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Internet of Things to Enhance Real-Time Monitoring Using Linear Regression Algorithm

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Abstract. Automatic machine or computer identification, metadata recording, and target control are all made possible by radio frequency identification systems (RFID). When an RFID reader is linked to a computer, it can automatically and globally identify, track, and monitor any tagged items in real-time. The term "Internet of Things" (IoT) describes this phenomenon. Many people consider RFID essential for IoT. Combining RFID technology with the Linear Regression algorithm with IoT for real-time monitoring offers businesses looking to improve productivity, visibility, and data-driven decision-making in a variety of sectors and applications a potent solution. Using the advantages of both technologies, this method develops a complete and scalable process monitoring and optimization system in real-time. Use RFID) Technology and the Linear Regression algorithm with the IoT aim to improve real-time monitoring by building a sophisticated, data-driven system that maximizes operational efficiency, facilitates well-informed decision-making, and offers insightful information about processes. This article provides an overview of RFID and IoT technologies and then goes on to analyze their potential uses and potential pitfalls when used to the Internet of Things. A device that can detect environmental factors, create related data, and communicate it via a communications network may be attached to a non-living item (such as a car, plant, electrical system, roof, lights, etc.) using the Internet of Things. The results show the frequency and time taken for real-time monitoring.

Keywords: Radio Frequency Identification, Real-Time Monitoring, Internet of Things, Linear Regression Algorithm, and Frequency

INTRODUCTION

This article provides a summary of the technologies available for RFID sensing and their potential or existing uses. In the first section, provide a brief overview of wireless sensing technology and explore the advantages of using RFID sensors in place of traditional Wi-Fi nodes outfitted with sensors. RFID sensors are highlighted for their low-cost and battery-free operation compared to other sensor options. By dissecting RFID sensors into chipped and chip-less varieties, we can make more informed comparisons. Each class is broken down even further according to its underlying mechanism (electrical, magnetic, or auditory) for producing results [1]. Now a fully developed technical option, RFID sensing via chip-equipped tags, is rapidly expanding in both market share and scope of use. However, chip-less RFID sensing is a novel idea that has the potential to revolutionize the industry; however, further study is needed to determine how best to use this technology in various settings. Demonstrate and explain the advantages and disadvantages of various tag settings. Finally, examples of the optimal uses for RFID sensors are shown. Finally, a comparison is made of different commercially accessible sensor technologies.

The rapid global spread of COVID-19 was unexpected. The coronavirus pandemic has prompted action from the government, business, academic, and charitable sectors of the community. It's quite clear that we need technological solutions immediately. This research is a baby step in the path of constant health data collection and monitoring. In this work, construct a network of intelligent nodes, each of which has a sensor, a microcontroller, and an RFID tag. Clusters of intelligent nodes are built on a regular basis. Once the cluster head's reader has gathered enough information from its members, it will relay that information to the main reader, and so on [2].

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Just scanning tags that are directly near the main RFID reader relieves some of the reader's workload. In addition, this method lessens the demand for access to the channel, which in turn minimizes interference. Advanced Encryption Standard (AES) 128-bit with hashing is one of two layers of security algorithms in place to prevent unauthorized access to the information being sent. Validation of the suggested approach was achieved by Integer programming-based mathematical modeling, simulation, and prototyping. The suggested method reduces transmission time considerably and has minimal data delivery loss as compared to advanced techniques.

