human and resources both indoor and outdoor. GSM is used to send the message after receiving the goods. RFID tag is placed in goods and the RFID reader is placed in the vehicle. SN74HC00 are used to coordinate GSM, GPS, and RFID is interfaced with PIC microcontroller. Weight sensor is used to find out the overload in the vehicle. Thus issues like misplacement of goods and overload of vehicles can be solved. Tracking of cargo vehicle and periodic information about arrival of goods is also accomplished.

Nosaiba et. al. [13] discusses mobile robot location based on RFID sensor and Neural Network. The researchers deploy RFID technology for mobile robot localization. The robot senses the location information from a RSSI (received signal strength indicator) tag and adds it to a list of tag IDs. The robot is a learning agent that learns about the environments and interacts with the objects through received percepts. The tags contain the x and y coordinates of the location of the objects. Robot uses these coordinates and trigonometric function to compute the distance that must be travelled. Specific tag is recognized by the RFID reader when the mobile robot crosses circular region around the tag, to reduce the mobile robot localization error. The RFID system used is a 433-MHz Wavetrend L-RX300 receiver, which has a baud rate of 57,600 bps, and Wavetrend TG501 Personnel active Tags that transmits its data every 1.5 s. The RF waves are electromagnetic waves that cause a signal to be transmitted from the tag to reader. It is further transmitted to a remote PC by the microcontroller where it is stored. It is basically an autonomous navigation agent making use of RFID systems. Ali Asghar et. al. [16] discusses equipment location in hospitals using RFID based positioning system. To improvise the flow of material, equipment, personal and patient, sensors and radio frequency identification (RFID) technologies have been deployed. In hospitals, real-time location systems (RTLS) are famous for bed tracking, real-time logistic analysis, critical equipment tracking and patient monitoring. RTLS increases efficiency in the utilization of processes and staff productivity. It brings transparency within the logistics and reduces inventory and over buying. It decrease search times, and ensure that the right patient is available for the right procedures. It helps to monitor wandering patients which is one of the hot

topics in developing assisted system for elderly safety. Passive (RFID) technology mounted on flooring plates and several peripherals for sensor data interpretation. It determines accurately, the location and orientation of mobile objects in an indoor environment by proposing a robust and novel system based on RFID technology. Lionel et. al. [30] presents LANDMARC, a location sensing prototype system that uses Radio Frequency Identification (RFID) technology for locating objects inside buildings. It uses reference tags. These tags have known distance from the readers and allow the system to adjust on the fly when measuring signal strength. If the signal strength for a known tag decreases, this is taken into consideration when nearby tagged assets are read and allows correction of signal strength. One of the most well-known location-based systems is the Global Positioning System (GPS), widely used to track moving objects located outdoors but not inside buildings. RF tags can be read despite extreme environmental factors, such as snow, fog, ice, paint etc and are helpful in tracking objects even inside the buildings, unlike GPS. The proposed LANDMARC approach shows that active RFID is a cost-effective candidate for accurate indoor location sensing. Jeffrey et. al. [31] discusses a tagging technology for three dimensional locations sensing which is based on radio signal strength analysis. Algorithm used is the aggregation algorithm. Reference readers are used in this approach. Each reader finds the location of all the tags with respect to that individual reader. Then each calculation is sent to a central database and a final location is approximated for the asset. Even though these tags are low powered they have enough power for authentication and caching tasks.

Apatcha et. al. [10] discusses surveillance of juvenile behavior using RFID and CCTV monitoring. The use of modern technology to track the behaviour of the Juvenile is not an easy task. CCTV is used for surveillance and monitoring. CCTV communication system sends data to a control centre and the data is analyzed. Children and youth are monitored by a social worker and psychoanalyst. RFID and GPS is attached to wrist bands to coordinate the information that must be recorded. The missing children can be tracked by the GPS. It is a modern way of supervising children. Ted Chih et. al. [21] proposes an architecture which integrates the video surveillance into RFID tag at range of 250 kbps data rate for video data transmission. Here the video surveillance part is done by padding based Distributed Video Coding (DVC). The RFID transmitter and receiver operate at the same data rate, frequency and bandwidth, and the received data is directed to a wireless network. If the general video compression method is adopted, it would generate unbalanced computational complexity between encoder and decoder. This is a disadvantage for lower power surveillance system. Therefore, the part of video processing is replaced with padding-based DVC scheme for video encoding where computational complexity at encoder is shifted to the decoder side. The DISVOVER codec is deployed as it outperforms at the range of 250 kbps data rate, which is desirable for RFID tag application. Hence there is no need to use high data rate RFID tag technology.

