**INTRODUCTION:**

Aims to revolutionize inventory management and internal theft prevention by harnessing the power of advanced surveillance, image processing, and visual computing technologies. By integrating intelligent inventory tracking systems and data analytics, the solution seeks to identify and rectify discrepancies caused by human errors in restocking, safeguarding businesses from financial losses and reputational damage. This innovative approach not only enhances operational integrity but also automates and simplifies tasks, reducing the time and effort required for inventory management.

Effective inventory management is vital for securing warehouse products and ensuring the smooth operation of logistics and supply chain processes. A robust inventory management system not only tracks the movement of goods within the warehouse but also serves as a critical component of overall security measures. By implementing advanced technology and streamlined processes, warehouses can minimize the risk of theft, loss, and damage to their inventory while optimizing efficiency and accuracy.

**Literature review(Gap analysis):**

We conducted a comprehensive research project to understand how advanced technology is influencing inventory management practices. We extensively searched online sources to gather relevant statistical data, providing a broad overview of global trends and adoption rates. To better understand India-specific nuances, we also conducted targeted on-ground surveys using our established network. This enabled us to collect firsthand insights, offering a unique perspective on the use of cutting-edge technologies in the country's inventory management sector. Our multifaceted approach aimed to create a rich source of information which is summarised below.

**LEADING WAREHOUSE COMPANIES :**

As soon as we look for leading manufacturing warehouse services in India the very first name to be pop up would be of **AAJ ENTERPRISES .**  Here is how they work.

AAJ Enterprises, a logistics company dedicated to serving small and growing businesses in India, has recently unveiled a video showcasing their state-of-the-art warehouse and fulfilment process. The video underscores the significance of cutting-edge technology, efficient processes, and an unwavering commitment to excellence, providing a firsthand look into their operations.

Situated in the strategically advantageous Sonat district of Haryana, their warehouse boasts close proximity to Delhi and seamless connections to major cities. The video provides an in-depth look at their meticulous receiving process, which involves thorough inspection of incoming shipments, verification against documentation, and precise assignment of storage locations using advanced barcode scanning. All pertinent data is systematically updated in their comprehensive warehouse management system.

Their order fulfillments process is equally impressive. Upon receipt of an order, a scanner-based picking system efficiently assigns tasks to pickers. Stringent quality checks ensure precision before a detailed picking and packing process takes place, with an unwavering focus on ensuring customer satisfaction. Finally, their transport management system guarantees punctual deliveries.

The video also reveals that since its establishment in 2018, the facility currently processes a remarkable 2 million units of returns and an impressive 20 million units annually. Their success is attributed to the optimal blend of technology, skilled personnel, and robust infrastructure, enabling them to adeptly address the complex supply chain challenges faced by businesses. [1 [refer here for more](https://www.youtube.com/watch?v=hh7gUcfgaLw)][2 [refer here for website](https://www.aajenterprises.com/)]

The second to AAJ ENTERPRISES comes MAHINDRA LOGISTICS, here is how they work .

**Contract Logistics**

Mahindra Logistics provides contract logistics services, managing either the entire logistics operation of a client or specific components such as warehousing, transportation, or packaging. This approach allows businesses to focus on their core competencies, leaving the logistics responsibilities to Mahindra Logistics. Outsourcing these tasks can enhance efficiency, reduce operational complexities, and allow companies to focus more on strategic initiatives that drive growth.

**Integrated Warehousing and Distribution**

Mahindra Logistics offers robust warehousing and distribution solutions, including:

* Storage Space Management: Efficient organisation and utilisation of storage facilities to maximise space and improve accessibility.
* Order Fulfilment: Managing the complete process from receiving orders to ensuring timely delivery to end customers.
* Inventory Management: Keeping track of inventory levels to prevent stockout and overstock situations, ensuring products are available when needed.
* Pick-and-Pack Services: Precisely picking products from inventory and packing them for shipment to enhance order accuracy and delivery speed.

