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Modular Industrial Labeling and Stamping System with Conveyor Integration Using PLC Controller

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Abstract
The Stamping system for the industrial purpose offers a complete solution to streamline labeling and stamping tasks in industrial environments. By combining automated label application, stamping, and inspection, it guarantees top-notch quality, cuts down on labor costs, and boosts productivity. The PLC controller provides precise monitoring and control, enabling real-time adjustments and reducing downtime. The system's modular design makes it easy to customize and expand, allowing businesses to adapt to different product lines and production needs. It's especially ideal for industries with high-volume labeling and stamping demands, like manufacturing, pharmaceuticals, and food processing. With its advanced capabilities and adaptability, the system helps companies improve product quality, lower expenses, and stay competitive. By simplifying these operations, businesses can focus on what matters most, driving growth and achieving excellence.
Keywords: *Stamping system, plc-controller, automation, Modular design*

1. Introduction
Stamping machines have evolved significantly over the years, with various modern processes now being widely used across industries. These include pneumatic stamping machines, PLC stamping machines, and metal sheet stamping machines. Stamping is a process where text or images are reproduced using a master form or template. Traditionally, stamping was a manual operation, relying heavily on human effort and expertise. However, this manual process was prone to mistakes and inaccuracies, and it required a considerable amount of time and labour. Initially, stamping operations were conducted manually, often resulting in significant inefficiencies. Workers would use a template and press it down onto paper or another material to reproduce a design or text. The process, while effective for simple tasks, was slow and inconsistent. It was easy for errors to occur, and the quality of the finished product would often vary depending on the operator's skill level. In addition, the manual stamping process required a lot of human effort and time, leading to higher labour costs and slower production rates. The introduction of modern stamping machines, however, marked a turning point. One of the first advancements was the development of machines that could print a stamp logo on a fixed position on paper. The significant improvement over manual stamping, as it allowed for greater consistency and speed. Later, the invention of the movable arm stamping machine further advanced the process, making it more versatile and efficient. These machines were initially designed to handle single pages, and while they were a step up from manual labour, they still had limitations. The key vision behind these developments was to create machines that could produce high-quality results at a low cost. The focus was on maximizing output while keeping the production process simple and cost-effective. This vision continues to drive the development of modern stamping machines today. The goal is not only to improve the quality of stamped products but also to reduce the cost of manufacturing, making the process accessible to a wide range of industries. In

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today's fast-paced world, with rapidly advancing technologies, businesses strive for perfection and speed. The demand for quick and efficient processes is more significant than ever. In industries like food packaging, stamping is still commonly done manually by workers. To achieve higher output, companies often require up to seven workers per production line. While this may meet the immediate production target, it comes with several drawbacks. The manual process is time-consuming and generates higher labour costs. It also results in poor finishes due to human error and fatigue, which can affect the overall quality of the product. To stay competitive and maximize profit, there is an increasing need for automation in stamping processes, especially in small-scale industries. Automatic stamping machines can significantly improve productivity by eliminating the time and effort required for manual labour. They offer faster processing times, higher precision, and a more consistent finish. This shift to automation is essential for industries to maintain their competitiveness in the market, as it helps reduce operational costs, minimize errors, and increase the quality of the final product. The modern stamping machines of today provide businesses with a solution that balances cost efficiency, productivity, and quality. By embracing automation, small-scale industries can not only improve their output but also enhance the overall performance of their operations. With the right stamping technology in place, businesses can focus on other core areas, driving growth and achieving long-term success.

