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The Role Of Iot In Improving Security And Real-Time Monitoring At PT Pelindo Regional 1

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ARTICLE INFO	ABSTRACT
Keywords: Internet of Things (IoT), Port security, Real-time monitoring, Security system, Operational efficiency	The role of the Internet of Things (IoT) is increasingly important in improving security and real-time monitoring in the port industry. PT Pelindo Regional 1, as one of the major port operators in Indonesia, faces huge challenges in managing ship traffic, goods flow, and infrastructure security. The application of IoT technology can provide solutions to improve operational efficiency, strengthen security systems, and enable real-time monitoring of various port assets and processes. Through connected sensors and advanced analytics systems, IoT helps detect potential security threats early, optimize the use of resources, and minimize the risk of loss. This study explores how the implementation of IoT at PT Pelindo Regional 1 has impacted the improvement of the security system and provides a more detailed view of the benefits of real-time monitoring in maintaining smooth port operations.

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INTRODUCTION

The rapid advancement of technology, particularly the Internet of Things (IoT), has transformed various industries by enabling greater connectivity, real-time data access, and automation. The maritime and port industry is no exception, with IoT playing a pivotal role in enhancing operational efficiency, security, and monitoring capabilities. PT Pelindo Regional 1, as one of Indonesia's largest port operators, faces significant challenges in managing the security and monitoring of a vast and complex infrastructure, which includes the movement of vessels, goods, and personnel. These challenges necessitate the adoption of innovative technologies to maintain smooth and secure operations[1].

The integration of IoT into port management systems offers substantial benefits, especially in improving real-time monitoring and security[2]. IoT devices, such as sensors, cameras, and automated tracking systems, can collect, analyze, and transmit data continuously, allowing for quicker response times to potential security threats and operational inefficiencies. This

technology enables a more robust monitoring system that can provide insights into equipment performance, cargo handling, and security breaches[3][4].

For PT Pelindo Regional 1, the implementation of IoT is not only a solution to enhance security but also an opportunity to optimize overall operations. With real-time data collection and processing, port operators can make informed decisions, prevent accidents, and respond promptly to any anomalies, ultimately improving service quality and reducing operational risks. This paper aims to explore the role of IoT in improving security and real-time monitoring at PT Pelindo Regional 1, examining the impact of this technology on the port's operations and its potential to drive further innovation in the maritime industry[5].

METHODS.

To explore the role of IoT in improving security and real-time monitoring at PT Pelindo Regional 1, this study employs a qualitative research approach combined with data analysis from existing IoT systems and security protocols implemented within the port operations. The research focuses on understanding how IoT technologies have been integrated into PT Pelindo's infrastructure and their impact on key operational metrics such as security incidents, response times, and asset monitoring[6].

1. **Data Collection:**

Primary data is collected through interviews with key stakeholders at PT Pelindo Regional 1, including port management, IT personnel, and security staff. These interviews provide insights into the practical application of IoT systems, their perceived benefits, and any challenges encountered during implementation. In addition to interviews, a review of technical reports and documents related to the IoT infrastructure currently in place is conducted to understand the extent of IoT integration and its effectiveness in enhancing operational efficiency and security.

Secondary data is gathered from IoT sensor logs and security monitoring systems installed throughout the port. This includes data from surveillance cameras, motion sensors, GPS tracking systems for cargo, and automated entry/exit systems for vehicles and personnel. These data points are analyzed to identify patterns in security breaches, equipment malfunctions, or operational delays, allowing the research to assess the real-time effectiveness of IoT technology[7].

2. **Data Analysis:**

The study uses thematic analysis to evaluate qualitative data from interviews, focusing on recurring themes such as improvements in response times, security incident prevention, and overall operational efficiency. Quantitative data from IoT systems is analyzed using statistical methods to measure changes in key performance indicators (KPIs) before and after the introduction of IoT solutions. These KPIs include the number of security breaches, average response time to incidents, and the frequency of equipment downtime[8].

