International Journal of Reconfigurable and Embedded Systems (IJRES)
Vol. 13, No. 1, March 2024, pp. 85~95
ISSN: 2089-4864, DOI: 10.11591/ijres.v13.i1.pp85-95

Radio frequency identification based materials tracking system for construction industry

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Article Info

Article history:

Received Feb 4, 2023
Revised Jul 30, 2023
Accepted Sep 4, 2023

Keywords:

Construction site
Global positioning system
Internet of things
Materials
Radio-frequency identification
Tracking

ABSTRACT

The construction industry is an industry that is always surrounded by uncertainties and risks. The industry is always associated with a threat-industry which has a complex, tedious layout and techniques characterized by unpredictable circumstances. It comprises a variety of human talents and the coordination of different areas and activities associated with it. In this competitive era of the construction industry, delays and cost overruns of the project are often common in every project and the causes of that are also common. One of the problems which we are trying to cater to is the improper handling of materials at the construction site. In this paper, we propose developing a system that is capable of tracking construction material on site that would benefit the contractor and client for better control over inventory on-site and to minimize loss of material that occurs due to theft and misplacing of materials.

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1. INTRODUCTION

The construction industry is an industry that is always surrounded by uncertainties and risks. The industry is always associated with a threat-industry which has a complex, tedious layout and techniques characterized by unpredictable circumstances. It comprises a variety of human talents and the coordination of different areas and activities associated with it. So, whenever a construction company takes up a project there is a series of uncertainty associated with it, whether or not the project will be finished on schedule and on budget and also fulfilling the key performance indicators set particularly for the project. An Effective construction company would be able to fulfill the project demands with the stipulated resources allocated for the project and finally complete the project. Unfortunately, they are components of initiatives that are beyond the control of contractors. For instance, the achievement of the venture objectives can be jeopardized by using the deliberate efforts of others inclusive of thieves. Thieves can at once impact the achievement of a project and decrease the potential profitability of the assignment that is being constructed.

The utilization of radio-frequency identification technology has become a favorable option to increase the effectiveness of managing supply chains [1]. The utilization of radio-frequency identification (RFID) presents benefits like affordability, compact size, and the ability to track multiple items, which makes it appropriate for smart supply chain management (SSCM). Standard supply chain management faces numerous hurdles, including disperse control, slow operations, manual record-keeping, undependable supplies, unpredictable prices and deliveries. SSCM has the capability to surmount these difficulties by examining various situations where RFID plays a significant function. The proposed frameworks and combined framework offer practical solutions that can be implemented by practitioners to optimize supply chain efficiency. The implementation of RFID technology has become more prevalent within the logistics sector as it strives to enhance visibility and streamline operations within the supply chain. In the context of humanitarian supply chains, RFID technology can help organizations to manage inventory, track shipments, and distribute relief goods effectively [2]. The author focuses on the Indian food security system and examines the challenges faced by the system in managing food distribution, including inadequate infrastructure, limited access to technology, and inefficiencies in supply chain processes. The results show that the RFID-enabled system significantly improved warehouse efficiency, reduced order processing time, and increased delivery accuracy.

Incorporating the internet of things (IoT) into the construction industry has the capability to enhance the effectiveness and output of the supply chain by utilizing advanced technology. By employing IoT technologies like inventory tracking, equipment monitoring, and logistics management, in the management of construction materials supply chain, transparency can be increased, quality control can be improved, and safety can be enhanced [3]. Nevertheless, there may be some challenges when integrating IoT applications in the construction sector. Some scholars have explored the possible advantages and drawbacks of utilizing RFID technology in construction [4]–[9]. The authors argue that RFID technology can enhance the efficiency and accuracy of construction processes, leading to cost savings and improved project outcomes. To assess the efficacy of RFID technology in all of these domains, the authors use case studies and examples from the literature, highlighting the benefits and limitations of existing approaches. The authors additionally examine the possible future uses of RFID applications in construction, including asset and supply chain management. Smart technologies such as RFID and near field communication (NFC) have the potential to enhance the identification and tracking of reusable components within the construction industry, which can enhance productivity and sustainability [7]. The authors' case study provides a useful example of successful implementation of smart technologies in a construction project.

