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Enhancing Organizational Efficiency: A Cloud-Based Automation Solution

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Abstract: This article proposes an advanced automation solution tailored to modern organizational needs, focusing on digitizing, and integrating essential operations such as inventory, personnel, and departmental management. By transitioning from manual to a cloud-based system, the solution enables real-time tracking, streamlined workflows, and data-driven decision-making, aligned with emerging trends in transparency, operational efficiency, and sustainability. Leveraging innovative technologies like ReactJS, Node.js, and MongoDB, as well as barcoding and QR code tracking, the project was able to provide a scalable, adaptable platform suitable for small to medium-sized organizations. Moreover, this solution highlights the growing importance of automation in enhancing accountability, operational resilience, and scalability in today's dynamic environment.

Keywords: advanced automation, digitization, cloud-based system, real-time tracking, operational efficiency, scalability, data-driven decision-making

INTRODUCTION

Nonprofit organizations (NPOs) play a crucial role in advancing women's empowerment and sustainable community development by promoting initiatives that focus on traditional crafts and home-based work. By providing training and employment opportunities in textile production, these organizations support women in generating income while preserving cultural textile heritage. Home-based employment models, which enable women to work within their communities, offer a balanced approach that accommodates both family responsibilities and economic participation. These programs not only groom women but also strengthen community cohesion and cultural identity, fostering broader social impacts. This combined focus on economic empowerment and cultural preservation has been effective in addressing socio-economic challenges in marginalized areas. Furthermore, these initiatives revitalize regional crafts and build social capital within communities, as women contribute to both household income and the local market through NPO-supported

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channels. Overall, nonprofit-led programs act as catalysts for sustainable livelihoods, creating lasting value for individuals and communities alike [1].

However, dedicated to social welfare and community development, nonprofit organizations face unique operational challenges as they scale, particularly when employing home-based artisans who produce traditional crafts. Though, these organizations play a significant role by creating employment opportunities in economically underserved communities while preserving local heritage through craftsmanship, their growth often reveals limitations in their operational processes. Many nonprofits still depend on manual, paper-based methods for managing inventory, tasks, and records due to limited access to digital infrastructure. This reliance on outdated processes restricts their efficiency and responsiveness, making it harder to meet growing demands effectively.
In this regard, Enterprise Resource Planning (ERP) software exist commercially that nonprofits use for inventory management. Nonprofit organizations often manage a diverse range of inventory items, each serving a specific purpose in their mission to support communities. Organizations handling medical supplies, such as the Red Cross, use inventory systems to track essential items like bandages, syringes, and medications, ensuring rapid response during emergencies [2].

Similarly, nonprofits like Habitat for Humanity manage household items such as bedding, kitchenware, and furniture to support families transitioning into new homes. Efficient inventory tracking enables timely distribution of essentials. For educational support, organizations like UNICEF utilize inventory systems to manage textbooks, school supplies, and teaching aids, ensuring resources reach underserved communities and promote learning. Youth Development Programs depend on tools like work gloves and safety goggles for hands-on training. Proper inventory management guarantees these resources remain available and in good condition, enhancing skill development and employability. Disaster relief organizations maintain inventories of building materials such as plywood and roofing supplies, facilitating efficient disaster response and rebuilding efforts. By leveraging ERP systems, nonprofits optimize resource allocation, ensuring timely and effective aid delivery [3].

Above mentioned NPOs are amongst the few well established non-profit organizations around the world that can bare substantial cost to utilize the commercially available off-the-shelf inventory management solutions. Thus, the use of technology that possess smart processes and strategies to handle meticulous tasks such as inventory management is not possible for majority of NPOs due to tight budgets where already the NPOs have to lookout for optimizing the use of their assets. Table 1 gives a quick overview in terms of percentage, the key challenges faced for funding and technology adaptation for nonprofits across continents.

TABLE 1
KEY CHALLENGES FACED FOR FUNDING AND TECHNOLOGY ADAPTATION FOR NONPROFITS ACROSS CONTINENTS IN TERMS OF PERCENTAGE

Continent	Funding Challenges	Technology Adaptation Challenges
Asia	35%	25%
Africa	40%	20%
Europe	30%	25%
North America	30%	20%
South America	40%	15%
Oceania	30%	20%

The data presented in this analysis draws on general insights and common challenges observed in the nonprofit sector across various continents. This synthesis is based on a review of sectoral patterns and informal expert knowledge rather than specific, primary-sourced data.