The value of RFID technology has been shown. RFID is utilized in a wide variety of products, including equipment chasing, access panels for people and vehicles, logistics, luggage, and shop security. RFID's primary advantages are in the areas of resource maximization, high-caliber customer service, pinpoint precision, and streamlined corporate and medical operations. RFID may also improve the likelihood of products serving their intended purposes by recognizing relevant information. However, RFID parts require research before they may be used in medical settings. The three major parts of an RFID system are the antennas, the tags, and the readers [3]. The study of these factors sheds light on how and where they are used in healthcare settings. Patients' safety is increasingly a major concern in public health across the world, especially for the elderly, who need sophisticated physiological health monitoring systems. In this study, the authors suggest a healthcare monitoring system that makes use of RFID tags and IoT. High-frequency body information monitoring is accomplished using RFID dual-band protocols, which are used in the approach. Sensors capture and analyze the patient's physiological data to identify them with an RFID tag. Through IoT and RFID technology, individuals of all ages may access their own physiological data. In addition to giving doctors access to necessary patient data, they want to prevent unauthorized access by utilizing a signature technique based on the hyper-elliptic curve (HEC). In addition, patients of varying durations are guaranteed the privacy of their medical data. Different genus curves are shown in the assessment, revealing the method recommended for optimal health care [4]. In this study, we introduce unique inkjet-printed near-field RFID tags/sensor designs with consistent magnetic field properties. The theory of characteristics mode (TCM) served as inspiration for the creation of the suggested label. Further optimization utilizing particle swarm optimization (PSO) accomplishes the design's goal of present and magnetic field performance homogeneity. This tag employs the logarithmic spirals as its radiating structure, making it smaller and less electrically obtrusive than conventional near-field tags. The logarithmic spiral's strength is that its reception region for the magnetic field may be expanded, allowing for a greater reading distance to be achieved.

To achieve the appropriate resonance frequency and homogenous magnetic field, TCM is combined with PSO. In addition, the PSO was used to provide constant magnetic fields in the RFID near-field reader's antenna's horizontal normal phase. The design may be read from up to three times farther away than the most common commercials near field tags (Impinj J41). The suggested near-field tag design also has promising sensing applications, such as human body temperature monitoring and commercial item-level tagging of higher-value jewelry goods [5]. The problem statement is discussed below. The problem statement for using RFID technology with the Linear Regression algorithm to improve real-time monitoring with the IoT includes several difficulties and problems that must be resolved to meet the system's objectives. It's possible that current systems can't provide real-time insight into the whereabouts, status, and motion of objects with RFID tags. Inaccurate or delayed information may cause inefficiencies in the distribution of resources and decision-making.

The following are the contributions.

- Create strategies for integrating RFID technology with IoT platforms, fixing compatibility problems, and guaranteeing effective communication.
- Putting systems in place to gather data in real-time from RFID-tagged objects and send it effectively to the IoT platform, making certain that the system delivers correct and timely data for analysis and monitoring.
- Put in place systems for ongoing system performance monitoring and adjust as necessary. Guaranty the system's continuous efficacy and dependability in practical situations.
- Together, these innovations have made it possible to successfully create and implement an IoT system for real-time monitoring that makes use of RFID technology and linear regression technique.
- They tackle major issues, enhance system functionality, and provide a basis for data-driven decision-making across a range of applications and sectors.

The following section will be a literature survey discussed in section 2. After that, the proposed system is discussed using a Linear Regression algorithm for IoT in section 3. The Results and discussion are discussed for the given dataset to improve the real-time monitoring in section 4. Finally, the conclusion provides the overall performance of the healthcare system and recommendations for future work.

LITERATURE SURVEY

IoT has become more commonplace in many industries, particularly in "smart" ones like "smart" warehouses and "intelligent" factories. RFID technology is a foundational component of the IoT network, allowing for the identification and tracking of a vast number of physical items across a wide area network. An important area of study for IoT networks is the efficient management of large numbers of RFID tags. This work examines a basic management issue known as tag-sorting, which involves (1) arranging a set S of identifiable tags into a desired order by communicating a unique number (t) 1, 2, |S| to each tag t S, and (2) preventing unidentified tag from being sent any of these integers [6]. This issue must be solved as soon as feasible for RFID systems because once sorted, each identifiable tag t S may be controlled using an integer much less than its 96-bit long tag-ID (log 2 (|S|); 96), greatly improving efficiency. However, current research is unable to quickly find a solution to this issue since (1) and (2) are handled independently utilizing an aloha-like protocol and Bloom filter, which results in extended communication times that are not optimal. In this research, we propose a procedure called P sort that may quickly resolve this issue. To accomplish (1) and (2) concurrently with a communications time shown to be significantly shorter than the advanced protocol, this protocol is constructed using a unique data format and communications technique. The simulation findings show that P sort can speed up the process by around 1.4 times compared to the best existing methods [7].

