Smart Industrial Job Allocation and Quality Verification System Using RFID and Machine Vision

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Abstract: Industrial manufacturing environments often rely on manual job allocation and quality inspection processes, which can lead to inefficiencies, lack of accountability, and inconsistent product quality. To address these challenges, this paper proposes a Smart Industrial Job Verification and Allocation System that integrates RFID-based worker authentication with machine vision–based job quality verification. In the proposed system, each operator is assigned a unique RFID card that enables secure identification and controlled access to job distribution. Operators can request raw jobs through a keypad interface, and a conveyor-based mechanism dispenses the required number of jobs while maintaining traceability. After completing the assigned tasks, the operator returns the finished jobs, which are automatically inspected using a camera-based image processing system implemented using OpenCV. The captured images are analyzed to verify job quality and detect defects based on predefined parameters corresponding to different job types. The system architecture employs a Raspberry Pi for high-level processing and an Arduino Uno for real-time hardware control, ensuring efficient coordination between sensing, processing, and actuation components. All transactions, including operator identity, job count, timestamps, and inspection results, are logged in a digital database for monitoring and analysis. Experimental evaluation of the prototype demonstrates improved operational efficiency, enhanced traceability of manufacturing tasks, and reliable automated quality verification. The proposed system provides a cost-effective and scalable solution for smart manufacturing environments aligned with Industry 4.0 principles.

Keywords: *RFID Authentication, Computer Vision, Automated Quality Inspection, Smart Factory, Manufacturing Process Monitoring.*

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I. INTRODUCTION

Manufacturing industries increasingly rely on automated systems to improve productivity, maintain consistent product quality, and reduce operational errors. In many conventional workshop environments, job allocation, operator monitoring, and quality inspection are still performed manually. Such manual processes often lead to inefficiencies, lack of accountability, and difficulty in tracking production activities. Moreover, manual inspection methods are prone to inconsistency and human error, especially when large volumes of jobs are processed.

Recent advances in embedded systems, identification technologies, and computer vision have enabled the development of intelligent monitoring systems for industrial environments. Technologies such as Radio Frequency Identification (RFID), microcontroller-based automation, and machine vision provide efficient tools for monitoring operator activity, automating material handling, and verifying product quality. By integrating these technologies, it is possible to create smart industrial systems capable of improving workflow management, maintaining digital production records, and ensuring reliable quality control.

The system proposed in this work integrates RFID-based operator authentication with image-processing-based job verification to automate the job allocation and monitoring process. The architecture combines a Raspberry Pi for data processing and image analysis with an Arduino microcontroller responsible for controlling hardware components such as the conveyor mechanism, sensors, and display units. This integration enables automated job distribution, operator identification, and quality verification

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within a single system suitable for modern manufacturing environments.

➢ *Background of Industrial Automation*

Industrial automation involves the use of control systems, sensors, and computing technologies to perform manufacturing operations with minimal human intervention. Automation systems improve production efficiency, accuracy, and repeatability while reducing dependence on manual supervision. Components such as microcontrollers, sensors, and actuators allow automated machines to perform tasks like material handling, object detection, and process monitoring.

Despite the widespread adoption of automation technologies, many small and medium-scale industries still rely on semi-manual systems for job allocation and quality inspection. These systems often lack proper monitoring mechanisms, making it difficult to track worker activity or verify completed tasks accurately. Consequently, there is a need for cost-effective automation solutions that can improve process transparency and operational efficiency.

➢ *Industry 4.0 and Smart Manufacturing*

Industry 4.0 represents the latest phase of industrial development, characterized by the integration of cyber-physical systems, Internet of Things (IoT), and intelligent data processing into manufacturing systems. Smart manufacturing environments enable machines, sensors, and computing systems to communicate and exchange data in real time, leading to improved productivity and better decision-making.

Technologies such as machine vision and RFID play an important role in smart manufacturing systems. Machine vision allows automated inspection of products using cameras and image processing algorithms, enabling accurate defect detection and quality monitoring. Similarly, RFID technology provides automatic identification of workers, tools, or materials without physical contact. When integrated together, these technologies support the development of intelligent industrial systems that enhance monitoring, traceability, and quality assurance.

