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A fully automated asset-tracking RFID system

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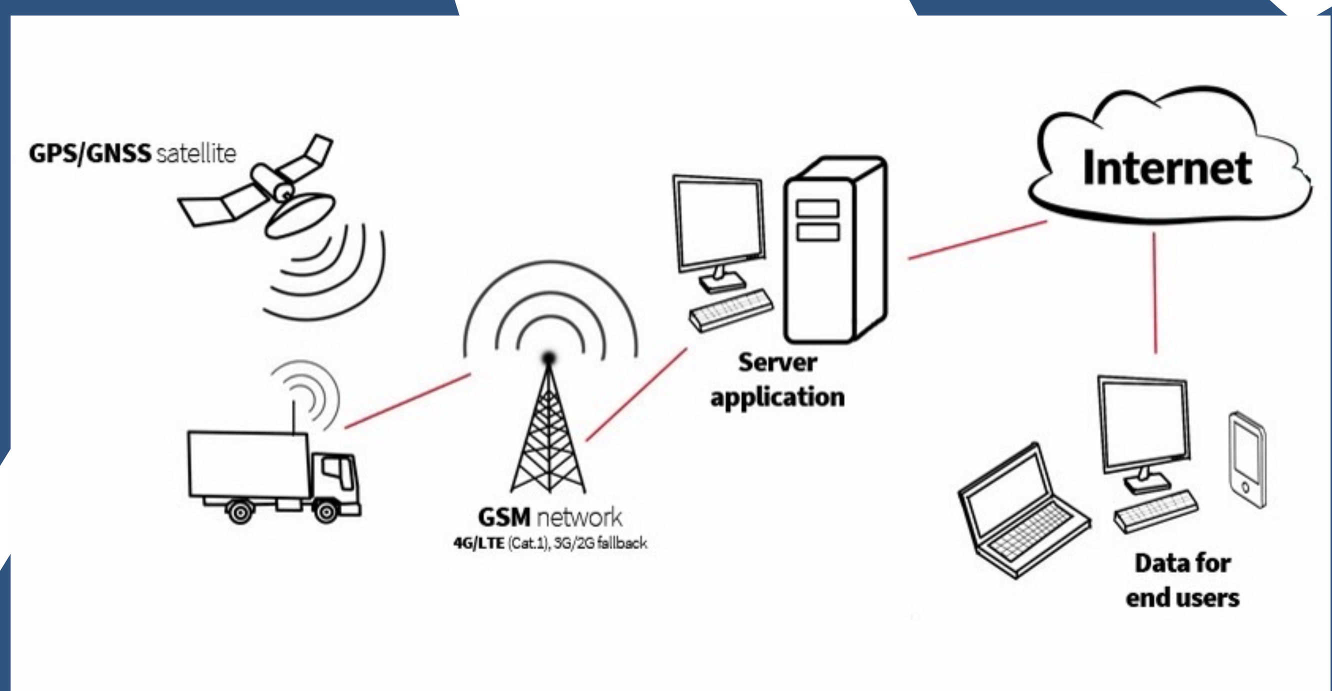
Introduction

This paper explores implementing advanced asset tracking technology to address the challenges faced by a prominent nationwide equipment rental company. Research will focus on identifying the most suitable tracking solution, considering RFID, GPS, IoT, and others. Integration with existing processes, efficiency gains, and profitability will be evaluated, along with data security and maintenance requirements.

Methodology

To assess the problem root and adding value several tools were introduced. Value stream mapping is a methodology that analyses value-adding processes and non-value-adding processes in an organization to enhance efficiency and deliver superior value to customers. It visualizes processes in a diagram and collects resource, time-based, and quality-based data. Gap analysis and problem mapping are crucial tools for identifying and addressing operational issues, measuring the "gap" between desired objectives and current performance levels. Through value stream mapping and these tools, organizations establish strategic goals and propose recommendations for improvement. Problem mapping helps visualize and analyze the causes of a problem, leading to targeted solutions. Digital maturity refers to an organization's ability to leverage digital technologies for business success, and the 360 Digital Maturity Assessment is a tool that assesses an organization's digital maturity through a five-step process involving awareness, scope definition, data collection, evaluation, and debriefing. These methodology would suggest and show the correct order for the direction of the tool.
For comparison reasons tables, scoring of technologies and product development approaches were introduced. Finally, a proof of concept was developed.

After conducting a comprehensive market analysis, the M5Stack solution was identified as the most suitable. The equipment selection process involved evaluating various RFID-enabled devices, including PN5180, PN532, MFRC522, WS1850S, RDM6300, and 113020002 at frequencies of 13.56 MHz and 125 kHz, along with RFID tags. Additionally, other related equipment like GPS modules, batteries, LTE modules, and SD cards were considered. The programming was primarily done in Blocky by Google, with minor modifications in microPython. The code aimed to display information on the microprocessor's LCD and transmit data to a server via an API. The server-side API code was developed in Next.js to ensure reliable data transmission, storage, and retrieval. A dedicated application webpage was created to visualize data and provide a user-friendly interface for viewing server logs and transmitted data. This real-time update interface enhanced the user experience and facilitated efficient data monitoring and analysis. In the final phase of the proof-of-concept stage, a program was developed for real-time asset tracking. It allowed data extraction, processing, and integration with the company's existing system. The program included features such as searching for RFID IDs, identifying missing IDs, exporting data in various formats, and displaying asset locations on an interactive map. Testing was conducted in different scenarios to assess the equipment's performance. Initially, the equipment was tested under normal conditions without obstructions, evaluating their performance at various distances. The results showed consistent performance across different RFID devices. Further tests were performed with a plastic separator to simulate real-world conditions. The presence of the plastic material had minimal interference with the RFID readings, aligning with the results obtained under normal conditions.
To evaluate the system's performance in rainy conditions, the equipment was enclosed in a plastic casing, and water was introduced between the RFID system and the sensor. The RFID system demonstrated favorable performance even in the presence of rain. Lastly, the system's limitations in reading through metallic materials were confirmed through a proof-of-concept experiment. The presence of aluminum significantly hindered RFID functionality, highlighting the challenges associated with metallic obstacles. Overall, the testing phase provided valuable insights into the equipment's capabilities, robustness, and limitations, ensuring that the selected RFID solution meets the project's requirements.



Conclusions

Developed a robust and independent tracking system utilizing RFID readers and M5Stuck controller. The system autonomously monitors assets, counting them simultaneously, and operates reliably in diverse environmental conditions. Weatherproof design protects the system from water damage. Affordable implementation cost contributes to the company's productivity and efficiency.

M5STACK

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