Nonprofit organizations (NPOs) in Asia face significant challenges, especially regarding funding and technology adaptation, when compared to other regions. The difficulty in securing and sustaining funding, alongside the complex issues associated with digital adoption, places unique pressures on nonprofits operating in this region. These challenges are amplified by the diversity in economic, regulatory, and infrastructural conditions across Asian countries, making both funding stability and technological integration more challenging relative to other continents and in such underserved regions, where funding is already scarce, investing on an ERP software becomes next to impossible.

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In terms of funding, Asia presents distinct regulatory hurdles. Strict regulations on foreign funding in some countries limit access to international support, which is often a lifeline for many nonprofits. Consequently, organizations are left to rely heavily on local donors and government grants. This dependence on local funding sources can be unpredictable, particularly for large projects, as financial support may fluctuate with political and economic changes, making it challenging to plan long-term initiatives effectively.

On the other hand, at the technology adaptation front, Asia faces similarly unique difficulties. While many Asian countries have rapidly advancing tech sectors, the digital infrastructure remains unevenly distributed, especially between urban and rural areas. Many nonprofits operate in rural or underserved regions, where access to technology and reliable connectivity is limited, impeding the effective use of digital tools for resource management and data tracking. Additionally, nonprofits often lack the financial resources and technical expertise to implement sophisticated systems for operations, leaving them at a disadvantage in leveraging digital innovations to improve efficiency.

This combination of funding instability and limited technological resources highlight why nonprofits in Asia encounter some of the highest challenges in sustaining their operations effectively. Complex regulatory landscapes, limited access to reliable tech infrastructure, and a heavy dependence on localized funding sources create a challenging environment for NPOs to operate successfully.

In this regard, implementation of efficient digital and automated inventory management practices is required to allow NPOs to strategically streamline their processes, making it easier to manage inventory items and allocate resources effectively. By maintaining accurate records of inventory, nonprofits can track how their resources are used, ensuring financial transparency and accountability. Additionally, automated systems enable data-driven decision-making by providing insights into stock levels, production efficiency, and workforce productivity. These insights empower managers to make informed choices on resource allocation, scheduling, and task distribution, enhancing transparency for stakeholders and supporting strategic planning.

Beyond immediate efficiency gains, automation also supports scalability and data integrity. For growing organizations, cloud-based platforms reduce the administrative burden of managing a larger workforce and client base. Furthermore, secure digital storage minimizes risks of data loss, protects essential records, and ensures operational continuity even during disruptions, making automation a crucial tool for sustainable growth and community impact.

In this context, this paper presents a low-cost management solution based on a case study of a nonprofit organization in Asia after analyzing its challenges. The solution is designed to be easily adaptable with minimal infrastructure, making it applicable not only to NPOs in underserved regions but to any nonprofit organization around the world. It aims to optimize resource management, enhance service delivery, and improve decision-making processes in the nonprofit sector. The paper is organized as follows: Section II details the challenges faced by the chosen nonprofit organization. Section IV presents the proposed solution.

CASE STUDY

Nonprofit organizations play a crucial role in addressing social and economic challenges, often focusing on empowering marginalized communities and preserving cultural heritage. By fostering sustainable livelihoods and promoting inclusive growth, these organizations contribute significantly to community development and social welfare [4]. They often operate in resource-constrained environments, relying on innovative approaches to achieve their missions effectively. One such organization is the Behbud Association of Pakistan (BAP), which exemplifies these principles through its impactful initiatives.

The Behbud Association of Pakistan (BAP) is a nonprofit organization dedicated to social welfare by providing employment opportunities, especially to women, through home-based work in producing traditional garments and crafts. This initiative not only supports economically disadvantaged communities but also helps preserve Pakistan's rich heritage of textile arts, embroidery, and craftsmanship. BAP has grown over the years due to its strong commitment to community development and women's empowerment, playing a vital role in the local economy by providing sustainable employment [5].

