TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

PULCHOWK CAMPUS

A REPORT ON:

CASE STUDY

(NEPAL DISTILLERIES PVT. LTD.)

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ABSTRACT

This report is based on a field study at **Nepal Distilleries Pvt. Ltd.**, an alcoholic beverage company known for producing spirits like Khukuri Rum and other liquors. The main objective of the study was to apply our theoretical knowledge of microprocessor-based instrumentation systems to understand real industrial processes. We observed that the production line of alcoholic beverages involves several steps such as rinsing, bottle inspection, filling, capping, hologram and QC sticker application, sleeving, and final packing. While many processes are automated, some still require manual involvement to ensure quality and accuracy. The existing system includes electrical, pneumatic, and hydraulic mechanisms along with microprocessor-based monitoring to maintain efficiency, product quality, and compliance with legal standards. From our analysis, it is clear that increasing automation in certain areas would reduce human effort, minimize errors, and improve productivity in the long run.

1. INTRODUCTION

Alcohol has been a cherished part of Nepalese culture for centuries, deeply intertwined with the rhythms of life, traditions, and heartfelt celebrations. Whether marking the joy of festivals or the reverence of sacred rituals, its presence is a symbol of unity, warmth, and shared moments that bring communities together. Across Nepal, families take great pride in crafting homemade brews, with recipes passed done through generations. These time-honored traditions aren't just about creating beverages; they are about preserving legacies, nurturing bonds, and celebrating the rich history that flows through every sip.

In 1959, a bold new chapter began with the founding of the Nepal Distrillies Pvt. Ltd. (NDPL). Driven by a passion for excellence and a commitment to elevate Nepal's alcohol industry, NDPL become the country's first distillery dedicated to producing high-quality liquor. This wasn't just about making alcohol it was about setting a new standard, landscape, bringing craftsmanship and consistency to an industry that had long been rooted in tradition.

The impact of NDPL rippled far beyond bottles and barrels. It sparked an economic awakening creating jobs and opportunities and barrels. It sparked an economic awakening, creating jobs and opportunities for countless families, empowering communities, and breathing new life into the nation's spirits industry. With every carefully crafted batch, NDPL honors the soul of Nepal, blending tradition with progress.

NDPL's legacy is one of pride, passion, and perseverance building a foundation for future generations to carry forward. It is not just a distillery; it's a testament to the spirit of Nepal itself, a symbol of resilience, craftsmanship, and cultural celebration that continues to inspire and uplift, generation after generation.

1.1 Profile Table

Business Type	Alcohol / Distillery Industry
Key Customers	Common People
Registered Address	Balaju Industrial Area, Balaju, Kathmandu
Year of Establishment	1959
Legal Status of Firm	Private Limited
Major Markets	National and International
Team and Staffs	114
Installation / Testing Facilities	Yes

1.2 Objective

The primary objective of this case study is to gain practical knowledge about the application of instrumentation in a real industrial environment. Our research at **Nepal Distilleries Pvt. Ltd. (NDPL)** focused on understanding how different electronic and control systems are utilized in the production process. Guided by senior engineers and technicians, we observed the plant's operation, studied the existing systems, and identified possible areas for improvement. Based on our observations, we proposed solutions to address issues related to the operation and manufacturing processes.

The objectives of our visit can be summarized as follows:

- To visit Nepal Distilleries Pvt. Ltd. and study its production and operation under the supervision of senior engineers and technicians.
- To understand the company's management system and technological practices.
- To become familiar with the engineering aspects and requirements specific to the distillery industry.
- To recognize the vital role of engineers in ensuring smooth operation and quality production.
- To study the application of electronic system design, instrumentation, and automation in industrial processes.
- To carefully observe the existing system, detect any faults or inefficiencies, and analyze their impact.
- To propose solutions aimed at improving efficiency, reliability, and overall system performance.