2. Literature Review

Sheela.et al proposed Low-Cost Automation for Sorting of Objects on Conveyor Belt which describes that using Raspberry pi [1] making the model generally sensing the colour of the object is a big challenge as there is a chance of high uncertainty due to the external lighting conditions and each nose. Similarly, while collecting objects from conveyor belt by a linear actuator, there are variations in weight and size of object. Further approaches to this system can be made to increase the capability to segregate large and heavy objects and sort them effectively. The objects once kept on the conveyor belt, the further assembly makes the work of sorting the objects very efficiently. In the paper, the author shave revealed that they have proposed a system which sorts the objects based on them colour which can future be enhanced to sort them based on their size and shape with the help of IR sensor of near about short-range communication requirements. Amruta Pandit et al proposed Object Counting using Image processing techniques that are helpful for object counting and reduce the time of counting effectively [2]. Proper Recognition of the object is important for object counting. The accuracy of the algorithm depends on camera used, size of object, whether or not objects touching and illumination conditions. Object counting using image processing system has huge applications where automation is to be introduced and time of counting is to be reduced linearly it reduces the man power required behind the counting, sorting and identification mechanism. Avadhoot et al proposed Colour Object Counting and Sorting Mechanism Using I'm-age Processing Approach [3] that the colour object counting and sorting is the major task that needs to be done at final dispatch section. Manual sorting is the tradition approach that preferred by industries. In this approach, visual inspection performed by human opera-tors. This traditional approach is time-consuming and non-consistent. Gundawar et al proposed Pneumatic Stamping Machine [4] the idea behind the project is to create a pneumatic stamping machine at a very low cost. Pneumatic control systems are widely used in our society, especially in the industrial sectors for the driving of automatic machine. The general purpose of the present invention, which will be described subsequently in greater details, is to provide a portable automatic pneumatic stamping machine which has many advantages of the low power consumption and effective performance and many specified features of the system, which is not anticipated. further objective of the system is, this is susceptible of a low cost of manufacturing with regards to both cost and labour, and which accordingly is then susceptible of low prices of sale to the public, so thereby making such automatic stamping machine are very

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economically available to the public Raju et al proposed Automatic Pneumatic Stamping Machine [5]. From last few years it has been seen that the pneumatic system playing very important role in industries due to its precision and cost. Mainly there is no need to be operated by skilled ones. The main advantage of this machine that it can be operated at low pressure. Solenoid valves are used as direction control valves for operation. By replacing some attachment, we can also elaborate other applications. The further objective of the system is, this is susceptible of a low cost of manufacturing with regards to both cost and labour, and which accordingly is then susceptible of low prices of sale to the public, so thereby making such automatic stamping machine.

3. Description of Existing System

The Modular Industrial labelling and Stamping System with Conveyor Integration using a PLC is a sophisticated solution designed to streamline and automate labelling and stamping processes in manufacturing environments. This system integrates seamlessly with a conveyor belt, allowing for continuous flow of products or items to be labelled or stamped without manual intervention. The modular design means that components of the system can be customized or expanded to fit specific needs, making it adaptable to different production lines or varying product types. (Figure 1)

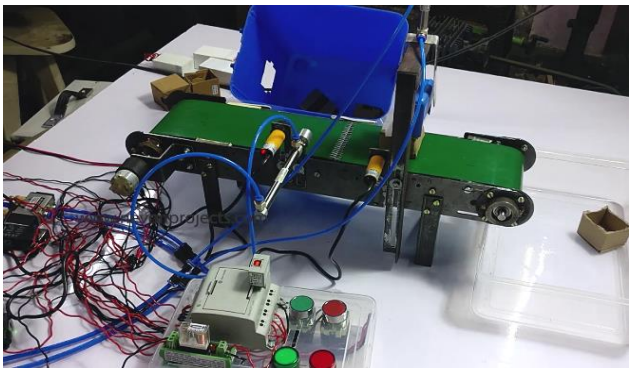

Figure 1 Existing System of Stamping Machine

At the heart of the system is a Programmable Logic Controller which acts as the brain, controlling the entire process. The PLC coordinates the timing and synchronization of the labelling and stamping equipment, ensuring precision and efficiency. It ensures that each item moving along the conveyor is stamped accurately according to preprogramed specifications. This helps minimize errors, increase speed and maintain consistent quality across large volumes of products. The combination of automation with a flexible modular approach allows manufacturers to adapt the system as their needs change. Whether you're labeling boxes, stamping serial numbers or applying barcodes, this integrated solution provides a reliable and efficient way to automate key processes, reducing labour costs and improving production efficiency while maintaining a high standard of product quality. Additionally, the system's scalability ensures it can evolve as production volumes and product types change over time [6-10]