➢ *Motivation and Research Gap*

Existing industrial monitoring systems commonly utilize RFID technology for worker identification and process tracking. While such systems improve traceability and attendance monitoring, they typically lack mechanisms for verifying the quality of completed jobs. On the other hand, machine vision systems are widely used for automated product inspection but often operate independently of worker identification mechanisms.

This separation between worker authentication and job verification creates a limitation in many manufacturing environments. Without linking operator identity with job quality outcomes, it becomes difficult to maintain accountability and accurately monitor production performance. Therefore, there is a need for an integrated system that combines operator authentication with automated quality verification.

➢ *Objectives and Contributions of the Proposed System*

The primary objective of this work is to develop a smart industrial system that automates job allocation, operator authentication, and job verification using integrated hardware and software technologies. The proposed system utilizes RFID for operator identification, a conveyor-based mechanism for job distribution, and image processing techniques for automated quality inspection. The main objectives of the proposed system are:

- To implement RFID-based authentication for secure operator identification.
- To develop an automated job distribution mechanism using a keypad and conveyor system.
- To perform automated quality verification using image processing techniques.
- To maintain digital records of job allocation and verification results for monitoring and analysis.

The proposed system integrates Raspberry Pi for high-level processing and Arduino for real-time hardware control, creating a cost-effective automation framework. By combining RFID technology with machine vision, the system enhances operator accountability, improves job traceability, and supports efficient quality monitoring in industrial environments.

II. LITERATURE REVIEW

The integration of automation technologies such as RFID, machine vision, and intelligent monitoring systems has significantly improved productivity and operational transparency in modern manufacturing environments. Several researchers have proposed systems for industrial monitoring, worker tracking, and quality verification using these technologies. This section reviews relevant studies that contribute to the development of automated industrial monitoring systems.

Rahul D. Chavhan, Sachin U. Chavhan, and Ganesh B. Chavan (2014) proposed the Operator Machine Allocation and Monitoring System (OMAMS), which utilizes RFID technology to automatically allocate machines to workers and monitor their activities in real time [1]. The system enables improved machine utilization and reduces the need for manual supervision. However, the proposed system primarily relies on RFID identification and does not incorporate visual verification mechanisms to confirm whether the assigned tasks are correctly performed.

R. Kumar, O. Patil, K. Nath, K. Rohilla, and K. S. Sangwan (2021) presented a system that combines RFID technology with machine vision for real-time part traceability in a learning factory environment [2]. Their approach enables accurate tracking of workpieces as they move through different workstations. The integration of RFID and computer vision improves visibility across the production process and supports quality monitoring. However, the system mainly focuses on tracking parts rather than monitoring worker

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activities or verifying the completion of specific jobs.

Mahdi Alidoost, M. A. Mahmoudi, and M. G. Zadeh (2018) developed an automated warehouse monitoring system that integrates RFID technology with image processing techniques [3]. The proposed system enables real-time monitoring of material movement and enhances the efficiency of warehouse management. The study demonstrates the effectiveness of combining identification technologies with visual analysis. Nevertheless, the system focuses primarily on inventory and material tracking rather than worker authentication or job verification.

Berardinucci and Urgo (2024) presented a deep learning-based human localization system for industrial environments using computer vision techniques [4]. Their work employs neural network models to detect and track workers in real time, improving safety and monitoring within industrial facilities. Although the system effectively identifies worker presence, it does not integrate identification technologies such as RFID, and it does not address job allocation or task verification.

Yang, Luo, and Li (2016) proposed an RFID-based work-in-process (WIP) management system designed to monitor the progress of manufacturing operations [5]. The system improves transparency in tracking job status across different stages of production. However, it primarily focuses on monitoring the movement of workpieces and does not verify which operator is responsible for performing the task or whether the work has been completed correctly.

Kadoura and Small (2017) developed an employee activity monitoring system using image processing techniques [6]. The system utilizes computer vision algorithms to detect worker presence and monitor activities such as attention or drowsiness. While the approach demonstrates the potential of image processing for monitoring worker behavior, it does not incorporate RFID-based authentication or mechanisms for verifying the quality of completed jobs.