2. LITERATURE REVIEW

This visit was conducted on 2082-04-16. For our case study, we selected **Nepal Distilleries Pvt. Ltd. (NDPL)**, one of the most renowned distilleries in Nepal, engaged in the production of high-quality liquor since 1959. The company supplies its products to both individuals and businesses across the country. We chose this organization for our field visit because it represents a pioneer in Nepal’s alcohol industry, combining tradition with modern production practices. Studying the use of instrumentation and manufacturing processes in such a reputed company gives us an insight into the present condition of industrial automation in Nepal.

Our main aim was to explore the real-field application of instrumentation in the distillery industry and to understand the crucial role of engineers in ensuring smooth operation and consistent product quality. A team of four members visited the company under the guidance of senior engineers and technicians.

In preparing this report, we also reviewed the past case study reports prepared by our seniors who had visited other manufacturing companies. Additionally, we referred to online resources and literature related to industrial automation in the distillery sector. These references provided us with useful insights and helped us in shaping our study.

In our analysis, we have attempted to identify the existing challenges in the distillery’s operation and proposed improvements to enhance efficiency and reliability. Compared to the past systems, our proposed design emphasizes reducing manual tasks that consume time and effort, while moving towards automation. With the implementation of such an automated system, the requirement for highly skilled or educated workers for routine monitoring can be minimized, ensuring both efficiency and ease of operation.

3. BACKGROUND THEORY

- **Microcontroller Unit (MCU):**
  The brain of the system that controls and coordinates all components, processes inputs from sensors, and sends commands to motors and actuators.

- **8255 Programmable Interface Controller (PIC):**
  An interface chip used to connect the microcontroller with input/output devices, allowing the system to read sensor signals and control actuators efficiently.

- **Timer Controller:**
  A device that generates precise time delays or triggers events at specific intervals, essential for synchronization and process timing in automation.

- **Emergency Stop:**
  A safety mechanism that immediately halts all machine operations to prevent accidents or damage during emergencies.

- **Motor (Input and Output Conveyor Belt):**
  Drives the conveyor belts to transport materials into and out of the system, enabling automated movement of workpieces.

- **Proximity Sensor:**
  Detects the presence or absence of objects near the sensor without physical contact, useful for position detection and material handling.

- **Arm Sensor:**
  Monitors the position or movement of a robotic arm or mechanical actuator to ensure accurate operation and alignment.

- **Servo Motor:**
  A motor with precise position control used to move components or arms to specific angles or positions as per system requirements.

4. METHODOLOGY

4.1 Manufacturing Process

The material (starch) that is required for making product is imported from **Terai region**. The basic manufacturing process includes the following process:

1. Rinsing
2. Empty Bottle Inspection.
3. Filling and Capping.
4. Filled Bottle Inspection.
5. Hologram sticking.
6. Sleeving.
7. Packing.
8. QC Sticking.

Rinsing:

The empty is loaded into a Rinser which cleans empty bottles before they are filled. This ensures that no dust, debris, or contaminants are present, maintaining hygiene and product quality. For rinsing, two types of Rinser were used: Gripmatic Rinser and Tunnel Rinser. The Gripmatic Rinser is best for expensive or special bottles like whisky, wine, or limited-edition spirits. It carefully holds each bottle and cleans it thoroughly, which is good for fragile or unusually shaped bottles. The Tunnel Rinser is used for regular beer or mass-produced spirit bottles. It can clean many bottles quickly but works best when the bottles are all the same size and shape.

Empty Bottle Inspection:

After rinsing, each empty bottle for alcoholic drinks was carefully checked manually for cracks, chips, or any damage. This ensures that the bottles are clean and safe to use, and that they will not leak or break during filling. For drinks like wine, whisky, or other spirits, this step is very important to maintain the taste, quality, and hygiene of the product. Only bottles that are clean and intact are sent for filling, while any rejected bottles are destroyed or removed from the production line.

Filling and Capping:

After the empty bottles have been inspected and approved, they are sent to the filling station. Here, each bottle is carefully filled with the alcoholic beverage, such as wine, whisky, or other spirits, ensuring the correct volume is maintained. After filling, the bottles are immediately moved to the capping station, where caps or corks are securely placed to prevent leakage and preserve the quality of the drink. This step is very important to maintain the taste, aroma, and hygiene of the product. Once capped, the bottles are ready for labeling and packaging.