4. Components of Existing System

The Automatic Stamping Machine controlled by a Programmable Logic Controller is designed to apply labels, logos, or markings on products with high precision and speed. This automation reduces human effort, minimizes errors, and enhances efficiency in industrial production. At the heart of the system, the PLC acts as the control unit, processing inputs and managing machine operations. Operators interact with the system through a Human-Machine Interface allowing them to set parameters, monitor performance, and troubleshoot issues. To ensure accurate stamping, a sensor array consisting of proximity and photoelectric sensors detects the position and presence of products. The actuators, such as pneumatic cylinders or servo motors, drive the stamping mechanism, applying the right amount of force for a clear and consistent imprint. A conveyor system moves products into position, synchronizing with the stamping process for smooth operation. Solenoid valves regulate airflow in pneumatic systems, ensuring precise control over movement. The power supply unit provides stable energy to all electrical components, maintaining uninterrupted functionality for safety, the machine is equipped with emergency stop buttons and safety switches, preventing accidents and ensuring operator protection. This automated

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stamping system offers higher efficiency, accuracy, and reliability, making it ideal for industries requiring fast and flawless product marking.

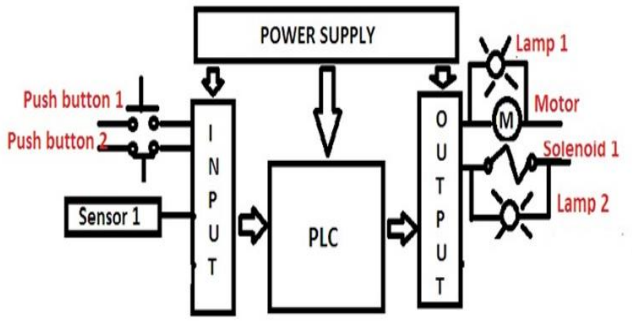

Figure 2 Block Diagram of Existing System

5. Proposed System

In order to the proposed Automatic Stamping Machine using a Programmable Logic Controller is designed to enhance efficiency, precision, and consistency in industrial stamping applications. This system automates the process of imprinting labels logos or markings on products, significantly reducing manual labour and human error. At its core, the PLC controls entire operation ensuring smooth synchronization of all components. Products move along a conveyor system guided by proximity and photoelectric sensors that detect their presence and position for accurate alignment. Once in place, actuators such as pneumatic cylinders or servo motors drive the stamping mechanism, applying a controlled force to ensure a clear and consistent impression. Figure 3 shows Block Diagram of Proposed System.

5.1.Block Diagram

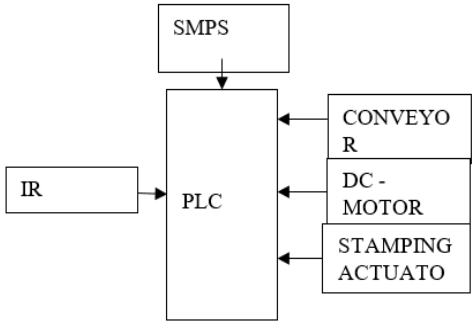

Figure 3 Block Diagram of Proposed System

Operators interact with the machine through a Human Machine Interface which allows for easy configuration, real time monitoring, and troubleshooting. To enhance safety, the system is equipped with emergency stop buttons and safety switches, ensuring immediate shutdown in case of malfunctions. The advantages of this system include increased efficiency by automating stamping tasks, high precision for consistent and error-free markings, and reduced manual labour, which lowers operational costs and minimizes worker fatigue. Additionally, its intuitive control system makes operation seamless while maintaining high safety standards. This proposed stamping machine is an ideal solution for industries requiring fast, high-quality and reliable marking, making the production process more streamlined and cost effective. (Figure 2)