However, despite BAP's impactful contributions, its internal management processes have not evolved at the same pace as its operations. The organization currently relies on physical records and manual systems to manage crucial aspects of its workflow, such as inventory tracking, staff assignments, and production outputs. This reliance on traditional paper-based methods has led to several operational inefficiencies. For example, inventory

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levels are manually updated, which increases the likelihood of human error, missing entries, or misplacing critical data. The challenge of keeping accurate records across different departments has made it difficult for management to track product status in real-time, leading to delays in fulfilling orders and responding to market demands.

Additionally, the lack of integrated systems has resulted in redundant data, fragmented communication between departments, and an overall lack of transparency in reporting. These inefficiencies create a ripple effect throughout the organization. Management has limited visibility into the day-to-day operations, which hinders timely decision-making. For example, the production department might overestimate the availability of raw materials, or the sales department may face delays in processing orders due to incomplete records. Moreover, since BAP employs a significant number of home-based workers, managing their assignments, tracking work progress, and calculating wages are time-consuming tasks that add complexity to BAP's operations. The manual handling of these processes introduces risks, including the potential for data loss or inaccuracies that can impact both worker compensation and inventory control.

In this regard, automation can offer a sustainable solution to these challenges by digitizing and centralizing the key functions that drive BAP's operations. By introducing an automated system for inventory control, production monitoring, and staff management, BAP can streamline its processes, reduce errors, and enhance operational efficiency. Real-time inventory tracking can be added advantage that can allow managers to monitor stock levels more accurately, reducing overstock or stockout situations, which have a direct impact on production timelines. Production monitoring can be made more transparent, as each stage of the product's life cycle—from raw material procurement to final assembly—if tracked using barcodes or QR codes, can ensure better accountability and traceability. Staff management can be significantly improved, with supervisors able to assign tasks, track progress, and evaluate performance through digital records.

Furthermore, such an automation would enhance the ability of BAP to also generate data-driven reports, which provide insights into production efficiency, stock levels, and worker performance. These reports can allow BAP management team to make more informed decisions regarding resource allocation, production scheduling, and workforce management. For example, data on which products are in high demand can inform future production priorities, while tracking worker productivity can help supervisors optimize task distribution. Moreover, the level of data visibility can enhance transparency for stakeholders, such as donors and partners, by highlighting the organization's operational efficiency and impact on community development [6].

In summary, Behbud Association currently relies on a manual record-keeping system that leads to inefficiencies such as data redundancy, miscommunication, and challenges in tracking production timelines. Disconnected departmental management causes delays, reporting errors, and complications in task distribution, deadline tracking, and quality control for home-based workers. These issues hinder scalability, responsiveness to market demands, and accurate production forecasting, while also increasing the risk of data loss. A centralized, cloud-based automation system is needed to streamline data management and integrate operations.

PROPOSED SOLUTION

To automate BAP's operations and address its inefficiencies, we propose a cloud-based system that digitizes production and management processes through a web interface. This solution streamlines workflows, enhances oversight, and ensures scalability [7]. Key components of the proposed system are depicted in Fig. 1. A brief description of each key functional component of the proposed solution is detailed next.

Inventory Management: Each product in the system is assigned a unique barcode or QR code to facilitate seamless tracking from raw materials to the final product. This feature is helpful to ensure real-time visibility of stock levels, flags low inventory to prompt timely replenishments, and automatically generates purchase orders to avoid production delays.

Production Workflow Automation: The system introduces automation in the production process by enabling each department (e.g., stitching, embroidery) to scan products at every stage and ensure continuous tracking of progress while supervisors can digitally manage tasks, set deadlines, and assess product quality, enhancing accountability and operational efficiency.

