Smart warehouse for fish wholesale market

Build new products based on AI and IoT technologies.

The Challenge

The company operates in the wholesale marketing sector, specializing in the distribution of fresh fish. To meet their specific needs, several challenges must be addressed. First, the company seeks to implement an automated inventory control system for its warehouses that would minimize the need for human intervention. This would ensure efficient inventory management without relying on manual processes. Second, the company aims to have real-time visibility and tracking of products in transit. Since the nature of goods is perishable, it is critical to monitor the location and condition of each item to maintain quality standards. All of this would enable the company to make informed decisions based on up-to-date information, resulting in increased revenues through optimization of sales strategies.

Industry Sector:
wholesale marketing of fresh fish

Challenge classification:
Inventory Management and Material Flow Control based on IoT Technologies

Time for Project Completion:
6 months

Main Requirements

N/A

Other Requirements

Due to the high number of devices (rfid tags for example) the cost of each one must be minimal.

Key Performance Indicators

Implementing a real time monitoring and visualization of warehouse stocks allows to perform data analytics, to take data-driven decisions, and to increase revenues based on sales.

Other informations
The company expects to deploy One tag for each lot of product (hundreds a day) devices.

Need for device management operations (such as managing or updating the software remotely)?
Yes

Strict deadlines in device operations for doing the tasks?
No

Research Phase

Taking into account the challenge description, its requirements and its information, elaborate at least 5 questions that can lead your research for a solution.

Research questions:

1. How can label scans be taken simultaneously without human intervention?
2. How can vehicle tracking be implemented?
3. How can real-time stock visualization on a running truck be achieved without human intervention?
4. How can temperature on trucks be measured?
5. How can real-time data visualization of stock be incorporated?

Given the questions and the main requirements of the challenge previously listed:

- *identify possible technologies using the Planet4 Taxonomy Explorer;*
- *identify and analyze the sources (papers, articles, etc.) of those technologies that best suit the challenge;*

Technologies identified in the taxonomy:

- RFID
- Data Visualization Tools and Platforms
- Connectivity (5G, WiFi, etc.)
- Cloud Data Storage and Computing

Sources of those technologies that best suit the challenge:

1. https://www.researchgate.net/publication/326823239_Industry_40_Smart_Scheduling
2. https://www.digiteum.com/internet-of-things-logistics/
3. https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/ai-in-production-a-game-changer-for-manufacturers-with-heavy-assets#
4. http://scientiairanica.sharif.edu/article_21299_7178257779f1119484087880ef786335.pdf
5. https://www.st.com/content/dam/artificial-intelligence/edge-ai/stmicroelectronics-stlivedays-low-power-predictive-maintenance-Lacroix-marketing-presentation-2171.pdf
6. Smart Warehouse System (Zerynth)

In light of the discoveries made:

- *report the answers for the questions above;*
- *compare 2-3 of the more common solutions identified in the sources (how would they change the approach to the solution? What are the possible benefits/issues in such a use of these technologies?);*
- *draw initial conclusions on which path you want to take in proposing a solution.*

Answers:

1. RFID technology with UHF tag
2. GPS tracker
3. RFID gateway
4. IOT Gateway
5. Cloud infrastructure with plug-in dashboard service

Comparison:

Leading requirements from the Company are about controlling stock in warehouses without human intervention and also monitoring the product during truck transportation. Regarding the RFID technology we can choose between HF and UHF solutions. In this case it's better to opt for an UHF solution given the greater read range (up to 12 mt) and the lower cost compared to the HF. In this case the RFID gateway should be installed in the front part of the shelves and at the entrance of the truck body. Regarding the GPS tracker we can choose between OBD GPS, hardwired GPS tracking system and a battery powered tracking unit. The first type (OBD GPS) is the most integrated with the vehicle and can lead to additional information given by other parameters while the other two (hardwired and battery powered) were installed only where any OBD is available.