Wang and Jiang (2019) proposed a machine learning-based approach for predicting job completion time using RFID data collected from job shop environments [7]. Their system uses deep neural network models to analyze real-time RFID data and estimate production completion times. Although the research highlights the potential of RFID data for predictive analytics, it does not incorporate visual inspection systems for verifying the quality of the completed work.

From the reviewed literature, it can be observed that RFID-based systems are widely used for worker identification and process monitoring, while machine vision techniques are commonly applied for product inspection and defect detection. However, most existing systems address these functions independently. Very few studies combine worker authentication, job allocation, and automated quality verification within a single integrated framework. Therefore, there is a clear need for a unified system that integrates RFID-based operator identification with image-processing-based job verification to enhance accountability, traceability, and efficiency in industrial manufacturing processes.

Table 1 Summary of Literature Review

Sr. No.	Title / Author / Year	Objective	Technologies Used	Key Findings	Limitations
1	Real Time Industrial Monitoring System (OMAMS) – Rahul D. Chavhan, Sachin U. Chavhan, Ganesh B. Chavan (2014) [1]	To allocate machines to workers automatically and monitor worker activity in industrial environments	RFID tags, RFID readers, Wireless communication modules	Enables automated operator–machine allocation and improves monitoring of industrial operations	Does not include image processing; unable to verify actual job execution or worker presence visually
2	Machine Vision and RFID-Based Real-Time Part Traceability in a Learning Factory – R. Kumar, O. Patil, K. Nath, K. Rohilla, K. S. Sangwan (2021) [2]	To track parts and workstations in manufacturing environments	RFID, Computer Vision, Tracking systems	Combines RFID and vision technologies to enable real-time monitoring of manufacturing parts	Focuses on part traceability; does not address worker authentication or job verification
3	Optimization of Industrial Warehouse Using RFID and Image Processing – Mahdi Alidoost, M. A. Mahmoudi, M. G. Zadeh (2018) [3]	To improve warehouse management and monitor material flow	RFID, Image Processing, Object Detection	Improves accuracy in detecting material movement and inventory tracking	System focuses on warehouse management and lacks worker authentication and job allocation features
4	Human Localization in Industrial Settings Using Deep Learning – Berardinucci and Urgo (2024) [4]	To detect and track workers in industrial environments for safety and monitoring	RGB Cameras, Deep Learning, CNN/YOLO based models	Enables accurate real-time localization of workers	Does not integrate RFID identification and does not address job allocation or quality

					verification
5	RFID-Based Work-in-Process Management System – Yang, Luo, Li (2016) [5]	To track work-in-process (WIP) in manufacturing environments	RFID technology, Data management systems	Improves visibility and transparency in monitoring job progress	Does not identify which operator performs the task and lacks product quality verification
6	Employee Activity Monitoring Using Image Processing – Kadoura and Small (2017) [6]	To monitor worker presence and activity using computer vision techniques	Image Processing, Face and Eye Detection, Haar Cascade algorithms	Enables automated monitoring of employee activity and presence	Does not integrate RFID technology and lacks job allocation and verification functionality
7	Order Completion Time Prediction Using RFID Data – Wang and Jiang (2019) [7]	To predict job completion time using RFID data and machine learning algorithms	RFID systems, Deep Neural Networks, Machine Learning	Provides predictive analytics for estimating production completion time	Does not include machine vision or worker verification mechanisms

III. PROPOSED SYSTEM AND IMPLEMENTATION

This section describes the design and implementation of the proposed Smart Industrial Job Verification and Allocation System. The system integrates RFID-based operator authentication, automated job allocation, and machine vision-based quality verification. The implementation uses a hybrid architecture consisting of a Raspberry Pi for high-level processing and an Arduino Uno microcontroller for real-time hardware control. The overall system is designed to automate job distribution, track operator activity, and verify the quality of completed jobs in an industrial environment.