Among the most significant technological advancements in recent years, RFID devices and sensors have had a profound effect on the physical communications layers of IoT, as well as the fields of logistics and robotics. The focus of this article is on the most important technologies now accessible for RFID sensors, with the goal of determining the advances when these technologies are applied to practical IoT settings. To begin with, the advantages and disadvantages of radio backscattering and harmonics backscattering are discussed. The potentials of RFID-based sensing are then surveyed by reporting state-of-the-art systems and discussing their respective performances [8]. RFID is an inexpensive way to facilitate the IIoT and serves as a foundational technology for the emerging fifth industrial revolution. RFID is well suited to Industrials IoT because it can be retrofitted for ordinary objects and does not need a direct line-of-sight connection. However, the RFID transmission is influenced by the material permittivity of the tag's attachment. RFID transmission is hindered by the prevalence of metal in smart manufacturing settings and supply chains. Industry 5.0 applications need a tag design that can stand up to these sorts of pressures. In this work, we compare RFID antenna designs with and without metals below the tag to determine which provides superior communication performance. The simulation-proven RFID tag designs were fabricated, and their read ranges were tested on material with variable relative permittivity and thicknesses to simulate situations. Results have shown the sturdiness of "Cyber" to "Physical" designs, and suggestions aid in IoT tag selection for practitioners [9]. This study introduces a method for detecting contaminants in beverages and foods using RFID and machine learning. Ultra-high-frequencies (UHF) RFID tags manufactured using inkjet technology are used for contamination sensing experiments. Antennas for radio-frequency identification tags were attached to both uncontaminated and tainted foods whose levels of contamination were measured. Tag-performance Pro is used to measure both the received signals strength indicators (RSSI) and the phases of the backscattered signals from the RFID tags attached to the food items.

For further model training and to increase the sensing accuracy to about 90%, we employed a machine-learning approach called XGBoost. Therefore, this work opens the road for ubiquitous contamination/contents detection using RFID and machine learning technologies, which can educate people on food safety and health issues. RFID is a cutting-edge method of labeling individual items [10]. Among the many possible uses for RFID technology is healthcare systems, where protecting sensitive patient information is of the utmost importance. The widespread use of RFID technology in healthcare creates significant privacy and security problems, especially in areas such as real-time patient monitoring, patient medication information, medical emergencies, and drug administration systems. Propose an Elliptic curves-based authentication technique for RFID as a means of resolving these safety concerns. For use in the IoT, this article suggests a detection mechanism and physical layer security for printed sensing tags. Using printed sensing tags may be a cheap and efficient solution to spread the IoT's smart infrastructure more quickly. Sensory tags use chip-less, completely printable, non-line-of-sight (NLoS) reading, inexpensive, and environmentally hardy RFID technology. The identification and widespread implementation of security measures for such tags in a secure setting remains difficult [12]. The article begins by introducing a powerful method for recognizing tags that makes use of the amplitudes and phase information of the frequency signatures. The research then proposes unique physical-layer security utilizing deep learning models to stop the cloning of tags after the successful identification of tag IDs. Results demonstrate that the suggested method can distinguish between genuine and clone tags based on their distinctive physical characteristics. This technology is thought to be closer to commercialization for IoT applications because of its real-time and accurate detection and security characteristics [13]. In the next iteration of the IoT, RFID and sensor technologies will play a crucial role. It is anticipated that advancements in RFID and sensor technology will lead to a rise in IoT applications, particularly in healthcare, as compared to currently available systems. This study provides concise overviews of RFID technology based on IoT. This article critically examines RFID sensors by categorizing them as either near-field or far-field readers. The mechanism of operation of the two classes is then compared. Adopting RFID tag sensors for healthcare applications is explored. RFID sensing via tags loaded with chips is now a sophisticated technical gadget that continually grows its presence in the markets and numerous application scenarios. A variety of RFID-based IoT healthcare settings are discussed, along with their benefits and drawbacks. Furthermore, the best use cases for RFID sensors are summarized using examples. Finally, the overall satisfying solutions provided by machine learning (ML) for RFID antenna design are discussed [15].