5.2.Flow Chart

The Automatic Stamping Machine follows a structured sequence to ensure smooth and efficient operation. The process begins with the Start command, initializing the system. The Switched Mode Power Supply provides stable power to all electrical components including the Programmable Logic Controller which acts as the brain of the system. Once powered, the IR sensor continuously monitors the conveyor belt for incoming products. When a product is detected, the PLC signals the DC motor to activate the conveyor belt, moving the product into the stamping position. As soon as the product reaches the designated spot, the IR sensor sends a signal to the PLC prompting the system to stop the conveyor. At this moment, the stamping actuator, controlled by the PLC engages to press the marking onto the product with precision. After stamping, the conveyor belt resumes its motion, ensuring the stamped product moves forward for further processing or collection. The process continues seamlessly until there are no more products detected, at which point the system either waits for the next product or reaches the Stop state when manually turned off. This well-coordinated flow ensures accuracy, speed, and automation, reducing human effort while a sensor array consisting of proximity and maintaining high efficiency in the stamping process.

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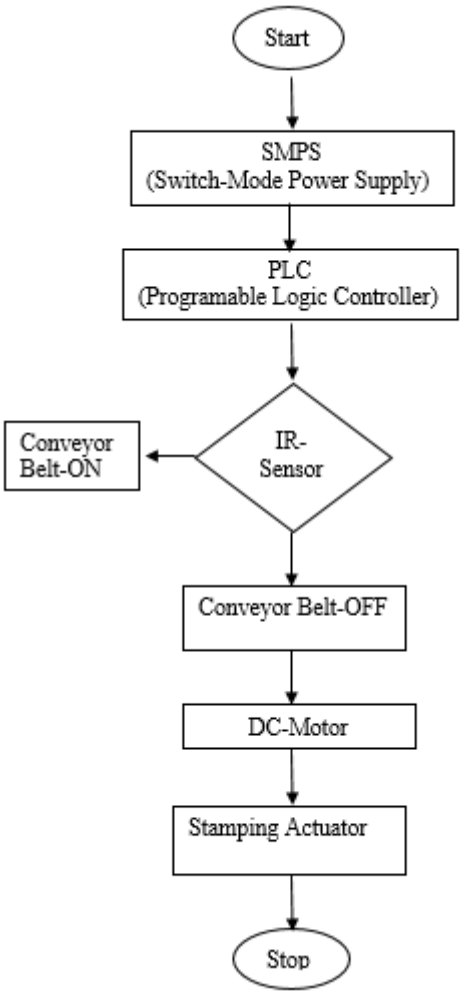

Figure 4 Flow Chart of Proposed System

6. Proposed System Methodology

6.1.Planning

- Requirement Analysis needs of the system such as precision stamping, automation level, and production speed. [11-14]
- Component Selection is essential parts like the PLC, IR sensors, conveyor belt, DC motor and stamping actuator to build a reliable system. (Figure 4)
- Workflow Design the sequence of operations, from detecting products to stamping and moving them forward.
- Risk Assessment is potential challenges, such as sensor accuracy, stamping force, and safety concerns, and planning solutions in advance

6.2.Development

- Hardware Assembly Integrating all components, including mechanical, electrical and pneumatic systems for a seamless setup.
- PLC Programming and testing logic control programs to automate the entire stamping process.
- HMI Integration an intuitive interface that allows operators to set parameters and troubleshoot efficiently.
- Conducting initial tests to verify the proper working of sensors, actuators, and conveyor movement.

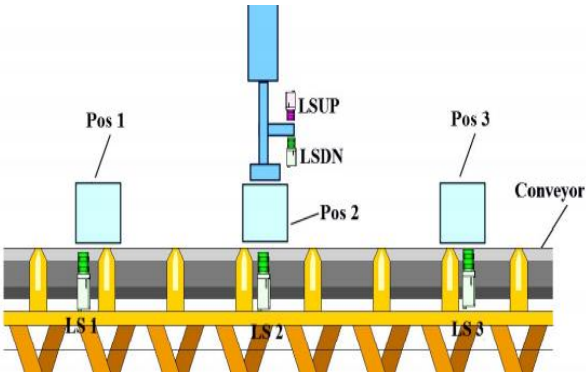

Figure 5 Developed Model of Proposed System

6.3.Implementation

- System Installation by Setting up the machine in an industrial environment ensuring proper alignment connectivity.
- Calibration and fine-tuning the sensor accuracy, actuator speed, and conveyor movement for optimal performance.
- Verifying the effectiveness of emergency stop buttons, overload protection, and fault detection systems.
- Running the machine under real working conditions to detect and fix any operational issues before full-scale production.