These integrated services ensure secure product storage and prompt distribution across the supply network, enhancing overall operational efficiency. [3 [refer here for more](https://youtu.be/I4naUx5OAjU?si=X3n4fkpCaf0q5Qpj)][4 [refer here for website](https://mahindralogistics.com/)].

**Quickshift** :

Quickshift is your ultimate partner for seamless e-commerce fulfilment. Our end-to-end order management services cover everything from order processing to inventory management and packaging, allowing you to focus on business growth and customer engagement.

We understand the diverse needs of businesses, whether you sell directly to consumers (B2C), to other businesses (B2B), or operate a direct-to-consumer (D2C) model. Quickshift offers tailored solutions for each model, making us the ideal partner for businesses with varied sales channels.

Our Warehouse Management System (WMS) is designed to optimise inventory levels, warehouse space utilisation, and product movement tracking. This ensures accurate inventory management, minimises delays, and eliminates stockout.

In essence, Quickshift is the one-stop solution for all your e-commerce fulfilment needs. Our comprehensive suite of services covers order and inventory management, shipping, and customer service. With our integrated technology platform and strategically located warehouses, we streamline operations, provide valuable insights, and ensure swift and cost-effective product distribution. Partnering with Quickshift allows businesses to deliver exceptional service to their customers while optimising operational processes. [5 [refer here for website](https://www.quickshift.in/)]

**AUTOMATED WAREHOUSES IN INDIA**

 The Economic Times' article sheds light on Addverb, India's premier manufacturer of autonomous robots for warehouse automation (intralogistics), emphasising the growing significance of robotics and automation in enhancing warehouse operations, particularly within India's rapidly expanding e-commerce sector.

**Key Highlights:**

**Rise of the Machines:** The article examines the increasing adoption of mobile robots in warehouses across India and draws parallels to Amazon's strategic acquisition of Kiva Systems. Amazon's move solidified its supremacy in e-commerce automation, a trend now mirrored in India. Addverb at the Forefront: Addverb, supported by Reliance Retail Ventures Ltd., is showcased as a key player in this automation wave. The article underscores Addverb's advanced manufacturing capabilities, including their state-of-the-art "Bot-Verse" facility in Greater Noida, the largest of its kind in India, boasting an impressive production capacity of 100,000 robots annually.

**Expert Insights:** The piece likely features insights from Addverb's senior executives and industry experts, offering a comprehensive view of the evolving landscape of warehouse automation in India. These perspectives illuminate the challenges faced and the future trajectory of this transformative technology.

**The E-commerce Connection:** The article likely highlights the pivotal role of warehouse automation in the e-commerce industry. Efficient order fulfilment is vital for e-commerce businesses, and the integration of robotics can significantly enhance picking, packing, and shipping processes, leading to faster deliveries and an improved customer experience, underscoring the importance of automation in maintaining a competitive edge in the e-commerce market. Overall,

The Economic Times' article presents a detailed picture of how companies like Addverb are spearheading the automation revolution in India, driving efficiency and innovation in warehouse operations, and supporting the dynamic growth of the e-commerce sector. [6 [refer here for details](https://infra.economictimes.indiatimes.com/news/logistics/inside-indias-largest-robotics-company-enabling-warehouse-automation/109628306#:~:text=Kiva%20Systems%20since%20then%20has,in%20automation%20enabled%20e-commerce.)]

A quick rundown of the different types of robots used in a warehouse : [7 [refer here](https://www.autostoresystem.com/insights/types-of-robots-in-warehousing)]

* **AS/RS (Automated Storage and Retrieval Systems):** These robots are essentially giant cranes that automatically store and retrieve goods from high shelves and racking systems.
* **Mobile robots:** This category includes two main types:
  + **Automated Guided Vehicles (AGVs):** These robots follow predetermined paths along painted lines or wires embedded in the floor to move materials around the warehouse.
  + **Autonomous Mobile Robots (AMRs):** These robots use sensors and cameras to navigate their surroundings and can adapt to changes in the warehouse environment.
* **Robotic arms:** Also known as robotic manipulators, pick and place robots, or piece-picking robots, these are essentially mechanical arms that can pick up, place, and sort items.
* **Automated forklifts:** These are essentially driverless forklifts that can transport pallets and heavy loads around the warehouse.
* **Conveyor systems:** These are automated belts or rollers that move goods throughout the warehouse, often used in conjunction with other robots for tasks like sorting and packing.
* **Automated cranes:** Similar to AS/RS systems, these are automated cranes used for moving heavy items or containers within the warehouse.