The research results reveal various intriguing patterns in IoT investigations in logistics and supply chain management [10]. Nevertheless, businesses encounter challenges in embracing and implementing IoT technologies, such as privacy and security concerns, issues with data management, and the necessity for fresh skills and capabilities [11]. These challenges have been explored in the literature [12]–[18]. The authors suggest valuable strategies for conquering these obstacles, such as collaborating with technology vendors and establishing new organizational structures and procedures. The authors have put forward a comprehensive approach to enhance supply chain management in both the liquefied natural gas (LNG) and construction industries by utilizing advanced technologies such as RFID, global positioning system (GPS), geographic information system (GIS), and building information modeling (BIM) [19]–[21].

Incorporating IoT technology in supply chain management has the potential to improve productivity, efficiency, and reduce expenses [22]. This review of literature investigates the implementation of IoT technology in construction projects, manufacturing, and the LNG industry. The analysis highlights various enabling technologies, protocols, and challenges associated with adopting IoT in industries. The authors proposed a systematic approach to follow the LNG industry's supply chain by combining GPS and RFID technologies [21]. The overview also covered the physical, network, middleware, and application layers of the IoT architecture. Additionally, the authors analyzed the significant challenges and research problems faced in adopting IoT technology in various areas, such as healthcare, environmental monitoring, and smart cities [23]. The author proposed an RFID-based construction materials management system that incorporates wireless sensor networks. The study demonstrates the feasibility and effectiveness of the proposed system in improving the accuracy and efficiency of construction materials management [24].

Song *et al.* [25] also proposed a cost-effective solution for the tracking and locating of materials in a laydown yard using RFID tags and sensors, combined with a web-based database and visualization tool for real-time monitoring of material flow. Similarly, Kasim *et al.* [26] highlighted the importance of accurate and efficient materials tracking for successful construction project management and proposed a framework for implementing a material tracking system using RFID technology. The logistics and supply chain management system for building projects incorporates the supply chain operations reference (SCOR) model. The system is designed to improve communication and coordination among project stakeholders, enhance efficiency, and reduce costs [27]. Niu *et al.* [28] examined the challenges associated with inventory management and proposed a solution that integrates IoT and Web 2.0 technologies, providing real-time monitoring of inventory and using data analytics to optimize inventory levels.

Yang *et al.* [29] analyzed the use of cloud-based real-time BIM and RFID for interior localization in order to manage construction operations. The author illustrated how integrating BIM and RFID technologies can increase the precision and effectiveness of managing and tracking indoor materials. Furthermore, the authors identified the challenges associated with managing construction materials and proposed a framework for implementing a material tracking system using RFID technology [26]. Luo *et al.* [16] also analyzed the challenges faced in the construction industry and the strategies adopted by companies to address these challenges. The paper presented a case study of a prefabricated building project and demonstrated how effective supply chain management can improve project performance. The benefits of enhancing the transparency, efficiency, and sustainability of the construction supply chain through the use of IoT technologies were explored by Ali *et al*. [27]. Bi *et al*. [30] conducted a thorough examination of the current state of IoT in manufacturing and identified potential research areas for the future. They emphasized the obstacles that must be overcome to successfully implement IoT in enterprise systems, such as ensuring data security and privacy, integrating with existing systems, and requiring a skilled workforce.

2. RESEARCH METHOD

The construction industry is familiar with problems related to material management. According to the national equipment register, construction sites experience annual inventory losses ranging from $300 million to $1 billion. So, the purpose of this literature review is to find out and suggest a viable solution based on IoT for inventory management, counterfeit material, and transparency in supply chain in construction industry. The IoT enables us to reduce human error and it allows real-time data monitoring with effective decision making which can lead to an un-haphazard way of dealing with things. Thus, the IoT in the construction field can change the overall scenario of construction material management on the site.

The qualitative approach has been adopted to review the research papers which have been studied from different sources like Science Direct, ASCE, Research Gate and Google Scholar. We have chosen the combination of IoT, smart supply chain and RFID as keywords. We got to know from the extensive literature review that RFID, barcode, and GPS are possible solutions and by the comparison amongst them we concluded that RFID is the most viable solution for material handling problems.

2.1. Process specification

2.1.1. Purpose

The RFID integrated model serves a crucial role in logistics and supply chain management by automating the tracking of material arrival on site. This technology eliminates the need for human intervention, reducing the chances of errors and delays in tracking and managing materials. By accurately recording arrival dates and times, this system enhances overall efficiency and transparency in the supply chain process, contributing to smoother project operations.