Conclusions:

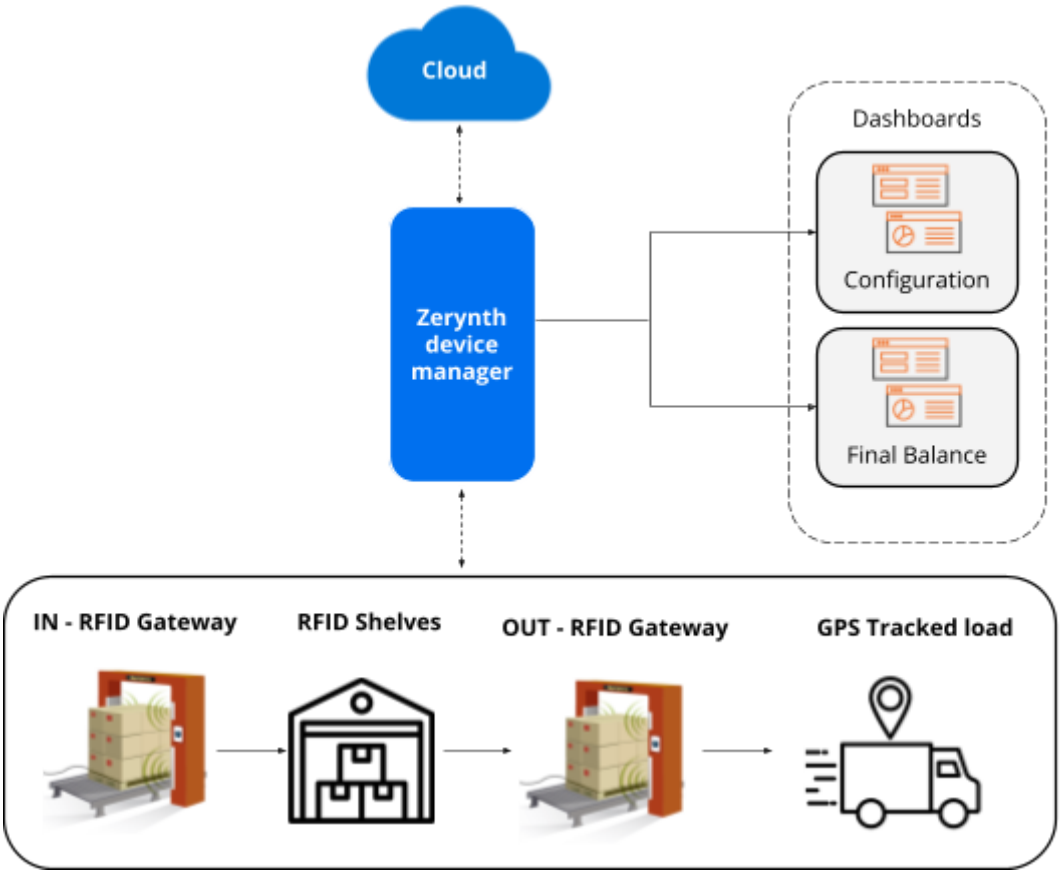
Regarding the RFID, it is better to opt for an UHF solution: it is cheaper and allows us to add some important measurements in tracking perishable products, for instance the temperature. Regarding the GPS tracking system, it depends on how the logistic chain is organized and what kind of truck is used. If the logistic chain is outsourced it's not possible anymore to install the GPS onto the truck and the tracking system has to follow the basket with all the products in it; conversely, if the logistics is owned, the GPS system can be mounted on the truck together with a RFID gateway.

Proposed Solution

Making use of the technologies identified after the analysis of the sources, describe a possible solution to the challenge. Also, do not forget the constraints (time, number of devices to produce/connect, etc.): the solution must be applicable to the real context of the company that commissioned the challenge.

Solution Summary

Based on the analysis made in the previous two sections, the following solution is proposed:



The perishable products must be labeled before entering the depot in order to spot the transit. Once in the depot, the products should be placed on the shelves where an RFID antenna ensures real time stock traceability. Once the item leaves the shelves and then the depot, the traceability is provided by a GPS system on the truck or on the basket in which the item is contained.