➢ *System's Operation*

The proposed system consists of several interconnected hardware and software components that collectively automate the job allocation and verification process. The system architecture primarily includes the following components:

- RFID reader and RFID cards for operator identification
- Keypad for job quantity input
- Conveyor belt mechanism for job distribution and collection
- USB camera for capturing images of returned jobs
- Raspberry Pi for image processing and system coordination
- Arduino Uno microcontroller for hardware control
- Sensors for job detection and counting
- LCD display and buzzer for operator feedback

In the system, the Raspberry Pi acts as the main processing unit responsible for decision-making, operator authentication, and image processing tasks. The Arduino Uno performs low-level hardware control such as operating the conveyor motor, reading sensor inputs, and controlling peripheral devices.

The system operates in two main stages: job allocation and job verification. In the first stage, an operator authenticates using an RFID card and requests a certain number of raw jobs using a keypad interface. The conveyor system then dispenses the requested number of jobs. In the second stage, the operator returns the completed jobs, which are inspected using a camera-based image processing system. The results are logged in a digital database for monitoring and analysis.

➢ *Block Diagram Description*

The block diagram of the proposed system is shown in Fig. 1. The diagram illustrates the interaction between the major hardware and software components of the system.

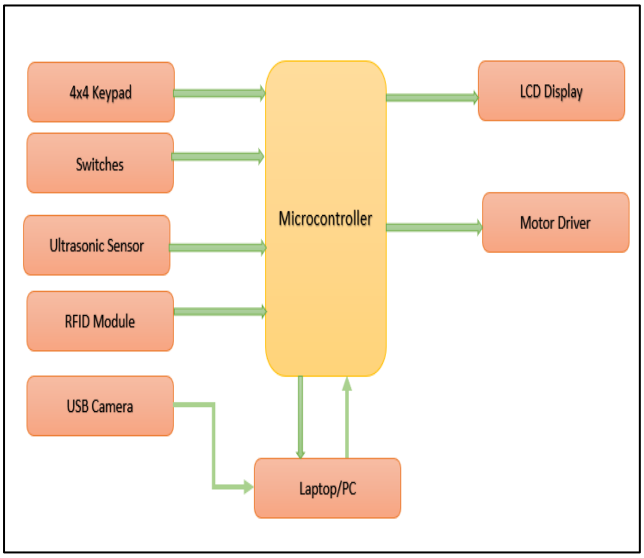

Fig 1 Block Diagram

The central component of the system is the Raspberry Pi, which communicates with the Arduino Uno through a serial interface. The Raspberry Pi receives data from the RFID reader and keypad to authenticate operators and process job requests. It also processes images captured by the USB camera using image processing algorithms implemented in Python and OpenCV.

The Arduino Uno controls the physical hardware elements of the system, including the conveyor belt motor, sensors, LCD display, and buzzer. When a command is

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received from the Raspberry Pi, the Arduino executes the corresponding hardware operation, such as activating the motor to dispense jobs or detecting job presence through sensors.

The block diagram also includes input devices such as RFID cards, switches for job type selection, and sensors that detect job placement on the conveyor. The output components include the conveyor motor, LCD display for user instructions, and buzzer for alert signals.

➢ *Job Allocation Process*

The job allocation process ensures that raw jobs are distributed to operators in a controlled and traceable manner. The sequence of operations involved in job allocation is as follows:

- The operator scans their RFID card using the RFID reader.
- The system verifies the operator identity using the stored database.
- After successful authentication, the operator enters the required number of jobs using the keypad.
- The Raspberry Pi processes the request and sends a command to the Arduino Uno.
- The Arduino activates the conveyor belt motor through a relay module.
- Sensors detect the movement and count the number of jobs dispensed.
- Once the requested number of jobs has been delivered, the conveyor motor stops automatically.
- The LCD display confirms the job allocation to the operator.

This automated job allocation process prevents unauthorized access to raw jobs and ensures proper monitoring of job distribution within the system.

➢ *RFID-Based Operator Authentication*

RFID technology is used to uniquely identify and authenticate operators within the system. Each operator is assigned an RFID card containing a unique identification number. When the card is placed near the RFID reader, the reader detects the card and sends the identification data to the Raspberry Pi. The Raspberry Pi compares the received RFID ID with the stored database of authorized operators. If the ID matches a valid operator record, access to the system is granted. Otherwise, the system denies access and displays an error message.