2.1.2. Requirements

The successful implementation of the RFID integrated model necessitates several key requirements. First and foremost, a reliable RFID reader is essential to capture data from RFID tags attached to materials. Additionally, the system should include RFID tags that can be affixed to various items, enabling their identification and tracking. To enhance location accuracy and monitoring, the integration of a GPS tracker is also crucial, allowing real-time tracking and providing valuable insights into the movement of materials throughout the supply chain process. These requirements together form the foundation for an efficient and automated material tracking system.

2.1.3. Behavior

In the RFID integrated model, the behavior revolves around the seamless interaction between the RFID reader and the connected system, typically a personal computer (PC). As the central element of the process, the RFID reader plays a pivotal role by reading data from the RFID tag affixed to materials. This data transfer to the PC allows for real-time monitoring and tracking, facilitating efficient material management and reducing the need for manual intervention. This behavior ensures that accurate and up-to-date information about material movement is readily available, enhancing overall supply chain transparency and operational efficiency.

2.2. System management requirement

The successful management of the RFID integrated system demands several essential components. Firstly, the PC utilized in the system should be equipped with the necessary universal serial bus (USB) port to accommodate the RFID reader, ensuring seamless data transfer. Additionally, it should have either Microsoft Office or Google Sheets installed to facilitate data storage and analysis. Furthermore, the integration of the iSearching application on a mobile phone is crucial for enabling remote monitoring and control of the system, adding an extra layer of flexibility and convenience to system management.

2.2.1. Data analysis requirement

An integral aspect of the RFID integrated system is its capability to carry out on-site data analysis. This feature enables the system to process and interpret the data collected from RFID tags and readers in real time. By performing this on-site analysis, the system can provide valuable insights into material movement, helping streamline supply chain operations and enhance decision-making processes.

2.2.2. Security requirement

To ensure the integrity and security of the RFID integrated system, it is imperative to incorporate fundamental user authentication functionalities. This security measure helps restrict unauthorized access to the system, safeguarding sensitive data and preventing potential breaches. Figure 1 illustrates the key components and flow of the system, providing a visual representation of its functionality within the text.

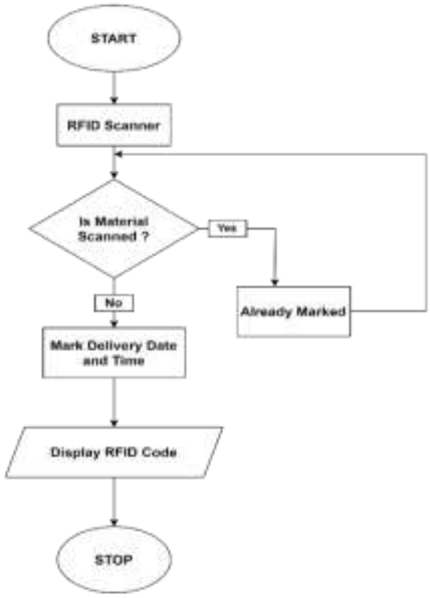

Figure 1. Process specification

2.3. Service specification

The IoT system offers a multitude of services, each meticulously detailed in the service specifications. These specifications encompass various aspects such as the types of services provided, the inputs required for their execution, the resulting outputs, the endpoints or interfaces utilized, scheduling parameters determining when services are activated, production mechanisms, and the anticipated effects of each service. These comprehensive service specifications enable a thorough understanding of the IoT system's capabilities and functionalities. In IoT integrated model RFID reader as shown in Figure 2 reads data from RFID card which is input and display data like date and time which is output and reader is schedule to read data from card whenever it passes through reader.