6.4.Evaluation

- Performance Analysis by Monitoring key factors like stamping accuracy, cycle time, and error rate to measure efficiency.
- Operator Feedback Collecting input from workers to understand usability and identify areas for improvement.

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- System Optimization necessary software or hardware adjustments to enhance reliability and performance.
- Ensuring the system remains efficient, durable and cost-effective over extended periods.

6.5.Working of Proposed System

The automatic stamping machine using PLC operates in a structured and efficient manner to ensure accurate and consistent stamping of products. The process begins when the system is powered on, and the switched mode power supply provides the necessary electrical supply to all components, including the programmable logic controller which controls the entire operation. As products arrive on the conveyor belt, an IR sensor detects their presence and signals the PLC. Once detected, the DC motor drives the conveyor belt, moving the product into the stamping position. The IR sensor continuously monitors the position, and when the product reaches the exact spot, the PLC sends a command to stop the conveyor. At this stage, the stamping actuator, which may be a pneumatic cylinder or servo motor, is triggered to press the stamping mechanism onto the product, ensuring a clear and precise imprint. After the stamping process is complete, the PLC reactivates the conveyor belt, allowing the stamped product to move forward for further processing or collection. The system operates in a continuous cycle, ensuring high-speed and error-free stamping. Safety mechanisms such as emergency stop buttons and overload protection are incorporated to prevent accidents and ensure smooth operation. The human-machine interface allows operators to monitor real-time data, adjust parameters, and troubleshoot issues easily. This automated process enhances efficiency, reduces human intervention, and ensures consistent quality in industrial stamping applications.

6.6.Applications of Proposed System

The automatic stamping machine using PLC is a highly efficient system that can be used across various industries to improve productivity, accuracy, and consistency. Its ability to automate the stamping process makes it ideal for applications where speed and precision are essential. One of the primary applications is in the manufacturing and packaging industry, where products require branding, labeling, or batch number stamping. This ensures that every item is marked uniformly, reducing human errors and improving traceability. In the automotive sector, the machine can be used for stamping serial numbers, logos, or specifications on metal and plastic components, ensuring compliance with industry standards. The system is also beneficial in the pharmaceutical industry, where medicine packaging and labeling need to be precise and legible. It helps in marking expiry dates, batch codes, and regulatory information on bottles, blister packs, and cartons. Additionally, in the electronics industry, the machine is used to imprint part numbers and identification codes on circuit boards and components, aiding in quality control and easy tracking. Beyond industrial applications, the automatic stamping machine can be used in printing and publishing, such as stamping official seals on documents or creating embossed impressions on certificates and legal papers.

7. Results and Discussions

- The automatic stamping machine ensures precise and uniform marking on every product, reducing human errors and inconsistencies in stamping.
- Automation speeds up the stamping process, allowing industries to handle large volumes of products efficiently without delays.
- The PLC-controlled system minimizes the need for human intervention, making the process more convenient and reducing labor costs.
- The system is designed to integrate smoothly with existing production lines, ensuring a hassle-free transition to automated stamping.
- The IR sensor accurately detects product positioning, ensuring proper alignment before stamping for consistent results.
- The conveyor belt ensures smooth product movement, preventing jams or misalignment during the stamping process.
- The stamping actuator applies controlled force, ensuring clear and legible imprints on various materials, including metal, plastic, and paper.
- Enhanced Safety Features for the system

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includes emergency stop buttons and overload protection to ensure safe operation and prevent damage or accidents.