The RFID authentication mechanism ensures that only authorized personnel can collect or return jobs. Additionally, all job transactions are linked to the operator ID, which enables accurate tracking of worker activity and job performance. The system also includes a special RFID card assigned to the manager or supervisor. This card allows unrestricted access to the system for administrative control and monitoring purposes.

➢ *Image Processing for Quality Verification*

After completing the assigned jobs, operators return the finished products to the system for quality verification. The jobs are placed on the conveyor belt, where a USB camera captures images of the items. The captured images are processed using computer vision algorithms implemented with the OpenCV library in Python. The image processing procedure typically includes the following steps:

- Image acquisition using the USB camera
- Conversion of the captured image to grayscale
- Noise reduction using filtering techniques
- Edge detection to identify object boundaries
- Feature extraction and comparison with reference parameters

The system verifies whether the returned job satisfies the required dimensional or structural parameters. If the detected features match the expected characteristics, the job is classified as “OK.” Otherwise, it is marked as “NOT OK.” The quality verification process ensures that defective products are identified automatically, reducing reliance on manual inspection.

➢ *Hardware Components and Prototype Setup*

The prototype system consists of several hardware components integrated to perform different functions within the automation framework.

The Arduino Uno, based on the ATmega328P microcontroller, serves as the hardware control unit. It manages real-time tasks such as sensor monitoring, motor control, and display operations.

The Raspberry Pi acts as the main processing unit responsible for executing image processing algorithms and managing system logic. It interfaces with peripheral devices such as the RFID reader, camera, and keypad.

An RFID reader module is used to read RFID cards assigned to operators. The reader communicates with the Raspberry Pi to verify operator identity.

A USB camera is installed above the conveyor system to capture images of jobs for quality verification. The camera provides sufficient resolution for image processing tasks.

The conveyor belt mechanism, powered by a DC gear motor, is used for automated job distribution and collection. A relay module is used to control the motor operation from the Arduino.

Additional components include a 20×4 LCD display for user instructions, a keypad for job input, and sensors for detecting job presence and counting items on the conveyor.

➢ *Software Architecture (Arduino and Python/OpenCV)*

The software architecture of the system consists of two main components: the Arduino firmware and the Raspberry Pi software application. The Arduino program is developed using the Arduino IDE and is responsible for controlling the

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hardware peripherals. The firmware reads sensor inputs, operates the conveyor motor, controls the LCD display, and communicates with the Raspberry Pi through serial communication. On the Raspberry Pi, the system software is implemented in Python. The Python program performs the following functions:

- Processing RFID authentication data
- Managing user input from the keypad
- Capturing images using the USB camera
- Performing image processing using OpenCV
- Logging system data and results

The integration of Arduino firmware with Python-based processing enables efficient coordination between hardware control and computational tasks.

➢ *Communication Between Raspberry Pi and Arduino*

Communication between the Raspberry Pi and Arduino Uno is achieved through serial communication using a UART interface over a USB connection. This communication channel allows both devices to exchange commands and status information. In the system, the Raspberry Pi acts as the master controller, while the Arduino operates as a hardware control unit. When the Raspberry Pi determines that a hardware action is required, it sends a command to the Arduino through the serial interface. For example:

- A command may be sent to start the conveyor motor when jobs are requested.
- A command may be sent to stop the motor once the required number of jobs is dispensed.
- Sensor readings from the Arduino are transmitted back to the Raspberry Pi for monitoring purposes.

This communication mechanism ensures synchronized operation between software processing and physical hardware control.

➢ *Data Logging and Database Management*

To maintain transparency and traceability of industrial operations, the system records all job-related transactions in a digital database. The database stores important information related to job allocation and verification. The recorded data typically includes:

- Operator ID obtained from RFID authentication
- Number of jobs allocated
- Timestamp of job allocation
- Job type selected by the operator
- Quality verification result (OK or NOT OK)

The system stores this information in a structured data file such as a CSV file or a lightweight database such as SQLite. The stored data can later be used for production monitoring, performance evaluation, and record keeping. By maintaining digital logs of all job transactions, the proposed system provides improved accountability and enables detailed analysis of manufacturing activities.