Solution Description

The proposed solution to address this challenge involves the implementation of several technologies. First, perishable products are tagged before entering the depot so as to ensure traceability during transit and enable easy identification (Question 1). To further improve traceability during the product's journey outside the depot, a GPS system is used that tracks the location and movement of the product in real time (Question 2). This system can be installed on the truck or on the bin in which the item is contained. Once inside the depot, products are placed on shelves equipped with an RFID antenna, thus enabling real-time inventory tracking within the depot, and providing accurate information on inventory levels [R8-1]. The Zerynth cloud is used to enable real-time process visibility capabilities [R8-2]. This, in fact, offers tools such as the Device Manager and dashboarding services, which provide graphical visibility to users of real-time inventory information and thus make it easy to monitor and analyze this data (Question 5). Technically, communication between the RFID gateway and the Zerynth IoT gateway is via the RS485 bus. The IoT gateway, connected to Wi-Fi, transmits data to the Zerynth cloud using the MQTT protocol.
In addition, a battery-powered GPS tracking system is used to transmit tracking data to the Zerynth cloud. The integration of the GPS tracking system with the real-time inventory dashboard on the Zerynth cloud provides complete visibility into inventory levels and the location of products in transit (Question 3).
Finally, to ensure proper temperature monitoring, the solution incorporates temperature sensors installed within the trucks (Question 4). These sensors continuously measure the temperature of the perishable products during transportation. The collected temperature data can then be integrated into the system and transmitted to the Zerynth cloud alongside the GPS tracking and inventory information. By including temperature measurement, the solution provides comprehensive visibility into the condition and quality of the products, ensuring that they are properly stored and transported within the required temperature range.

Implementation Plan

Describe the solution implementation plan considering among other things: gantt chart with milestones, high-level cost analysis, possible difficulties (at least 3 major issues or difficulties) and additional opportunities (at least 2 extra benefits).

1. RFID Gateway (4 hours)
   Milestone: Set up the connection between RFID gateway and IoT gateway
   Description: The focus of this phase is to establish a seamless connection between the RFID gateway and the Zerynth IoT gateway. As the compatibility with RS485 communication protocol is already ensured, the setup process should not take more than 4 hours. The primary task is to configure the communication between the gateways, enabling data transmission from the RFID system to the Zerynth cloud.
2. GPS Tracker (few minutes)
   Milestone: Installation and integration of GPS tracker
   Description: This phase involves the installation and integration of the OBD GPS tracker, specifically the Zerynth TracKcar. The process is relatively quick, taking only a few minutes (it depends on the

number of trucks to be connected) to set up the GPS tracker and connect it to the Zerynth cloud.

3. Data Visualization and Dashboarding (4-6 weeks)
   Milestone: Development of data visualization and dashboarding system
   Description: The most time-consuming part of the implementation plan is the development of a comprehensive data visualization and dashboarding system. This phase involves cross-referencing data from different sources, including the RFID system, GPS tracker, and potentially temperature sensors. The Zerynth dashboarding service, with its drag and drop capabilities, helps expedite this process. However, it is important to note that this phase requires an iterative approach, allowing the system integrator to gain an in-depth understanding of the customer's processes and tailor the dashboarding system accordingly.

Additional opportunities:

- Enhanced Supply Chain Efficiency: Real-time stock traceability and integrated data visualization offer opportunities to optimize inventory management and improve supply chain efficiency, reducing stockouts and waste.
- Quality Control and Customer Satisfaction: Incorporating temperature sensors for real-time monitoring ensures better quality control during transportation, leading to higher customer satisfaction and customer loyalty.
- Data-Driven Insights and Analytics: Comprehensive data from multiple sources enable data-driven insights and analytics, facilitating continuous process improvement, cost optimization, and revenue growth based on data-backed decision-making.

Possible difficulties:

- Scalability and Deployment: Scaling the solution to accommodate larger warehouses or multiple depots may pose logistical challenges in terms of deploying and managing a larger number of devices across multiple locations.
- Data Security and Privacy: Protecting sensitive inventory and tracking data, implementing robust security measures, and complying with privacy regulations are essential to maintain data security and privacy.
- Data Accuracy: Ensuring accurate and reliable data from temperature measurement can be challenging, requiring precise calibration and quality control measures as well as validation mechanisms to address potential inconsistencies and errors.