Hologram Sticking:

After the bottles are filled, capped, and packed, a hologram sticker is placed on each one. This sticker acts as a proof that the product is real and helps stop fake or counterfeit alcohol. It makes sure that drinks like wine, whisky, or other spirits are genuine and safe for customers. Adding the hologram is an important step to protect the product, gain customer trust, and follow the law.

Sleeving:

After the hologram sticker is applied, a sleeve is placed around each bottle. This sleeve is usually made of plastic or shrink film and provides an extra layer of protection and tamper evidence. It also gives the bottle a finished and attractive look for the customer. Sleeving helps ensure that the alcoholic product, such as wine, whisky, or other spirits, remains safe, sealed, and presentable until it reaches the consumer.

Packing:

After the hologram is applied, the bottles are carefully packed into cartons or boxes for storage and transport. Packing protects the bottles from breakage, dust, and contamination during handling and shipping. It also helps in organizing and transporting the bottles efficiently. Proper packing ensures that alcoholic drinks like wine, whisky, or other spirits reach the customer in good condition and safe to use.

QC Sticking:

After the bottles are packed, a Quality Control (QC) sticker is placed on each carton or box. This sticker shows that the bottles inside have been checked and approved for quality, including correct volume, proper sealing, and hygiene standards. QC sticking ensures that only safe and high-quality alcoholic products, like wine, whisky, or other spirits, are sent to the market. It helps maintain customer trust and ensures compliance with regulations.