- By reducing manual labor, errors and material wastage, the system proves to be a cost-effective solution for industries requiring high-speed and precision stamping

Conclusions

The automatic stamping machine using PLC is a reliable and efficient solution for industries requiring high-speed, precise, and consistent stamping. By automating the process, it significantly reduces human effort, minimizes errors, and enhances productivity. The integration of PLC control, sensors, actuators, and a conveyor system ensures smooth and accurate operation, making it suitable for applications manufacturing, packaging, automotive, pharmaceuticals, and electronics. With user-friendly interface safety mechanisms, and adaptability, this system not only improves operational efficiency but also ensures product quality and traceability. As industries continue to embrace automation, this stamping machine proves to be a cost-effective and essential solution for modern production environments, contributing to overall workflow optimization and industrial growth.

References

[1]. Pasha, S., and Rajendra, S. (2024) "Design and Fabrication of PLC-Based Automated Object Sorting, Stamping, and Storage System," in International Journal of Research Publication and Reviews, Vol. 5, No. 11, pp. 1262-1265.

[2]. Tongale, N. J., Kamble, N. D., Joshi, S. A., Jadhav, S. S., and Bhaisare, A. S. (2022) "Review Research Paper on Automatic Stamping Machine Using PLC," in International Journal of Advanced Research in Science, Communication and Technology, Vol. 2, Issue 1, pp. 286-289.

[3]. Saranya, M., Aishwaryaa, R., Madhumidha, S., Palaniappan, C., and Uthaman, G. (2021) "Automatic Electrical Stamping and Sorting Machine Using PLC," in International Journal of Mechanical Engineering, Vol. 6, No. 3, pp. 240-245.

[4]. Parihar, A., Yunus, S., Prasad, N., Sarthak, B., and Naresh, D. (2021) "Automatic Stamping Machine," in International Journal for Science and Advance Research in Technology, Vol. 7, Issue 7, pp. 222-225.

[5]. Dhoble, A. (2018) "Design and Fabrication of Automatic Stamping Machine," in International Journal of Scientific & Engineering Research, Vol. 9, Issue 5, pp. 204-208.

[6]. Sheela, S., Shivaram, K. R., Meghashree, S., Monica, L., Prathima, A., and Shriya, M. Kumar (2016) "Low-Cost Automation for Sorting of Objects on Conveyor Belt," in International Journal, Vol. 5, Special Issue 10, May 2016, pp. 195-200.

[7]. Amruta Pandit, Jyoti (2014) "Object Counting Using Image Processing Technique," in Journal Name, Vol. 3, Issue 4, April 2014, pp. 8509-8512.

[8]. Tripathi, E., and Chaudhary, P. (2011) "Material Sorting and Stamping Machine," in International Journal of Current Trends in Engineering & Research, Vol. 3, Issue 5, pp. 163-169.

[9]. Sehgal, R., and Sharma, A. (2009) "A Graphical Approach for Kinematic Design and Development of an Automatic Stamping Machine Using Four Bar Chain," in Indian Journal of Engineering & Materials Sciences, Vol. 15, pp. 229-235.

[10]. Shamsul, M. J. (2008) "Programmable Logic Control Application for Stamping Operation," in University Teknikal Malaysia Melaka Journal, Vol. 6, No. 4, pp. 178-184.

[11]. Pimpalgaonkar, S. M., Kale, S. V., Ghugal, S. G., and Borkar, S. V. (2007) "Automatic Stamping Machine for Postcards to Overcome Manual Repetitive Stamping Work," in International Journal for Research in Emerging Science and Technology, Special Issue, pp. 89-95.

[12]. Gunawardena, T. K., Dadigamuwa, P. R., and Madhusanka, B. G. D. A. (2009) "Low-Cost Automated Machine for Paper Gathering and Folding," in European Journal of Advances in

International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
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Page No: 760-767
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2025.0106

Engineering and Technology, Vol. 2, No. 2, pp. 40-43.

[13]. Welkar, D. S., Saindane, L. S., Nerker, N. S., Baviskar, H. R., and Sonawane, V. P. (2005) "Automatic Stamping and Pad Printing Machine," in 7th International Conference on Science, Technology and Management, ISBN: 978-93-86171-30-6, pp. 112-118.

[14]. Koppa, P., Nagaraja, N., Amith, V., Sushilendra, and Vyasaraj, T. (2002) "Development and Fabrication of Electro-Pneumatic Automatic Stamping Machine," in International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 9, pp. 1023-1030.