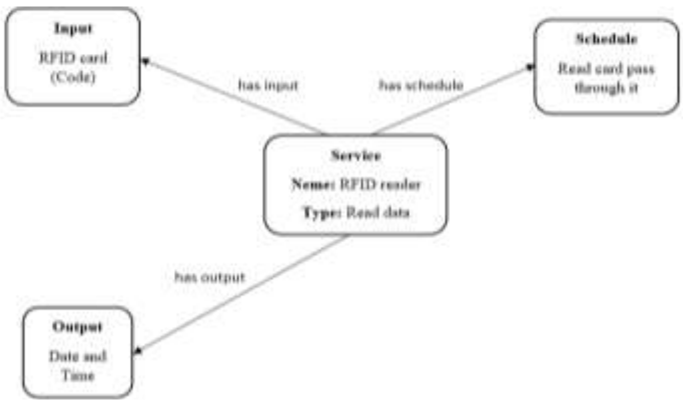

Figure 2. Service specifications

2.4. Construction site layout

In Figure 3, we provide an illustrative representation of the construction site's layout. In this scenario, RFID readers have been strategically placed at key locations within the site. These RFID readers are positioned at the site entrance, F7, F8 (material laydown area), buildings B1, B2, B3, and B4. To provide a clearer understanding of their placement, let's consider the distances from F7/F8 to the various buildings: F7/F8 to building 1 is approximately 500 meters, to building 2 is approximately 400 meters, to building 3 is just 5 meters, and to building 4 is around 80 meters. Now, when materials arrive at the construction site, the RFID reader located at the entrance will yield the following readings.

In Figure 4, we observe that our data collection process involved the tracking of four distinct material types: cement, steel, tiles, and paint. Each of these materials plays a crucial role in the construction process, and our comprehensive data collection approach encompasses their movement and delivery. By monitoring these materials, we gain valuable insights into the efficiency and effectiveness of the logistics and supply chain management system. This data not only helps in evaluating the performance of the system but also aids in optimizing material procurement and delivery processes, ultimately contributing to the overall success of the construction project.