IV. RESULTS AND DISCUSSION

➢ *Experimental Setup*

The proposed smart industrial monitoring and job allocation system was implemented as a prototype in a controlled laboratory environment. The system consists of a Raspberry Pi acting as the central processing unit and an Arduino microcontroller used for interfacing with hardware components. An RFID reader is employed for operator identification, while a camera module is used for capturing images for quality verification. Communication between Raspberry Pi and Arduino is achieved through serial communication.

Each operator is assigned a unique RFID tag. When the tag is scanned, the system verifies the operator's identity and automatically assigns a predefined job from the database. After completion of the task, the camera captures an image of the manufactured component. The captured image is processed using Python and OpenCV to determine whether the product meets the required quality standards.

The working output of the developed prototype system is shown in Fig. 2.

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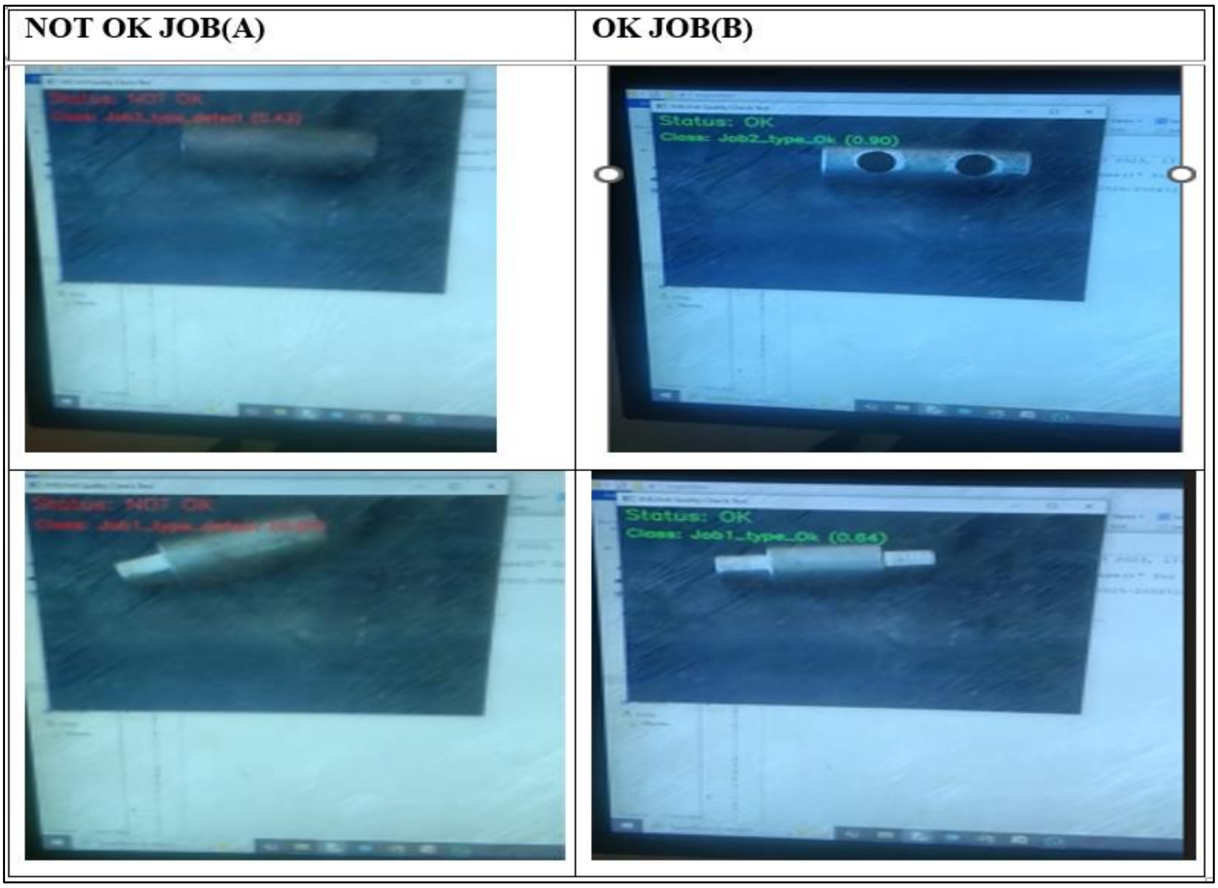