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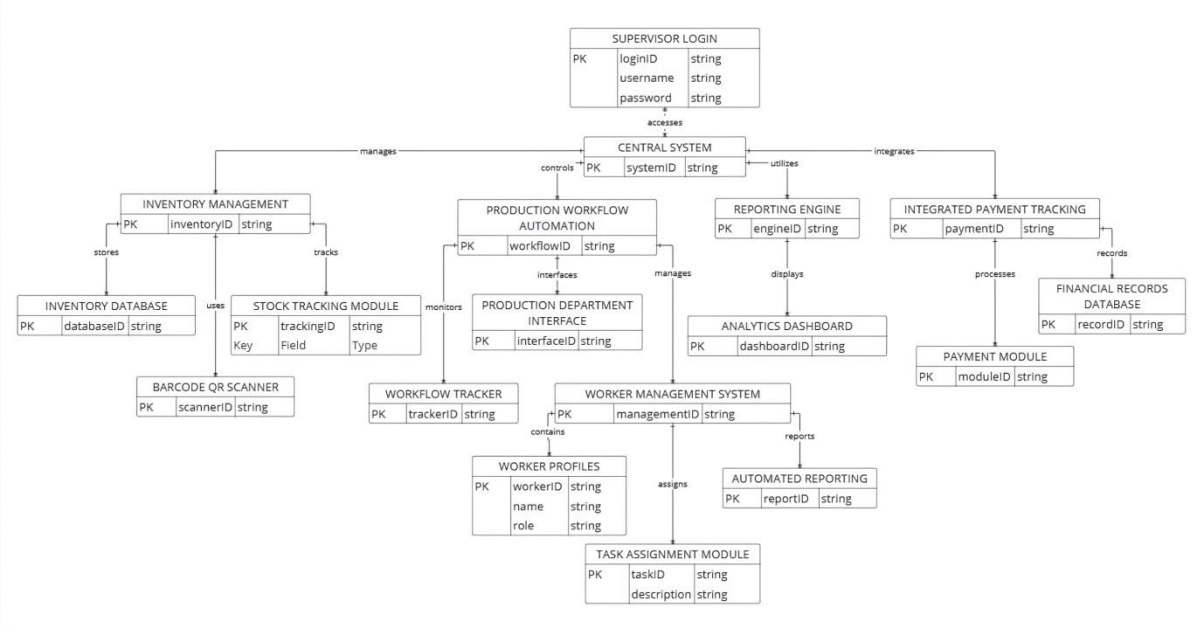

Fig. 1 An overview of the key components of the proposed system.

Worker Management System: A digital profile is created for every home-based worker, allowing supervisors to assign tasks, monitor their progress, and calculate wages based on productivity. This functionality simplifies workforce management and ensures fair and transparent compensation.
Automated Reporting: The system generates comprehensive reports on a daily, weekly, and monthly basis. These reports provide insights into production rates, worker performance, and inventory needs, enabling management to make informed, data-driven decisions.
Integrated Payment Tracking: The system automates the tracking of purchases, returns, and worker payments. This ensures accurate, timely transactions and reduced administrative overhead, streamlining financial operations.

Furthermore, the proposed system includes several core features designed to streamline operations and improve efficiency. A secure login system for supervisors ensures role-based access, protecting sensitive data and allowing only authorized personnel to interact with the system. The centralized dashboard provides a comprehensive interface for monitoring operations, offering real-time insights to support informed decision-making. Moreover, the task and workflow management feature allow for digital task assignments, progress tracking, and efficient worker supervision, enabling better organization and oversight of daily activities. These core features collectively enhance operational control and facilitate smoother management across departments.

Additionally, end-to-end system integration is achieved through several key modules designed to enhance operational efficiency and ensure seamless workflow across all stages of production. One of the core features is real-time product tracking, where each product is assigned a unique ID or QR code. This enables continuous monitoring of the product as it moves through different production stages, providing valuable insights into its status and location at any given time. This level of tracking helps to optimize inventory management, reduce errors, and ensure timely completion of each task.

Furthermore, the system is built to ensure data integrity and operational continuity, crucial for maintaining smooth and reliable operations. By leveraging cloud-based technology, the system not only guarantees the accuracy of data but also minimizes the risk of data loss that could otherwise disrupt business activities. Regular backups are automated to ensure that data is securely stored and can be easily restored in case of any unexpected issues. This cloud-based approach enhances operational resilience, providing BAP with the flexibility and security needed to maintain high performance even during unforeseen disruptions, ensuring that the organization can continue functioning efficiently and without interruption.
The development of the cloud-based digitized automated solution incorporates a carefully selected set of tools and platforms to ensure efficiency, scalability, and ease of use [8]. For software tools, ReactJS is employed to create an intuitive and responsive user interface, enhancing user interaction and experience. The server-side operations are managed using NodeJS, a robust framework for backend processes, while MongoDB serves as the database solution, efficiently storing and organizing both operational and historical data. To maximize compatibility, the system is designed to function seamlessly on devices running Microsoft Windows 7 or above.