4.2 Existing System

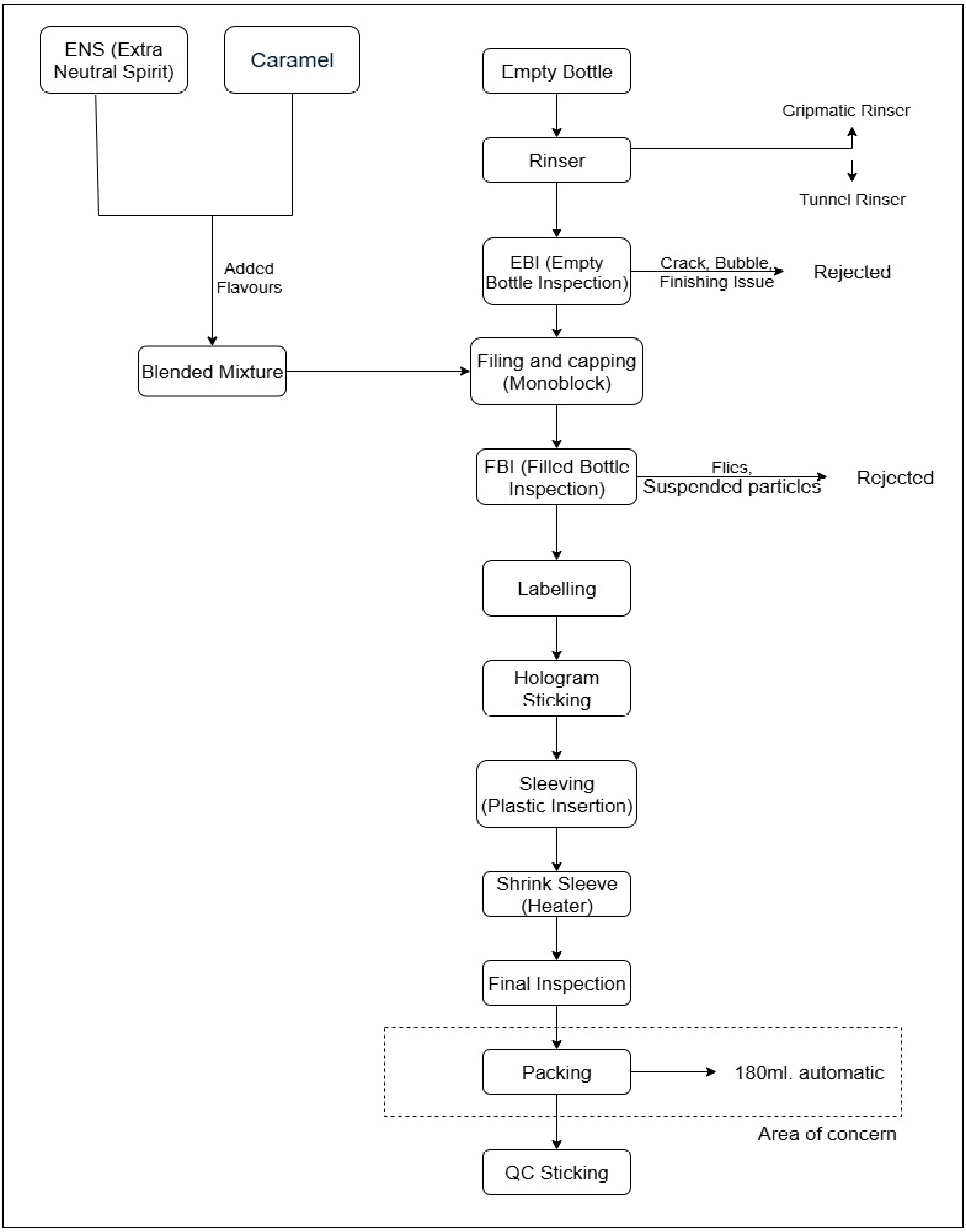

Fig: Block Diagram of Existing System

4.3 Recommended System

The proposed system shown in the diagram is designed to automate the packaging and handling process in NDPL. It integrates several subsystems—vision, identification, control, and conveyor mechanisms—working together to achieve efficiency, accuracy, and consistency in production.

At the front end, the **Vision System** plays a vital role in capturing images of objects moving along the conveyor. This information is sent to the **Object Identification System**, which determines the type, size, or characteristics of each object. Based on this identification, appropriate instructions are generated for the next stages of operation.

The information is then passed to the **Arm Controller** and **Gripper Controller**, which handle the physical manipulation of objects. The robotic arm, guided by these controllers, picks up the object accurately and positions it according to the packaging requirements. The gripper ensures a firm hold without damaging the product, allowing smooth and reliable transfer of items.

Once the object is ready for packaging, it enters the **Packaging Selection System**, where the appropriate type of packaging is chosen depending on product specifications. This is followed by the **Packing System**, which ensures that the item is securely packed. To maintain consistency, the **Quantity Specification System** checks that the correct number of items is packaged, thereby preventing underfilling or overfilling.

After packing is completed, the **Conveyor Controller** activates the conveyor belt to transport the packaged items to the next stage, such as storage or delivery. This smooth movement ensures a continuous flow of production with minimal delays.

By integrating these subsystems, the proposed automation setup eliminates the need for repetitive manual work, reduces human error, and ensures high precision in packaging. The use of a vision-based identification system ensures that only correct items proceed to the next stages, while the robotic arm and gripper provide speed and reliability in handling. Additionally, quantity checks and packaging selection guarantee that the final product meets quality standards.