Fig 2 Result

➢ *Job Allocation Performance*

The automated job allocation module reduces the time required for assigning tasks to operators. Once an RFID card is scanned, the system retrieves the corresponding operator details and assigns a job from the database. Experimental observations show that the authentication and job allocation process is completed within a few seconds. The system ensures proper job distribution without duplication and maintains a digital record of assigned and completed tasks. This significantly improves operational efficiency compared to manual job allocation.

➢ *Accuracy of Quality Verification*

Quality verification is performed using a camera-based inspection mechanism combined with image processing techniques. The captured images are analyzed using OpenCV to detect deviations from predefined product characteristics. The image processing workflow includes image acquisition, preprocessing, feature extraction, and comparison with reference images. Based on the analysis, the system classifies the product as either acceptable or defective. This automated inspection improves consistency and reduces dependence on manual quality checking.

➢ *System Performance Analysis*

The developed system demonstrates reliable performance and efficient integration of multiple hardware and software components. RFID technology enables fast operator authentication, while Raspberry Pi handles higher-level tasks such as database management and image processing. The system also maintains digital logs of operator activities, assigned jobs, and inspection results. Such records can be useful for monitoring production processes and improving industrial workflow management.

➢ *Comparison with Existing Systems*

Traditional industrial systems typically rely on manual job allocation and human inspection for quality control. These approaches are often time-consuming and prone to errors. The proposed system introduces automation through RFID-based authentication and image processing-based inspection.

Table 2 Comparison between Traditional and Proposed System for Job Allocation

Parameter	Traditional System	Proposed System
Job Allocation	Manual	Automated
Operator Identification	Manual verification	RFID-based
Quality Inspection	Human inspection	Image processing
Data Recording	Manual logs	Digital database

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The proposed system therefore improves efficiency, accuracy, and traceability in industrial operations.

V. CONCLUSION AND FUTURE SCOPE

➢ *Conclusion*

This paper presented a smart industrial monitoring and job allocation system that integrates RFID technology, embedded systems, and image processing techniques to improve automation in manufacturing environments. The proposed system enables automatic operator authentication, efficient job allocation, and automated quality verification of manufactured components.

The implementation of the system using Raspberry Pi, Arduino, RFID reader, and camera module demonstrates the feasibility of developing a cost-effective solution for industrial automation. The RFID-based authentication mechanism ensures secure and quick identification of operators, while the automated job allocation module minimizes manual intervention in task distribution. In addition, the image processing module implemented using Python and OpenCV provides a reliable method for product quality verification.

Experimental evaluation of the prototype system indicates that the proposed approach can improve operational efficiency, reduce human errors, and enable better monitoring of production activities. The integration of data logging and database management further enhances traceability and record maintenance within the manufacturing process. Thus, the developed system provides a practical step toward implementing intelligent monitoring solutions aligned with modern industrial automation requirements.

➢ *Future Scope*

Although the proposed system demonstrates effective functionality, several improvements can be incorporated in future work to enhance its capabilities.

Future developments may include integration with Industrial Internet of Things (IIoT) platforms for real-time remote monitoring and control of manufacturing operations. Cloud-based data storage and analytics can also be incorporated to enable large-scale production monitoring and predictive maintenance.

The image processing module can be further improved by incorporating machine learning or deep learning techniques to enhance defect detection accuracy under varying lighting and environmental conditions. Additionally, the system can be extended to support multiple machines and operators in large industrial environments.

Mobile or web-based dashboards may also be developed to allow supervisors to monitor job status, operator performance, and quality inspection results in real time. Such enhancements would make the system more scalable and suitable for deployment in modern smart manufacturing environments.

In summary, the proposed framework can serve as a foundation for developing advanced smart factory solutions aligned with the principles of Industry 4.0.

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➢ *Conflict of Interest*

The authors declare that they have no conflict of interest regarding the publication of this paper.