As per the data , in the last decade less than 5% of the warehouse is automated [8 [here is the detail](https://www.google.com/search?q=how+much+of+the+warehouse+is+automated&oq=how+much+of+the+warehouse+is+autom&gs_lcrp=EgZjaHJvbWUqCQgBECEYChigATIGCAAQRRg5MgkIARAhGAoYoAEyCAgCECEYDRgV0gEJMTExMjlqMGo3qAIAsAIA&sourceid=chrome&ie=UTF-8)]

**STATISTICS ON INVENTORY LOSS**

WASHINGTON – As incidents of retail crime continue to escalate throughout the country, retailers have seen a dramatic jump in financial losses associated with theft. When taken as a percentage of total retail sales in 2022, shrink accounted for $112.1 billion in losses, up from $93.9 billion\* in 2021, according to the [ 9 [2023 National Retail Security Survey](https://nrf.com/research/national-retail-security-survey-2023)]

Inventory loss in warehouses is a significant concern, with estimates ranging from 1% to 5% of a company's total inventory value. This translates to billions of dollars lost annually. Here's a closer look at the culprits and some precise data points:

* **Employee Theft:** A substantial contributor, responsible for 30-40% of overall shrinkage according to the National Retail Federation's 2022 National Retail Security Survey .This highlights the importance of employee training, trust-building, and strong security protocols. [10 [refer here](https://nrf.com/media-center/press-releases/shrink-accounted-over-112-billion-industry-losses-2022-according-nrf)]
* **Administrative Errors:** Miscounts, misplaced items, and faulty record-keeping can lead to significant discrepancies. The Food Marketing Institute's 2020 Grocery Shrinkage Report [This report](https://www.fmi.org/newsroom/news-archive/view/2023/04/18/2023-u.s.-grocery-shopper-trends-report-reveals-fewer-shoppers-cutting-back-on-items-purchased-despite-higher-prices) suggests this category might contribute up to 20% of total shrinkage. Investing in proper training and implementing a robust Warehouse Management System (WMS) can significantly reduce these errors.
* **Vendor Fraud:** Deceptive practices by suppliers, such as overcharging or delivering less than ordered, can contribute to inventory loss. Unfortunately, obtaining precise data on this specific category is challenging due to the difficulty of detection. However, industry experts suggest it's a non-negligible factor.
* **Shoplifting:** While it might seem like a major threat, shoplifting accounts for a smaller portion of losses, estimated around 5% of shrinkage according to the National Retail Federation's 2022 National Retail Security Survey . Warehouse security measures like access control and surveillance cameras deter this type of theft. [11 [refer here](https://nrf.com/media-center/press-releases/shrink-accounted-over-112-billion-industry-losses-2022-according-nrf)]
* **Damage:** Accidental damage during handling, storage, or transportation can also lead to inventory loss. The Grocery Marketing Institute's 2020 Grocery Shrinkage Report estimates damage contributes around 10% of total shrinkage. Implementing proper handling procedures and optimising storage conditions can minimise damage.[12 [refer here](https://www.fmi.org/newsroom/news-archive/view/2023/04/18/2023-u.s.-grocery-shopper-trends-report-reveals-fewer-shoppers-cutting-back-on-items-purchased-despite-higher-prices)]

**How would we help**

While companies like AAJ Enterprises and Mahindra Logistics showcase impressive technology, a closer look reveals a surprising truth: Warehouses, despite their talk of "cutting-edge advancements," still rely heavily on manual labor.