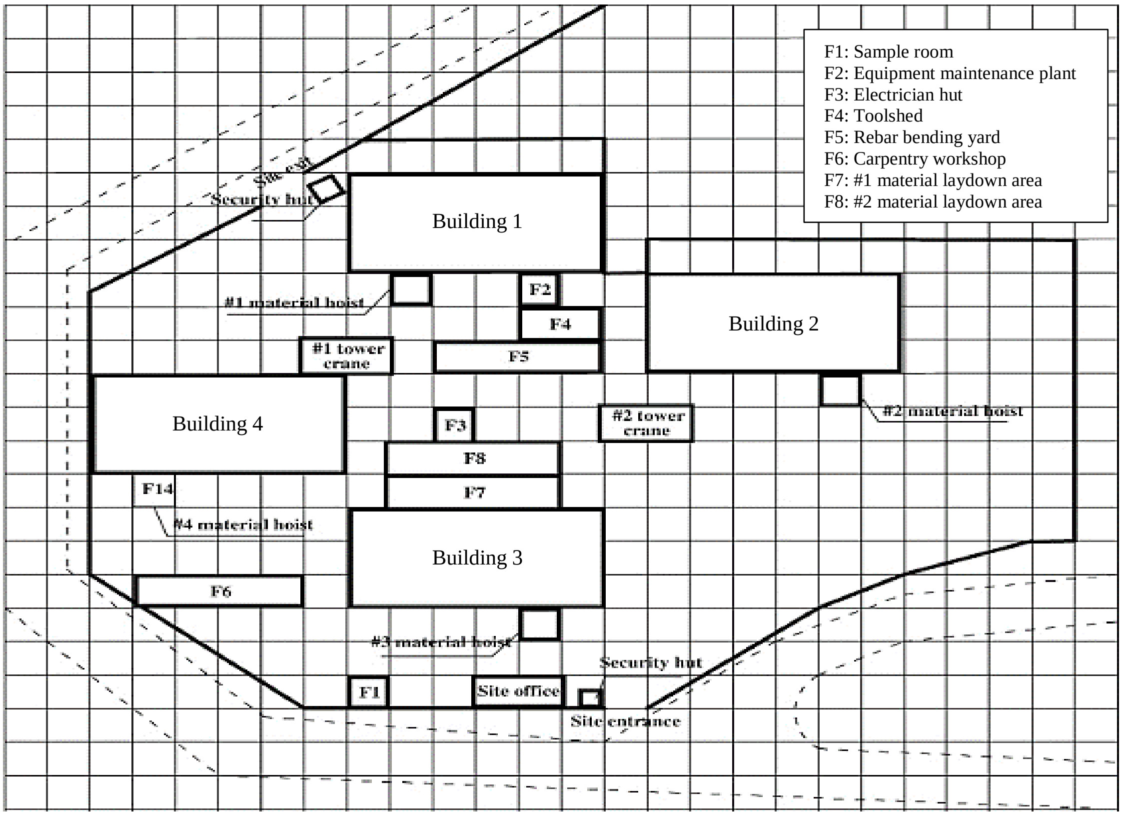

Figure 3. Construction site layout

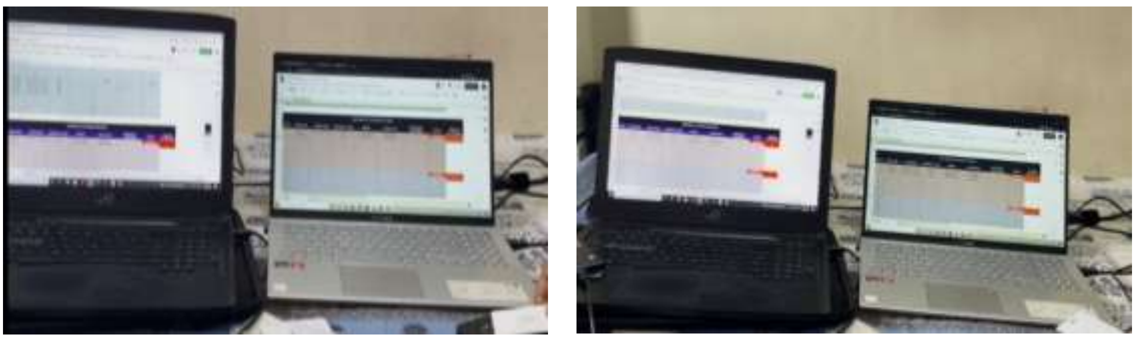

Figure 4. Execution set-up

In Figure 5, it provides a structured and comprehensive record of the material delivery process. This spreadsheet allows us to extract accurate and essential details, including:

- Date and time of delivered materials with material name.
- Dispatch origin (from which city/state material dispatched).
- Destination (on which site materials delivered).
- Quantity (how many nos. of material type delivered i.e., 1000 bags of cement, 500 box of tiles) as shown in Figure 6.
- Price (how much amount of material delivered) as shown in Figure 7.
- X and Y coordinates of site at where materials delivered.

For ease of understanding, we have generated the following pie charts (Figure 7 shown pie chart for price of delivered materials and Figure 6 shown pie chart for quantity of delivered material) based on the collected readings. These visual representations provide a clear and concise overview of the distribution of prices and quantities of the delivered materials. These pie charts offer a valuable visual insight into the composition and allocation of materials, facilitating a quick and intuitive understanding of the data.

MATERIAL DELIVERY DETAILS									
SR NO	RFID CODE	TIME STAMP	MATERIAL NAME	DISPATCH ORIGIN	DESTINATION	QUANTITY	PRICE	COORDINATES X	COORDINATES Y
1	2277408	16/01/2022 19:21:42	Cement	GUJARAT	PUNE	2	600	18.580118	73.762173
2	9980114	16/01/2022 19:21:45	Cement	GUJARAT	PUNE			18.580118	73.762173
3	9991373	16/01/2022 19:21:50	Steel	BHILAI	PUNE	2	110000	18.580118	73.762173
4	9946518	16/01/2022 19:21:54	Steel	BHILAI	PUNE			18.580118	73.762173
5	9946509	16/01/2022 19:22:02	Tiles	BHARUCH	PUNE	2	1680	18.580118	73.762173
6	9991363	16/01/2022 19:22:05	Tiles	BHARUCH	PUNE			18.580118	73.762173
7	9946508	16/01/2022 19:22:07	Paint	MUMBAI	PUNE	2	16000	18.580118	73.762173
8	9981029	16/01/2022 19:22:09	Paint	MUMBAI	PUNE			18.580118	73.762173

Figure 5. Material delivery details on Google spreadsheet

Figure 6. Pie chart for quantity of delivered material

Figure 7. Pie chart for price of delivered materials

Assuming we want to calculate the time, it takes to reach the materials at buildings like B1, B2, B3, or B4 from the store, we collected the following data from RFID readers placed outside of F7 and F8 (material storage area), buildings B1, B2, B3, and B4. In the 'Deliver' at construction site, as illustrated in Figure 8, the 'check' column prominently displays a 'missing' status. This status signifies a noteworthy discrepancy between the dispatch of materials from the store and their arrival at the construction site. While the materials were dispatched, they had not yet reached their intended destination at the time of this data collection. It's important to note that these readings were acquired four minutes after the materials were dispatched from the store. This delay in material arrival can have implications for construction timelines and underscores the significance of efficient tracking and delivery systems.