PROPOSED SYSTEM

The IoT is a worldwide system of interconnected computing networks that facilitates the exchange of information between real-world and digital entities. Independent cooperative services and applications may be built around its object-level identification, sensing, and connection capabilities. These will have advanced capabilities in data gathering, event transmission, network connection, and interoperability, all while operating independently. The perceptual layer is the IOT's informational foundation. Sensor, wireless sensor networks (WSN), tags and readers-writer, RFID systems, cameras, global positioning systems, intelligent terminals, electronics data interface (EDI), and so on are all used to gather data about the physical world that will be used by IoT in the next layer. Layers 2 and 3 make data transfer visible; they are the network and transport layers, respectively, using linear regression algorithms. The information from the perceptions layers could be sent to the upper layers by using the preexisting mobile communications networks, radio access networks, WSN, and other communication equipment, such as global systems for mobile communication (GSMs), general packets radio services (GPRS), worldwide interoperability for microwaves access (WiMax), wireless fidelity (WiFis), Ethernets, etc. At the same time, this layer offers effective, trustworthy network infrastructure platforms to the higher layers and enterprise-level applications in the sector. Figure 1 shows the system architecture of the proposed system.

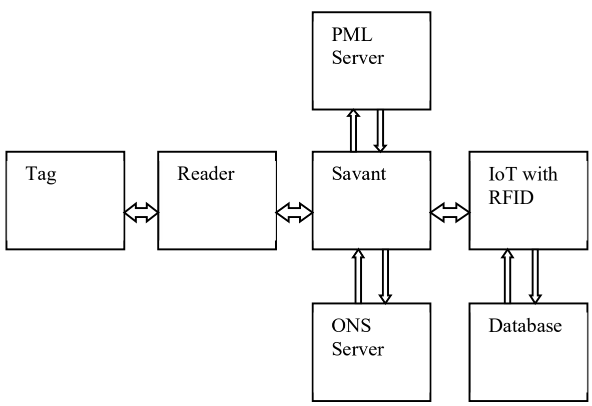

FIGURE 1. System architecture of the proposed system

Data management and applications services are included in the service layers, which are also known as the applications layers. Directory service, Quality of Services (QoS), facility management, geomatics, etc., are all provided by the data management sub-layer using service-oriented architectures (SOA), cloud computing technologies, and so on to process complex data and uncertain data. Logistics and supply, disaster warnings, environmental monitoring, agricultural management, production management, and so on all rely on the applications' service sub-layers to translate information into content and give suitable user interfaces. Attached to the items that want to tally or identify are RFID tags, also known as transponders (transmitters/responders). Both active and passive forms of tags existed. Tags that are "active" are self-powered, may exchange data with one another, and can start a conversation with the tag readers.

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RESULTS AND DISCUSSIONS

Monitoring, tracking, and supervising are the three primary roles of RFID systems. To keep tabs on a system and alert you to any changes, monitoring is the practice of keeping a close eye on it. To "track" someone or anything is to observe them while they are in motion and provide an ordered sequence of their whereabouts to a model in a timely manner. The term "supervising" refers to the practice of keeping tabs on someone else's actions, movements, or any other variable. It's not uncommon for this to occur covertly or behind the scenes. RFID technology has a wide variety of uses. Supply chain management, industrial process controls, and object tracking management are some of the most fascinating and effective applications. In Manufacturing, for instance, RFID technology has several potential uses in the automobile sector. Many modern automobiles are equipped with radio frequency identification-based anti-theft vehicle immobilizers. RFID also shows potential in vehicle manufacturing and assembly processes, especially in the areas of flexible and agile production planning, spare parts management, and inventory tracking using the Linear regression algorithm. In addition to facilitating the automation of the entire assembly process—during which time both costs and shrinkage can be significantly reduced—RFID technology also provides enhanced service for car owners, such as faster ordering of replacement parts and automatic generation of maintenance reminders. RFID provides the automobile sector with several advantages, including increased transparency, traceability, adaptability, and safety across the board, from raw materials to final consumers. As seen, the development of IoT parallels that of RFID and sensor technologies. RFID technology is a crucial and essential foundation for IoT, serving as a supply-chain assistant, enabling vertical-market applications, providing ubiquitous location, and so on.