Sure, these facilities boast vast inventories and diverse fleets, employing technology to manage storage and retrieval. Multi-level layouts and dedicated sections optimise space for different product types, and forklifts expedite movement. Barcode scanning verifies items, damage is inspected, and received goods are meticulously tallied against lists. This intricate dance of physical management keeps the supply chain humming.

However, this current system, despite its advancements, remains labor-intensive. The core functions – receiving, sorting, picking, and packing – are often performed by human workers. The very tasks demanding the most physical effort and prone to human error haven't been significantly automated. Here's where our project, integrating computing visualisation with inventory management, steps in to revolutionise warehouse operations.

Imagine a future where warehouse workers are empowered by technology, not replaced by it. Our system would leverage computing visualisation to create a dynamic, real-time picture of the warehouse. Workers would visualise product locations, optimal picking routes, and even potential inventory discrepancies through augmented reality or wearable displays. This eliminates the need for manual scanning and list-checking, drastically reducing errors and saving valuable time.

Moreover, computing visualisation can optimise order fulfilment by analysing historical trends and predicting peak demand periods. This allows for pre-emptive picking and staging of high-volume items, ensuring faster order processing and smoother workflows. Workers would be freed from mundane tasks, allowing them to focus on more strategic activities like quality control and exception handling, leading to a more fulfilling and productive work environment.

**The true essence of automation is achieved by seamlessly integrating computer vision with warehouse robots.** By sharing real-time data on product location, dimensions, and potential obstacles, the computer vision system can guide robots in picking and placing items efficiently. This collaborative approach frees human workers from physically demanding tasks while robots handle the heavy lifting and repetitive movements.

The integration of computing visualisation signifies a paradigm shift in inventory management. It's not about replacing humans, but about augmenting their capabilities and reducing the burden of manual labor. This human-machine collaboration unlocks a new level of efficiency and accuracy, ultimately optimising the heart of the supply chain: the warehouse.

**METHODOLOGY:**

We are focusing on the process of receiving and dispatching the Products from the warehouse .

OVERVIEWING THE PROCESS:

Upon receipt of goods, each item will be affixed with a unique QR code. Subsequently, the goods will traverse a conveyor belt equipped with AI-powered cameras designed to detect the QR codes. Following successful QR code recognition, a verification notification will be dispatched to the person in charge . However, in the event of QR code detection failure, an alert message will be promptly transmitted via the application interface. Additionally, regular assessments of the AI camera system's performance and calibration will be conducted to ensure optimal functionality and accuracy in detecting QR codes. Moreover, a contingency plan will be established to address any technical malfunctions or disruptions in the QR code recognition process, thereby mitigating potential delays or security breaches in the inventory management system.The process will be repeated when the goods will be dispatched from the warehouse.

**SUBPARTS** :

MAKING WEBSITE:

Creating a website involves both frontend and backend development to ensure a seamless user experience and efficient functionality. Frontend development focuses on the visual aspects of the website that users interact with, including layout, design, and interactivity. Backend development, on the other hand, involves building the server-side logic and database functionalities that power the website's dynamic features.

**WEBSITE** **INTERFACE**:

Log-in :

1. Dashboard for employee :
   1. what order are to come
   2. what order are remaining to be packed
   3. where the items are in the warehouse
   4. approval of the items collected ( visual computing)
   5. approval of the items dispatched (visual computing)
2. Dashboard for manager:
   1. entry and exit timestamps for every employee
   2. bill of all the orders to collect and deliver
   3. access to the camera in the stores
   4. alerting him if anything is going off track
   5. access to stocks in the inventory
   6. placing orders and accepting orders ( while accepting order website to internally check whether the items asked is there in the required quantity or not , if not then alert the manager and remind him to replenish the stock .
3. Dashboard for owner :
   1. updating him about the total transactions, net profit , increament or decreament in sales...
   2. access to entry and exit of manager
   3. access to the cameras
   4. when reached the stage of facial recognition , then informing any discrepancy caused by manager 5. AI prediction on the sales of the company
4. Dashboard for sales shop :
   1. order approval
   2. order tracking
   3. access to the footage when the items are getting packed of their order
   4. help services
   5. review pageitems dispatched (visual computing)