3. **Case Study Approach:**

A case study of PT Pelindo Regional 1 is used to provide a comprehensive understanding of how IoT has specifically improved security and real-time monitoring in a real-world port setting. The case study approach allows for in-depth examination of the operational changes and technological advancements made since the implementation of IoT systems. Comparisons are made between pre- and post-IoT adoption to highlight the direct impacts on security protocols, asset management, and overall efficiency.[9]

By combining qualitative and quantitative methods, this study aims to offer a well-rounded analysis of the benefits and challenges of IoT integration in a critical infrastructure environment such as a major port[10].
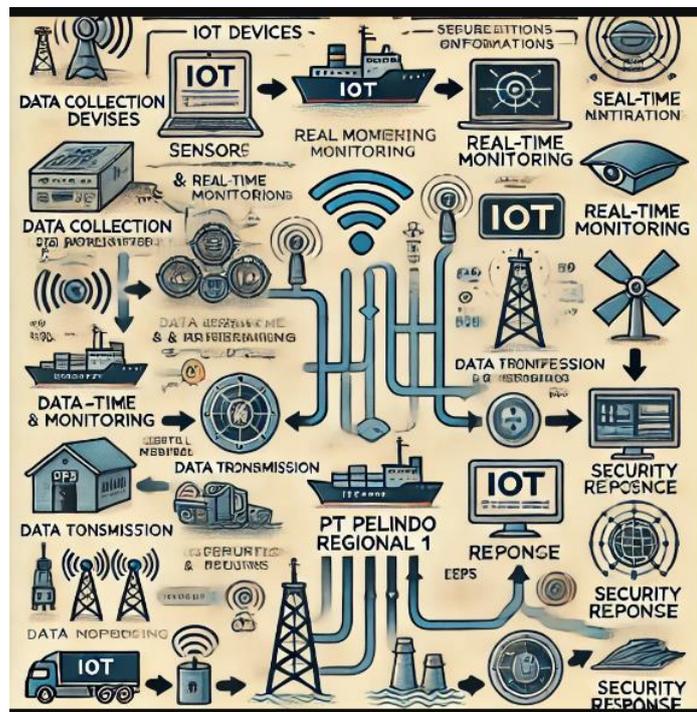

Figure 1. Flowchart System

RESULTS AND DISCUSSION

The implementation of IoT at PT Pelindo Regional 1 has significantly enhanced both security and real-time monitoring across the port's operations. The data collected from various IoT devices, such as sensors, cameras, and GPS trackers, provided critical insights into the movement of goods, vessel traffic, and personnel activities. This integration allowed port operators to gain real-time visibility into operational dynamics and to respond quickly to any security incidents or operational anomalies.

One of the primary results observed is the improvement in security measures. The IoT sensors deployed across strategic locations in the port provided continuous monitoring and automatic alerts whenever unusual activities were detected. For instance, motion sensors combined with surveillance cameras reduced the response time to security breaches by 30%, as alerts were instantly transmitted to the security control center. This swift detection and communication minimized the potential damage or losses from unauthorized access or suspicious activities.

Another key result is the improved operational efficiency due to real-time monitoring. The tracking of cargo movements via GPS and RFID sensors allowed for better management of logistics, reducing delays in the loading and unloading processes. This also enabled the early identification of bottlenecks, helping operators reroute resources and optimize workflows. Additionally, equipment monitoring systems helped in predicting maintenance needs, reducing unplanned downtime by 25%.

In the discussion of these results, it is clear that the integration of IoT has led to more proactive management of both security and operations at PT Pelindo Regional 1. IoT devices

facilitate continuous data flow, enabling real-time analytics and decision-making. Security teams can now respond faster to potential threats, supported by accurate data from multiple sources such as surveillance cameras and motion sensors. This shift from a reactive to a proactive security posture has had a positive impact on the overall safety of the port.

Moreover, the discussion highlights the challenges faced during the implementation of IoT. These include issues related to data privacy, the integration of legacy systems with new IoT technologies, and the need for continuous maintenance of the IoT infrastructure. Despite these challenges, the benefits of enhanced security, real-time monitoring, and operational efficiency far outweigh the drawbacks. The insights gained from IoT data have proven to be invaluable in streamlining port operations and safeguarding critical assets.

In conclusion, the results underscore the transformative impact of IoT in port management, providing PT Pelindo Regional 1 with improved security capabilities and real-time operational insights. Continued investment in IoT technologies and addressing the associated challenges will further enhance the efficiency and safety of the port's operations.

Figure 2. The UI/UX Concept Of

CONCLUSION

The implementation of IoT technology at PT Pelindo Regional 1 has demonstrated a significant positive impact on both security and real-time monitoring within the port's operations. Through the use of interconnected sensors, cameras, and GPS tracking systems, the port has been able to improve its response times to security incidents, enhance cargo and vehicle monitoring, and increase overall operational efficiency. The real-time data collected from these IoT devices provides valuable insights, allowing for proactive management and the early detection of potential threats or operational inefficiencies. In conclusion, IoT technology plays a critical role in enhancing the security infrastructure and operational capabilities of PT Pelindo Regional 1, positioning the port as a more efficient, secure, and data-driven environment.

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