In the Figure 9, we can see that for cement one quantity was dispatched from the store and it was successfully received at building 2 so in the check column, it is showing OK. But for steel two quantities were dispatched from the steel yard but only one quantity is successfully received at building 1 so in the check column it is showing MISSING. For tiles, one quantity was dispatched but hasn’t been received yet at a construction site that’s why the check column it is showing missing for the paint two quantities were dispatched and both were received at the construction site so in the check column it is showing OK.

DISPATCH FROM STORE							
SR NO	RFID CODE	TIME STAMP	MATERIAL NAME	DISPATCH QUANTITY	PRICE OF DISPATCH QUANTITY	REMAINING QUANTITY	PRICE OF REMAINING QUANTITY
1	9980114	18/01/2022 17:39:51	Cement	1	300	1	300
2							
3	9991373	18/01/2022 17:40:01	Steel	2	110000	0	0
4	9946518	18/01/2022 17:40:02	Steel				
5	9991363	18/01/2022 17:40:07	Tiles	1	840	1	840
6							
7	9946508	18/01/2022 17:40:14	Paint	2	16000	0	0
8	9981029	18/01/2022 17:40:15	Paint				

DELIVERY AT CONSTRUCTION SITE							
SR NO	RFID CODE	TIME STAMP	MATERIAL NAME	ORIGIN	DESINATION	RECEIVING QUANTITY	CHECK
1						0	MISSING
2							
3						0	MISSING
4							
5						0	MISSING
6							
7						0	MISSING
8							

Figure 8. Readings were taken at the time when material dispatch with MISSING check status

DISPATCH FROM STORE							
SR NO	RFID CODE	TIME STAMP	MATERIAL NAME	DISPATCH QUANTITY	PRICE OF DISPATCH QUANTITY	REMAINING QUANTITY	PRICE OF REMAINING QUANTITY
1	9980114	18/01/2022 17:39:51	Cement	1	300	1	300
2							
3	9991373	18/01/2022 17:40:01	Steel	2	110000	0	0
4	9946518	18/01/2022 17:40:02	Steel				
5	9991363	18/01/2022 17:40:07	Tiles	1	840	1	840
6							
7	9946508	18/01/2022 17:40:14	Paint	2	16000	0	0
8	9981029	18/01/2022 17:40:15	Paint				

DELIVERY AT CONSTRUCTION SITE							
SR NO	RFID CODE	TIME STAMP	MATERIAL NAME	ORIGIN	DESINATION	RECEIVING QUANTITY	CHECK
1	9980114	18/01/2022 17:44:23	Cement	STORE	BUILDING 2	1	OK
2							
3	9991373	18/01/2022 17:44:34	Steel	STEEL YARD	BUILDING 1	1	MISSING
4							
5						0	MISSING
6							
7	9946508	18/01/2022 17:44:57	Paint	STORE	BUILDING 2	2	OK
8	9981029	18/01/2022 17:44:58	Paint	STORE	BUILDING 1		

Figure 9. Readings were taken at the time when material dispatch with OK check status

In the Figure 10, a wealth of critical information becomes evident upon closer examination. This includes dispatch and delivery times, travel duration, and the status of delivery punctuality, allowing us to determine whether the delivery was made on time or experienced a delay. Additionally, this Figure 10 also reveals the individuals or responsible persons to whom the delivery assignments were entrusted. Notably, in our scenario, we assume that deliveries should ideally be completed within a 10 minutes timeframe from the moment of dispatch. It's important to emphasize that these readings were recorded after a 14 minutes interval from the initial dispatch of materials from the store.

In Figure 11, we present a comprehensive overview of the status of materials dispatched from the store and their reception at the construction site. Notably, this indicates that all materials dispatched from the store were successfully received at the construction site, as denoted by the 'OK' status in the check column. This exemplifies the efficient and reliable tracking and delivery system in place.