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The hardware infrastructure supports the system's functionality with a cloud server hosting the centralized operations, providing real-time accessibility and data security. A QR code scanner is integrated to enable precise inventory tracking and management. Additionally, workstations, including laptops or desktops equipped with Microsoft OS and modern browsers, ensure that staff can interact with the system effectively, facilitating streamlined operations across departments.

A comprehensive use case diagram illustrating user roles and interactions with system components, offering a clear view of functionality and user engagement is shown in Fig. 2.

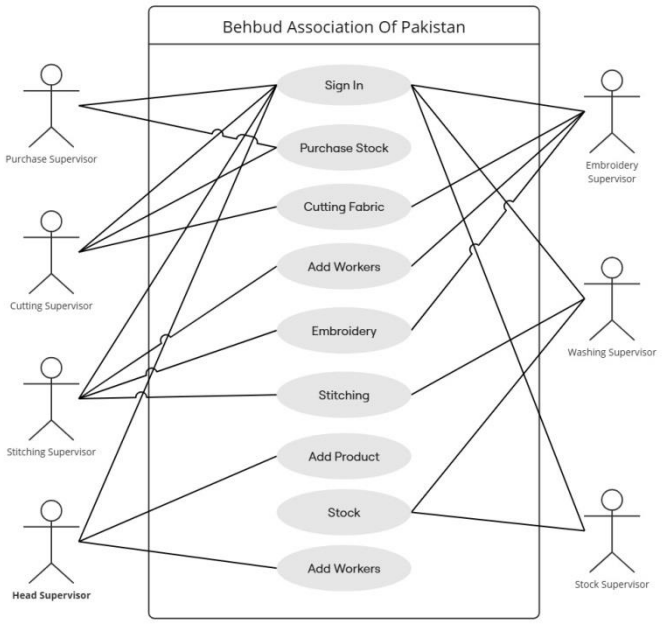

Fig. 2 Use case diagram for the proposed web-based system, illustrating user interactions across key modules for inventory tracking, production automation, staff management, report generation, and automated payments within BAP's operations.

MATERIALS AND METHODS

To achieve the proposed system design, we have employed a structured, methodical approach using the Waterfall Model. This model stood particularly suited for this project, given that the requirements were clearly defined, and the likelihood of significant changes during the development phase were minimal. The linear and sequential structure of the Waterfall Model facilitated a clear, step-by-step progression, ensuring that each phase was completed before advancing to the next [9]. The development process was divided into the following phases:

- ***Requirement Gathering:*** In this initial phase, we focused on understanding the specific needs of the Behbud Association of Pakistan (BAP) regarding inventory, staff, and production management. This phase involved extensive discussions with stakeholders to ensure all functional and non-functional requirements were captured accurately.
- ***System Design:*** Following requirement gathering, we proceeded with designing the system architecture and creating detailed blueprints for the system's structure. This included designing the database schema and crafting front-end mock-ups to visualize user interfaces and workflows, ensuring alignment with BAP's operational needs.
- ***Implementation:*** In this implementation phase, automated management solution development was initiated. We used ReactJS to develop the front-end interface, that is dynamic, responsive, and user-friendly. For the back-end, we utilized Node.js with the Express framework to handle API requests, user authentication, and manage database operations. This combination was chosen to ensure scalability and performance.
- ***Testing:*** A rigorous testing phase followed the implementation phase to ensure system's functionality, security, and usability. We conducted functional testing to verify that the system has met all requirements, security testing to safeguard data, and user experience testing to ensure ease of use for BAP staff.
- ***Deployment:*** After successful testing, the system was deployed on a cloud platform such as AWS or Azure to ensure reliability, scalability, and data security. Additionally, staff training was conducted to ensure the effective use of the system upon deployment.