Shaun et. al. [5] discuss the anti-theft designs for mobile phones. RFID is an automatic identification technology whereby digital data encoded in an RFID tag or smart label is captured by a reader using radio waves. RFID tags work over very short ranges (about one metre). RFID reader add-ons for mobile phones are available. Near field communications (NFC) technology is an evolution of RFID. NFC is aimed at electronic devices which are mobile (or moving). NFC adopts the same principle as RFID. However, it works at extremely short distances (i.e., only in close proximity to a reader). It is possible to track the movement of RFID tags with appropriately placed readers. NFC devices are used for security and crime-prevention purposes. Maxim's iButton is a computer chip that can be attached to a key fob, ring, watch, mobiles or other items. The iButtons can transfer and hold information to RFID tags. But, the device cannot be read remotely as physical contact is needed between devices for communication. This is surely a disadvantage in few cases where tracking at a distance is a necessity. But it does make the device more secure against remote hacking. Ali Asghar et. al. [17] discusses an RFID-based position and orientation measurement system for mobile objects in intelligent environments. Ambient intelligence (AmI) examines the environments in which applications and services adapt to changes in the surroundings and behave according to user's need. Recognizing the location and orientation of surrounding objects is one of the most challenging tasks. This is important for effective cooperation among mobile physical objects in such smart environments. A robust indoor positioning system that provides 2-D positioning and orientation information for mobile objects is needed. The system utilizes low-range passive radio frequency identification (RFID) technology. The system consists of RFID carpets and several peripherals for sensor data interpretation. Angus et. al. [18] discusses initial position estimation using RFID tags. Positioning of mobile vehicles is an important issue that is solved using GPS data. The position is obtained relative to a global frame of reference. Unfortunately, GPS reception is not possible in situations like underground mines, tunnels, or within buildings. In such situations an alternative approach known as simultaneous localization and mapping (SLAM) is used. The challenge for the SLAM algorithm is that the initial position given to the algorithm must be accurate. In these approach sensors such as accelerometers and gyroscopes are used to obtain relative position information sensors such as ground based laser range finder (LiDAR) is used to provide absolute position information. This technique is able to estimate the position, as well as map the environment the vehicle is travelling through. If 3-D LiDAR is used, then a full 3-D volumetric map can be generated. RFID-based positioning has the potential to provide relatively accurate and low-cost initial position estimation.

Avery et. al. [19] discusses the solutions for RFID smart tagged card security vulnerabilities. The use of Radio Frequency Identification (RFID) technology has increased in all industries. Companies and government agencies have used RFID solutions to make their inventory control systems more efficient. Even though there are many benefits that RFID can provide to industry, there are security problems that come with its use. Using RFID tags for tracking items carried by people could poses significant security and privacy risk to both organizations and individuals. A tag responds to a reader without the owner's approval and without the owner even noticing it. The communication between the tag and the reader is the weakest point of security in an RFID system. It does not utilize any encryption, especially when passive tags are used. The network interface between the reader and

host system or network is covered by the IT security policies of the corporate network. One of the easiest ways to safeguard consumer privacy is tag-killing. This method kills the functionality of the RFID tag once it is at the point of sale. The Kill command is built into the RFID tag and is executed once the RFID reader sends a code or PIN at the point of sale to make the tag unusable. Lanxin et. al. [24] proposes a method based on tag location-aware scheme to optimize the DFSA tag anti-collision algorithm called LaDFSA. The main limitation for a RFID system in large scale scenario is the heavy energy consumption of the reader battery, due to the frequent tag collisions. To avoid the collisions, Dynamic Frame Slotted ALOHA anti-collision algorithms (DFSA) are used. In the proposed method, the handhold reader firstly collects the tags location information and divides them into different clusters based on their distance from the reader. Then, it estimates the tag population for each cluster. The reader utilizes this value to achieve an optimum frame size and automatically adjusts the transmission power to scan the tags in corresponding tag cluster and avoids collision. Mohammad et. al. [28] presents IMAKA-Tate (Identity protection, Mutual Authentication and Key Agreement) using Tate pairing of Identity-based Encryption method. By applying cryptographic methods with security protection various RFID application challenges can be tackled. Thus, IMAKA-Tate protects the RFID system from various security and privacy threats such as unauthorized tracking, cloning attack, etc. There are several issues that must be tackled in smart RFID system like the nature of RFID tag which basically can be read without authorization introduces security risks and makes the RFID system susceptible to cloning attack, spoofing or data manipulation, collision attack, Man-in-the-Middle attack, replay attack, etc. Common RFID communication is not mutually authenticated, so it is highly susceptible to various impersonation techniques, leading to unauthorized tracking, spying, or analyzing the information leakage to reveal the user activities. This system performs encryption of the smart RFID tag even before the mutual authentication has started. The privacy preserving can be achieved well by preventing the tag identity being revealed by unauthorized party.