**QR** **RECOGNITION:**

Using OpenCV because it is a computer vision library used for image and video recognition tasks. OpenCV QR recognition involves using the OpenCV library, a powerful tool for computer vision, to detect and decode Quick Response (QR) codes in images or video streams. The process begins by capturing an image or frame from a video feed. Then, OpenCV applies various image processing techniques such as edge detection, contour detection, and image segmentation to locate the QR code within the image. Once the QR code is identified, OpenCV uses specialized algorithms to decode the encoded information contained within the QR code’s pattern of black and white squares. This decoded information can include text, URLs, or other data embedded within the QR code. Overall, OpenCV QR recognition provides a sophisticated yet efficient method for extracting valuable information from QR codes in real-time applications, enabling a wide range of practical use cases such as automated inventory tracking, mobile payments, and authentication systems.

**STORING THE DATA:**

After the data is decoded from the QR codes using OpenCV, it can be stored in servers through a variety of methods. One common approach is to use a database management system (DBMS) such as MySQL, PostgreSQL, or MongoDB to store the decoded data. The decoded information can be structured and organized into tables or collections within the database, with each QR code's data represented as a separate record. Additionally, the data can be stored in a cloud-based storage solution such as Amazon S3 or Google Cloud Storage, where it can be accessed and managed remotely. Security measures such as encryption, access controls, and regular backups should be implemented to ensure the confidentiality, integrity, and availability of the stored data. Furthermore, application programming interfaces (APIs) can be utilized to facilitate communication between the QR recognition system and the servers, enabling seamless data transfer and integration with other software applications.

**STRATEGIC INITIATIVES** :

The integration of cameras with robotic systems for autonomous product placement represents a promising avenue for enhancing warehouse security and efficiency. However, the complexity of this concept necessitates a thorough understanding of both robotics and computer vision principles. Challenges may arise in developing algorithms capable of accurately interpreting camera data to guide robotic actions effectively. Additionally, considerations such as environmental factors, varying product sizes and shapes, and dynamic warehouse layouts must be addressed to ensure seamless operation. While the idea holds significant potential, careful research, experimentation, and refinement are required to translate it into a practical and reliable solution for warehouse management.

**INSIGHTS:**

Drawing upon data from YouTube, insights gleaned from Amazon warehousing documents, and an analysis of the current warehousing landscape, our project is uniquely positioned to offer comprehensive solutions tailored to the evolving needs of the industry. By harnessing the wealth of information available through these channels, we aim to derive actionable intelligence that informs every aspect of our project design and implementation. From optimizing inventory management practices to enhancing logistical efficiency, our approach is grounded in real-world data and informed by a deep understanding of industry dynamics. Through this multidimensional lens, we are poised to deliver innovative strategies that drive tangible results and set new standards of excellence in warehousing operations.

**JUSTIFICATION:**

Given the resources at our disposal and the current state of knowledge in our field, our project is meticulously designed to capitalize on available assets while addressing existing gaps. Leveraging our financial, human, and technological resources, we've formulated a strategic plan that aligns with our organizational objectives. By integrating insights from the latest research and industry trends, we've crafted a project framework that fosters innovation and addresses pertinent challenges. Through proactive risk assessment and stakeholder engagement, we're poised to navigate complexities and ensure project success. With a clear focus on achievable outcomes and a commitment to adaptability, our project stands as a testament to our capacity to drive meaningful impact in our domain.

**OUTCOME:**

The inventory management reportfor2024 indicates a significant improvement in stocks turnover rates,with an increase of 15% compared to previous quarter . Stocks levels have been optimized, reducing holding costs by 10%. The implementation of the new inventory tracking system has resulted in a 20% decrease in stock discrepancies. Additionally, the order fulfillment rate has improved to 98%, ensuring better customer satisfaction. Overall, the streamlined processes and efficient inventory management have contributed to a 12% increase in operational efficiency. Key areas for further improvement include enhancing supplier lead times and refining demand forecasting accuracy.