In Figure 12 reveals that both steel and tiles experienced a minor delay, with a 4-minute lag in their expected arrival times. This delay can be attributed to the respective delivery persons, Rohit and Harsh, responsible for these materials. Figure 13 illustrated inventories in store room. The following pie charts Figures 14 and 15 are generated for ease of understanding and depict quantities and amounts of inventories remaining in store. From Figure 13, we can get details regarding:

– Which materials are available in the store?

– How many nos. are available of that material?
– How much worth of materials of that type is available?

TIME TAKEN BY MATERIAL TO REACH AT CONSTRUCTION SITE						
SR NO	DISPACH TIME	DELIVERY TIME	TRAVEL TIME	ON TIME OR DELAY	MATERIAL NAME	RESPONSIBLE PERSON
1	17:39:51	17:44:23	00:04:32	ON TIME	Cement	Manank
2			00:00:00			
3	17:40:01	17:44:34	00:04:33	ON TIME	Steel	Rohit
4	17:40:02		06:19:58	ON TIME	Steel	Rohit
5	17:40:07		06:19:53	ON TIME	Tiles	Harsh
6			00:00:00			Harsh
7	17:40:14	17:44:57	00:04:43	ON TIME	Paint	Animesh
8	17:40:15	17:44:58	00:04:43	ON TIME	Paint	Animesh

Figure 10. Time is taken by material to reach the construction site

DISPATCH FROM STORE							
SR NO	RFID CODE	TIME STAMP	MATERIAL NAME	DISPATCH QUANTITY	PRICE OF DISPATCH QUANTITY	REMAINING QUANTITY	PRICE OF REMAINING QUANTITY
1	9980114	18/01/2022 17:39:51	Cement	1	300	1	300
2							
3	9991373	18/01/2022 17:40:01	Steel	2	110000	0	0
4	9946518	18/01/2022 17:40:02	Steel				
5	9991363	18/01/2022 17:40:07	Tiles	1	840	1	840
6							
7	9946508	18/01/2022 17:40:14	Paint	2	16000	0	0
8	9981029	18/01/2022 17:40:15	Paint				

DELIVERY AT CONSTRUCTION SITE							
SR NO	RFID CODE	TIME STAMP	MATERIAL NAME	ORIGIN	DESINATION	RECEIVING QUANTITY	CHECK
1	9980114	18/01/2022 17:44:23	Cement	STORE	BUILDING 2	1	OK
2							
3	9991373	18/01/2022 17:44:34	Steel	STEEL YARD	BUILDING 1	2	OK
4	9946518	18/01/2022 17:53:56	Steel	STEEL YARD	BUILDING 2		
5	9991363	18/01/2022 17:54:09	Tiles	STORE	BUILDING 1	1	OK
6							
7	9946508	18/01/2022 17:44:57	Paint	STORE	BUILDING 2	2	OK
8	9981029	18/01/2022 17:44:58	Paint	STORE	BUILDING 1		

Figure 11. Readings after 14 minutes from materials dispatched from the store

TIME TAKEN BY MATERIAL TO REACH AT CONSTRUCTION SITE						
SR NO	DISPACH TIME	DELIVERY TIME	TRAVEL TIME	ON TIME OR DELAY	MATERIAL NAME	RESPONSIBLE PERSON
1	17:39:51	17:44:23	00:04:32	ON TIME	Cement	Manank
2			00:00:00			
3	17:40:01	17:44:34	00:04:33	ON TIME	Steel	Rohit
4	17:40:02	17:53:56	00:13:54	DELAY	Steel	Rohit
5	17:40:07	17:54:09	00:14:02	DELAY	Tiles	Harsh
6			00:00:00			Harsh
7	17:40:14	17:44:57	00:04:43	ON TIME	Paint	Animesh
8	17:40:15	17:44:58	00:04:43	ON TIME	Paint	Animesh