There is a natural vulnerability to electromagnetic interference in communication between the tag and the reader. Because RFID readers and tags often use the same wireless channel, collisions are inevitable whenever they transmit at the same time. As a result, effective anti-collision algorithms for recognizing several tags at once are crucial to the growth of RFID applications on a broad scale. RFID tag identification anti-collision techniques, including query tree protocols (QTs), binary tree protocols (BTs), etc., have been suggested, although virtually all of them have an overall identification effectiveness of less than 50%. In addition, standardizing the distribution of IDs has always been taken for granted. Additionally, it is a great tool for highlighting the most effective aspects of RFID tag identification protocols and developing brand-new, superior protocols. In this paper, we introduce collision tree protocol (CT), a unique and efficient anti-collision protocol for RFID tag identifications that significantly outperforms previously suggested methods. RFID tags' potential security and privacy flaws affect not just businesses but also people. Eavesdropping, traffic analysis, spoofing, denial of services, and other attacks may be possible against unprotected tags. Figure 2 shows the effect of implementing the RFID and IoT system, and Figure 3 shows the performance of frequency.

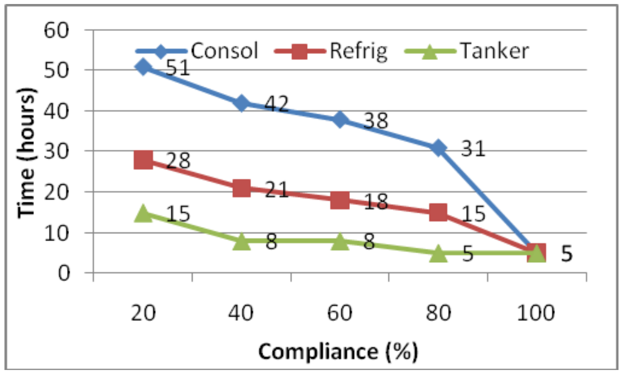

FIGURE 2. The effect of implementing the RFID and IoT

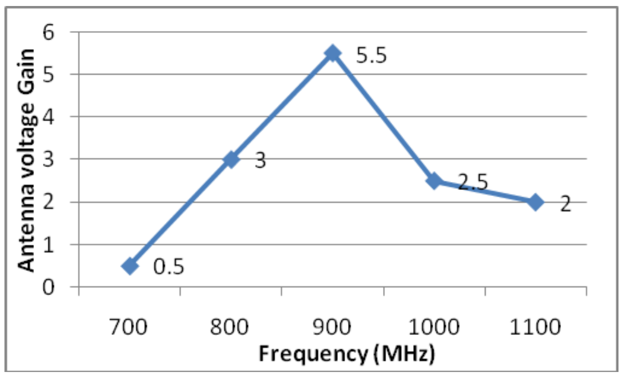

FIGURE 3. Performance of the frequency of the proposed system

Without sufficient access control, even unauthorized users may compromise privacy by reading tags. A traffic analysis attack may compromise "location privacy" even if the information contained inside the tags is encrypted. A denial of services attack is another way in which an attacker might compromise the safety of a system that uses RFID technology. RFID technology lacks adequate security and privacy support because of its high price tag and limited resources.

CONCLUSIONS

The outcomes of using RFID technology and the Linear Regression method with IoTS to improve real-time monitoring will rely on the implementation, data quality, and system efficacy. Obtain real-time visibility into the whereabouts, movements, and status of objects bearing RFID tags. Prompting and accurate information availability allows for proactive decision-making and adaptation to changing circumstances. Implement remote monitoring capabilities in an efficient manner. The capacity to remotely monitor RFID-tagged objects offers flexibility and lowers the need for physical presence. Continuing evaluation and improvement of system performance to guarantee its applicability in practical situations. It is imperative to acknowledge that the final outcomes are contingent upon many aspects, including but not limited to the caliber of the data gathered, the precision of the predictive models, the dependability of the hardware and communication infrastructure, and the effective amalgamation of RFID and IoT technologies. The system must be continuously monitored, evaluated, and adjusted to stay functional and meet changing operating needs. Expand monitoring capabilities to incorporate current air conditions, temperature, and humidity for use in cold chain logistics, among other real-time environmental data.

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