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- ***Maintenance:*** Post-deployment, regular maintenance has been declared to be carried out to ensure the system remain up-to-date, with updates and troubleshooting as necessary to address any issues.
  Further, the proposed system was kept modular that supports required standards of scalability, security, and performance. Each of the selected modern tech stack served as a significant block of the overall solution.
- ***ReactJS:*** used for building a dynamic and responsive front-end interface, enabling real-time interaction with the system.
- ***Node.js with Express:*** used for setting up the back-end framework for handling API requests, user authentication, and efficient database management.
- ***MongoDB Atlas:*** a cloud-based NoSQL database used to store and manage key data such as inventory, worker profiles, and product statuses, offering scalability and flexibility.
- ***Cloud Hosting (AWS/Azure):*** chosen for hosting the system on a reliable cloud platform, ensuring high availability, data security, and the ability to scale as needed.

This structured methodology, combined with the selected tools and technologies, ensured that the proposed system is robust, scalable, and secure, effectively addressing BAP's requirements.

Fig. 3 illustrates the system's user hierarchy and access control. The system design includes six types of users, referred to as "supervisors," who can access specific modules based on their roles. Only the main administrator has full access to all modules. The component diagram effectively demonstrates login authentication for each user, with API routes connecting the server to a centralized database. This database facilitates secure data storage and retrieval across all modules, ensuring operational efficiency and streamlined data management [10].

DATA SECURITY AND PRIVACY

To address the sensitive nature of organizational and personal data, the system was designed with robust security measures. All data stored in MongoDB and transmitted over the network was encrypted using SSL/TLS protocols to protect against unauthorized access. Role-Based Access Control (RBAC) was implemented to ensure that only authorized personnel, such as administrators and supervisors, could access critical system functions. Additionally, the system adhered to local data protection regulations, ensuring that workers' personal information was securely stored and used appropriately. For secure data transmission, HTTPS was utilized, providing a reliable and encrypted communication protocol. This enabled seamless interaction between web servers and browsers, with HTTP governing the formatting and transmission of messages and HTML defining the structure and display of web pages. Together, these measures ensured comprehensive data security and privacy.

BENEFITS OF PROPOSED SOLUTION

The proposed system offers several key advantages that will significantly improve operational efficiency and decision-making. First, it enhances productivity by reducing the need for manual data entry and eliminating redundant tasks, allowing workers to focus more on their core responsibilities. With automation in place, the system ensures greater data accuracy, minimizing human errors and providing reliable records of inventory, production progress, and staff productivity. Additionally, the system enables real-time monitoring, giving management instant access to information on stock levels, production timelines, and worker performance, which leads to faster, more informed decision-making. The automation of repetitive tasks also brings cost efficiency, reducing the time and effort spent on administrative work, thus lowering operational costs. The system further improves strategic planning by generating detailed reports on production efficiency, demand forecasting, and stock usage. Finally, the cloud-based nature of the system ensures scalability, easily accommodating future growth in both production and workforce size.