Byung Youn Song et. al.[1] propose a feasible and effective IT management system. An office consists of many devices which contain invaluable information and data for which there is no substitute. There are chances that the information is erased or damaged not merely by thieves or hackers, but by the employees themselves. If we are able to detect environmental conditions, severe damage caused by them can be prevented. Temperature sensing and acceleration sensing are the factors considered for testing. SAW RFID tags use piezoelectric crystals with reflectors at definite intervals to represent the tag's data (which is read by variations in time, phase or amplitude). Each location reflects back part of the signal when the incoming radio energy is transduced to a sound wave propagating along the surface of the tag. The relative position of each reflector is indicated by the spacing of these reflections or echoes. The central SAW reader checks ID and temperature of several SAW tags. The SAW reader is called when there is a missing ID, which watches the doors till it is found. If there is no signal inside the office or if there is a crossing signal through the doors, the RFID security system will send an alert to the central security centre. Shengguang Meng et. al.[2] proposes a RFID based Asset Management System (RAMS) used to automate the management of assets that are to be controlled in real time. RFID readers submit the data of asset to RFID component through GSM modems when assets enter or leave base station. The RFID component returns a confirmation to the RFID reader after finishing the analysis. The RFID technology implements the automatic recognition of the assets to facilitate their tracking, while GSM technology facilitates the gathering of such data and the WebGIS facilitates dynamic visual representation of the asset distribution's spatial information on an electronic map. They integrate data, calculation, analysis, and management. The communication between the AIS (Asset Identification Subsystem) and the application server ends when a confirmation SMS is received from the application server. Through SMS, an alarm is sent to the relevant administrator. The ASMS (alarm SMS management subsystem) utilizes an efficient MPF algorithm for accelerating the sending time of the alarm SMSs that have high-priority. Thus asset management is used for enterprises with extensive and dispersive distributions of assets. Ramkumar et. al. [12] discusses the tracking of location using RFID and GSM for vehicle theft alarm. It is an auto-guard system that combines RFID and GSM together. The vehicles have the RFID tags and reader continuously reads the tags. The GSM (Global system for mobile) uses a process called circuit switching. It provides functions like text messaging, calling a registered phone number, deleting memory locations etc. The system contains microcontroller circuit board, keypad, alarm system and a display board. The GSM module interfaced with the controller sends data through the SMS to the registered mobile number. The password is entered by authorized person using keypad. A buzzer is used to indicate the theft and gives the alert to the authenticated user. For mobile communication and also for alert messaging GSM is used. In this technique, both security and tracking the vehicle is done. Kirti et. al. [15] discusses detection of theft portable products by making use of RFID technology. This technology can be used in a place where there are space constraints, low power availability and immobility. They define two kinds of products, one of them is the product that contains a processor and can host reader. The others are the products that contain tags. The tags send packets of information to the reader. Tags contain unique ID that is used to match with the ID in the database of reader. The unique ID helps in countering replay attacks. The packets also contain information that is used by error correction mechanism using hamming code to detect false theft alerts. The working of the model is based on real-time theft-evident algorithm that matches the unique ID on tags with the ID in the database using STM RFID CRX14 reader. If it matches proximity flag is set to true. If not it is set to false after the error checking to indicate that a theft has occurred. This is almost real time theft alert system that alerts about the theft instantaneously and also provides evidence of theft.

III. CONCLUSION

As the relevance and importance of security, surveillance and monitoring is continuously increasing, the importance of RFID based technology is increasing parallely. This paper discusses the various applications based on the RFID applications which is the cutting edge of research today.

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