Figure 12. Time taken by material to reach at construction site

INVENTORIES IN STORE ROOM			
SR NO	MATERIAL NAME	QUANTITY	AMOUNT
1	CEMENT	1	300
2	STEEL	0	0
3	TILES	1	840
4	PAINT	0	0

Figure 13. Inventories in store room

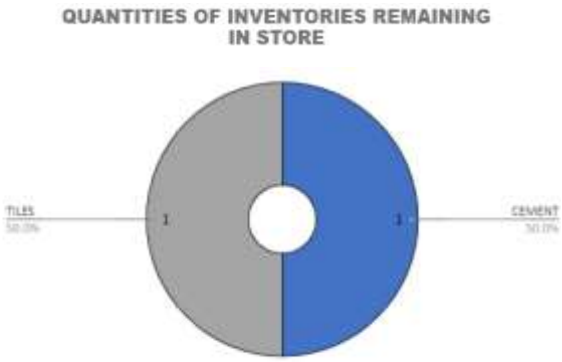

Figure 14. Quantities of inventories remaining in store

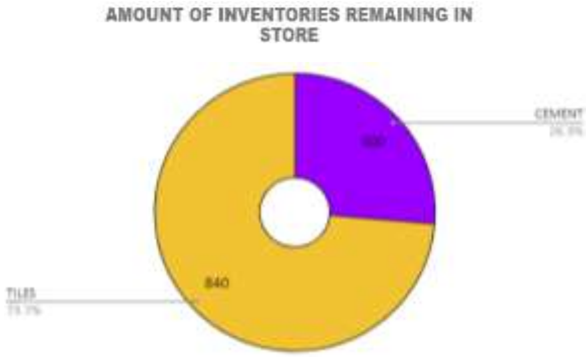

Figure 15. Amount of inventories remaining in store

3. RESULTS AND DISCUSSION

This paper sought to identify a workable IoT solution for inventory management, the detection of counterfeit items, and supply chain transparency in the construction industry. The researchers adopted a qualitative approach to review research papers and used IoT, smart supply chain, and RFID as keywords. From the extensive literature review, RFID, barcode, and GPS were identified as possible solutions, and after comparison among them, it was concluded that RFID is the most viable solution for material handling problems. The RFID integrated model was proposed to track the arrival date and time of materials on the construction site and eliminate human intervention the system comprises an RFID tag, an RFID reader, and a GPS tracker, and the information is analyzed locally. The IoT system's services are thoroughly explained in the service definition, including service types, input/output, endpoints, schedules, production, and effects. To oversee materials at the construction site, RFID readers are placed at various locations, including the entrance, F7 and F8, and buildings B1, B2, B3, and B4. Upon the arrival of materials, the RFID reader at the entrance furnishes accurate details regarding delivery time and date, dispatch origin, destination, amount, price, and X and Y coordinates of the site. The data can be used to generate a pie chart for ease of understanding. The researchers also used the RFID readers to find out the time it takes to reach the material at different buildings from the store. The readings were taken after four minutes for material dispatched from the store and 14 minutes in the case we assume that delivery should within 10 minutes from dispatch at the construction site after the material dispatch, and the data can be used to find out details such as dispatch and delivery time, travel time, status of delivery time, and responsible person to whom delivery is assigned. Overall, the result provides insights into how IoT can change the construction material management scenario at the site.

4. CONCLUSION

The construction industry is familiar with material management problems. Every year, construction sites experience inventory losses ranging from $300 million to $1 billion due to expensive and unreliable workforce performance. Organizations may control cost, time, and quality by implementing digital technologies for their workforce and physical environment. The entire productivity of the building site can be increased by utilising wireless internet networks combined with IoT technologies like RFID, sensors, cloud based systems, and GPS. By putting this approach into practise, via a cloud database that is easily accessed from a variety of devices, we might collect on-site real time material data, including PCs, cellphones, and tablets. Through this digital platform driven by IoT, you may get data about each material, including its dispatching and delivery times, name, person responsible, and location. Additionally, since the material allocation is given to a specific member of staff, he may be questioned further in the event that the material is lost or misplaced. The project managers and supervisors may better exercise control over the overall project by tracking and monitoring the materials at a construction site owing to these real-time data updates. The designed technology is still ineffective at handling the large RFID tag scanning. This is a prototype that shows how the system provides the outcomes we want. The created system can automate the warehouse and maintain a loop of inventory information. In the current world, data science is the future since it can help us predict consumer demand for a certain commodity, make statistically sound decisions, and create a leaner supply chain. Therefore, the system developed can be highly helpful to contractors managing medium-sized to large-sized projects. The system's initial cost can give high returns in the future and the data gathered through this IoT system can make the execution of the project successful.

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