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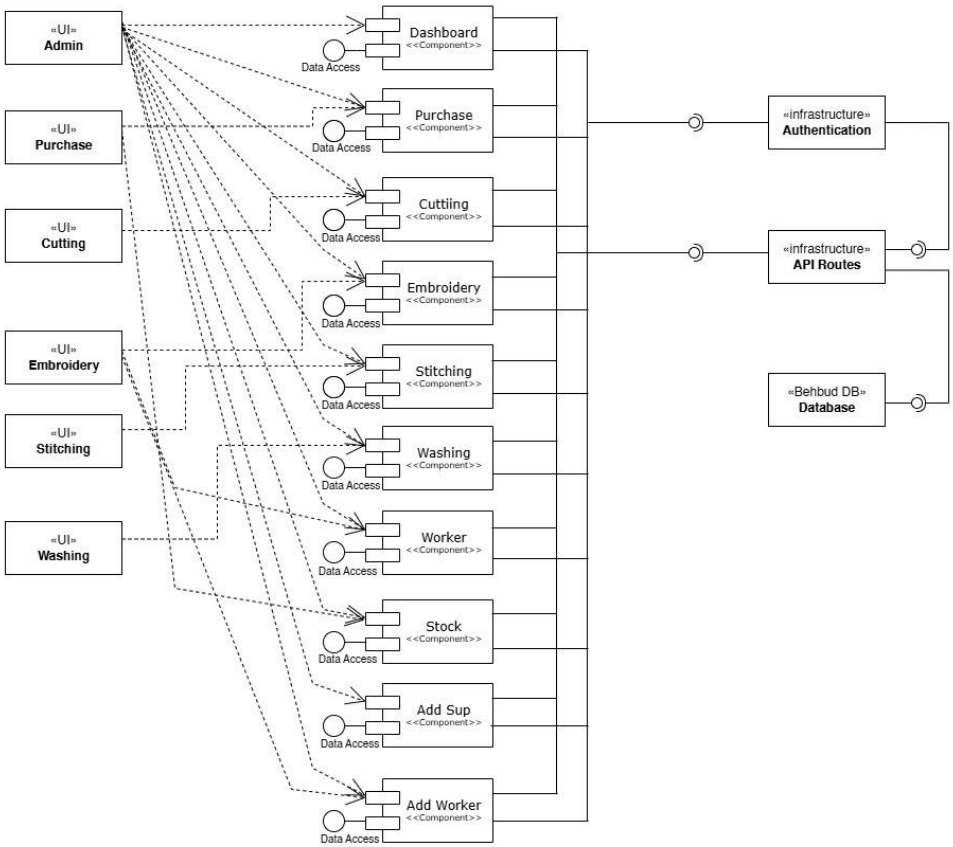

Fig. 3 Component diagram illustrating role-based module access in an industrial system, with six types of supervisors and a main admin managing login authentication, API routes, and data interactions with the server and database.

ANTICIPATED CHALLENGES AND MITIGATION STRATEGIES

Various challenges were encountered during the development and implementation of the proposed system and respective mitigation measures were adopted:

Data Migration: Transitioning from manual records to digital formats posed a risk of data entry errors. To minimize this, experienced staff was recruited in the migration process, and multiple verification stages were conducted to ensure accuracy.

User Adoption: Reluctance from workers and supervisors to adopt an automated system was identified as a potential challenge. To address this, comprehensive training workshops were conducted to ease the transition and foster confidence in the new system among all users.

Integration with Legacy Systems: Existing systems at BAP required compatibility with the new automation solution. The modular nature of the proposed solution was found helpful to ensure flexibility and seamless integration with legacy systems.

CONCLUSIONS

In conclusion, the proposed automation system for BAP represents a significant leap forward in operational efficiency, data accuracy, and scalability. By digitizing manual processes, BAP was able to enhance production monitoring, streamline inventory tracking, and improve staff management, ultimately boosting productivity and reducing overhead costs. This system not only empowered BAP to make informed, data-driven decisions but has also opened avenues of greater transparency for stakeholders, fostering trust and accountability. Additionally, the cloud-based nature of the solution is capable of ensuring future scalability and adaptability, allowing the system to evolve alongside the organization's growing needs. Throughout this project, we focused on addressing the specific challenges faced by BAP, such as inefficiencies from manual processes and the need for real-time data visibility. By implementing a modular, flexible, and secure system, BAP has been equipped to manage its operations effectively, maintain data integrity, and scale sustainably in the future. The comprehensive nature of this solution, from user training to integration with existing systems, ensured a smooth transition and long-term success for the association.

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FUTURE WORK

Future work on this project can be customized to meet the evolving needs of the organization. The design of the website can be improved as per BAP's preferences, and additional features can be integrated to enhance functionality, such as communication tools for supervisors and workers. The system has been developed with scalability in mind, enabling the seamless addition of new modules as BAP expands. Future enhancements could include e-commerce integration, which would link the inventory system directly to an online store, ensuring real-time updates on stock levels. Additionally, advanced analytics powered by AI could be implemented to forecast demand, optimize production processes, and track worker performance trends. As BAP continues to grow, the system could also support multi-location management, handling multiple production sites or warehouses, ensuring the system remains adaptable and robust to meet BAP's future needs.

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