REFERENCES

[1]. Rahul D. Chavhan, Sachin U. Chavhan, Ganesh B. Chavan, Real Time Industrial Monitoring System (OMAMS), arXiv preprint ,2014, 1402, 2231-2803.
[2]. R. Kumar, O. Patil, K. Nath, K. Rohilla, KS Sangwan, Machine Vision and RFID-Based Real-Time Part Traceability in a Learning Factory, Procedia CIRP,2021,104,630–635, doi: 10.1016/j.procir.2021.11.106
[3]. M. Alidoost, M. A. Mahmoudi, and M. G. Zadeh, Optimization of Industrial Warehouse Using RFID and Image Processing, International Journal of Research and Development Organization (IJRDO), 2018, 4,1811-1968, doi: 10.53555/cse.v4i1.1835.
[4]. Berardinucci F, & Urgo, M., “Advanced Computer Vision for Industrial Safety: Indoor Human Worker Localization Using Deep Learning, European Symposium on Artificial Intelligence in Manufacturing, Springer, 2024, 134–143, doi: 10.1007/978-3-031-86489-6_15.
[5]. W. Yang, G. Luo, and W. Li, Design and implementation of work-in-process management system based on RFID technology, International Conference on Internet and Distributed Computing Systems, 2016, 9864, 254–262, doi: 10.1007/978-3-319-45940-0_23.
[6]. Kadoura, A., and E. P. Small,Tracking Productivity in Real-time Using Computer Vision, IOP Conference Series: Materials Science and Engineering,2022,1218, 012041,doi: 1088/1757-899X/1218/1/012041
[7]. Wang, Chuang, Pingyu Jiang, Deep neural networks based order completion time prediction by using real-time job shop RFID data, Journal of Intelligent Manufacturing,2019,30, 1303–1318, doi: 10.1007/s10845-017-1325-3.
[8]. A. Akbari, S. Mirshahi , M. Hashemipour, Application of RFID system for the process control of distributed manufacturing system, IEEE 28th Canadian Conference on Electrical and Computer Engineering (CCECE),2015, 497-501,
[9]. Aydos, Thiago F., and Joao CE Ferreira, RFID-based system for lean manufacturing in the context of Internet of Things, 2016 IEEE International Conference on Automation Science and Engineering (CASE),2016 , 1140-1145, doi : 10.1109/COASE.2016.7743533.
[10]. Akundi, Aditya, and Mark Reyna, A machine vision based automated quality control system for product

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr1519

dimensional analysis, Procedia Computer Science, 2021, 185, 127-134, doi : 10.1016/j.procs.2021.05.014.

[11]. Sharma, Heena, and N. M. Suri, Implementation of quality control tools and techniques in manufacturing industry for process improvement, International Research Journal of Engineering and Technology,2017,4(5), 1581–1585.

[12]. Li, Jingshan, Semyon M. Meerkov, and Liang Zhang, Production systems engineering: Problems, solutions, and applications, Annual Reviews in Control, 2010, 34(1), 73-88, doi: 10.1016/j.arcontrol.2010.02.003.

[13]. Park M &Jeong J, Design and implementation of machine vision-based quality inspection system in mask manufacturing process, Sustainability,2022, 14(10),6009,doi: 10.3390/su14106009

[14]. Y. Tao, Y. Zhang, C. Zhang, W. Luo, and X. Cheng, Smart Factory of Industry 4.0: Key Technologies, Application Case, and Challenges, Ieee Access,2017, 4, 6505-6519, doi: 10.1109/ACCESS.2017.2783682.

[15]. J. A. Fortoul -Diaz, A. Morales-Velazquez, R. Rodriguez, and L. Valdez, A smart factory architecture based on Industry 4.0 technologies: Open-source software implementation, IEEE access 11 (2023), ,11, 101727-101749, doi: 10.1109/ACCESS.2023.3316116.

[16]. L. S. Goecks, J. Smith, and A. Kumar, Industry 4.0 and smart systems in manufacturing: Guidelines for the implementation of a smart statistical process control, Applied System Innovation 7.2 , 2024,24,525–585, doi: 10.3390/asi7020024.