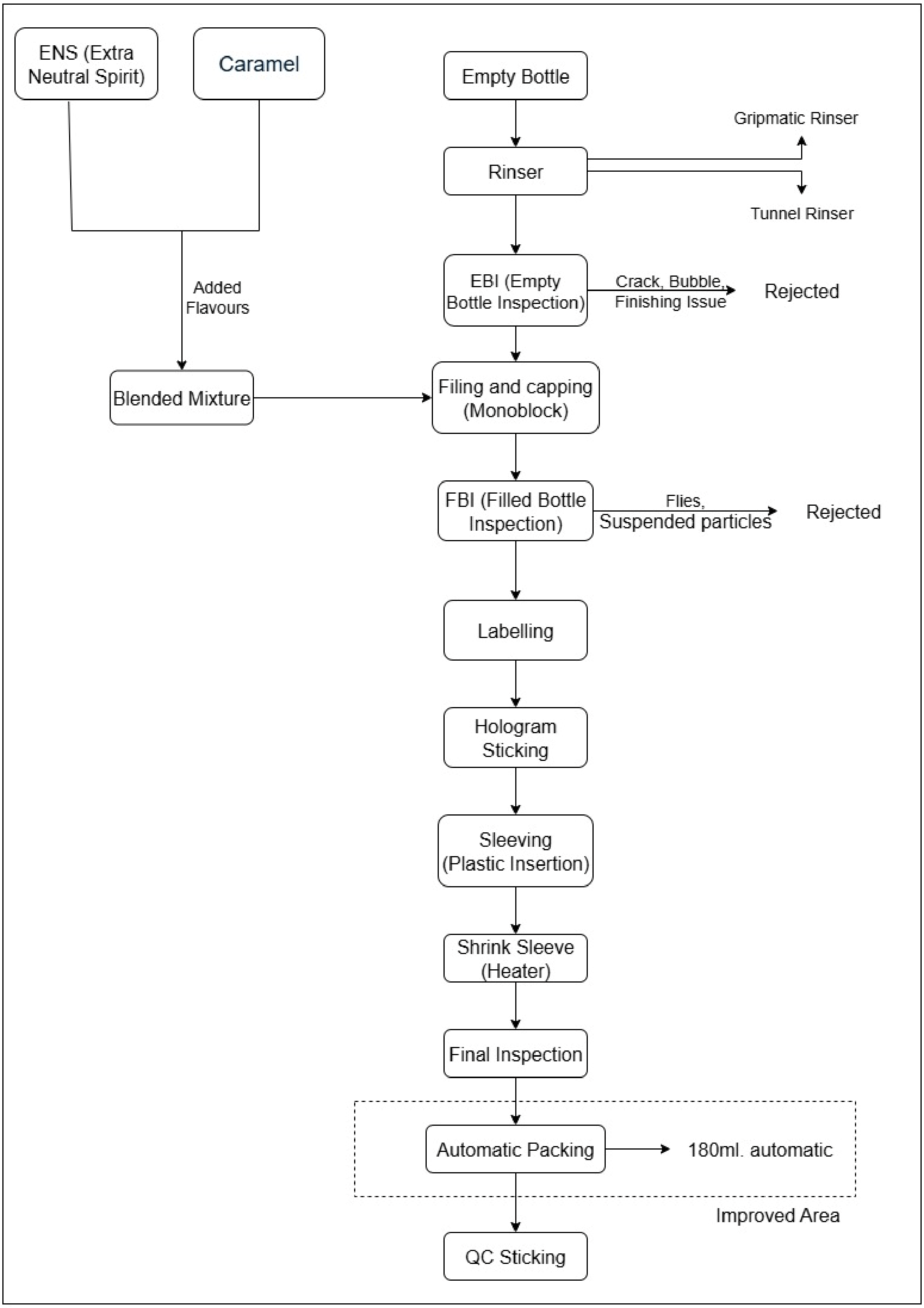

Fig: Block Diagram of Proposed System

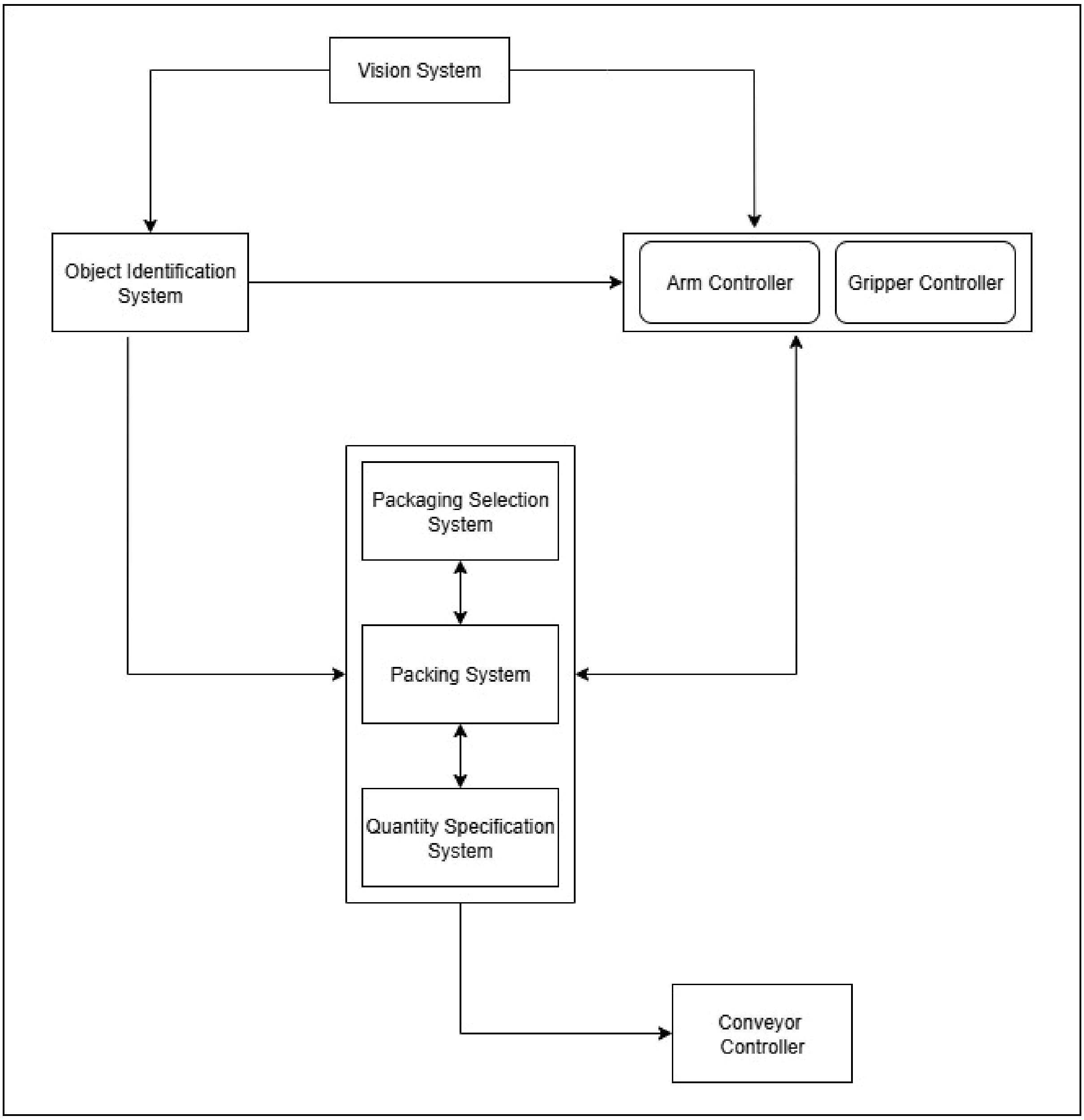

Fig: Detailed Proposed System

4.4 Circuit Diagram

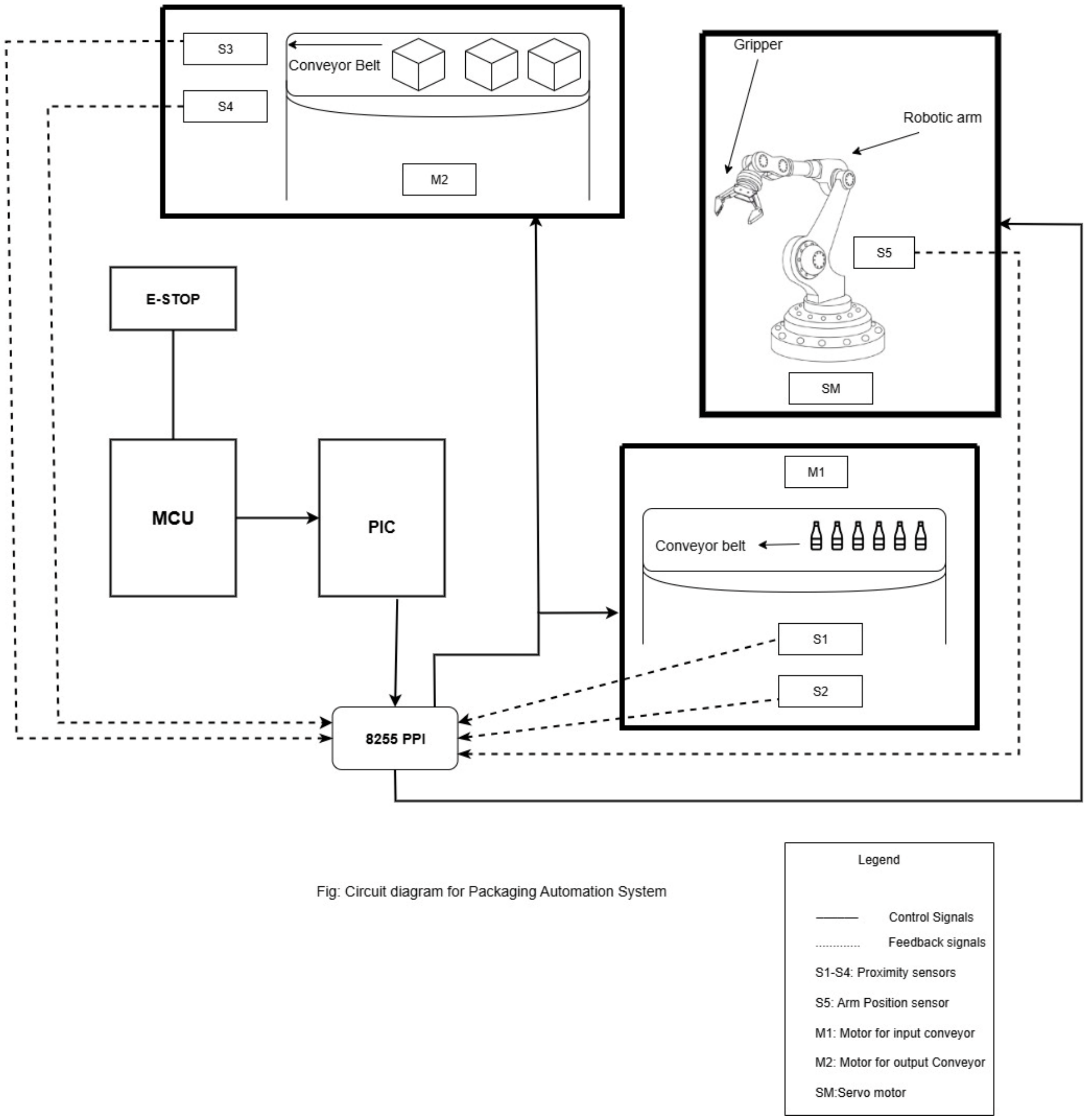

Fig: Circuit diagram for Packaging Automation System

5. EPILOGUE

5.1 Result

From our study and field visit at **Nepal Distilleries Pvt. Ltd.**, we observed that the existing production line integrates several semi-automated processes, such as rinsing, filling, capping, inspection, and labeling. However, the **packaging stage** still relied partly on manual intervention, which created bottlenecks in terms of efficiency, uniformity, and manpower requirements.

The following were the observed result from our finding: -

- **Efficiency** of packaging can be increased significantly, reducing delays and bottlenecks.
- **Consistency and quality** of the final product will be improved as human errors and inconsistencies are minimized.
- **Labor requirements** for repetitive packaging tasks will be reduced, allowing workers to focus on supervision and higher-value tasks.
- **Hygiene and safety** standards will be enhanced by reducing direct human contact with products.
- **Overall production cost per unit** is expected to decrease after automation, despite the initial installation investment.

5.2 Discussion

During our visit, we observed that the machines in the production line were well managed and operated according to proper guidelines. The introduction of modern equipment in recent years has significantly improved the production rate and consistency. However, certain challenges still persist in the existing system, particularly in the **packaging stage**, where partial manual intervention slows down efficiency and increases dependency on labor.

Our proposed automated packaging system is designed to address these shortcomings. By integrating conveyors, sensors, PLC-based controls, and automated carton sealing units, the system focuses on enhancing **accuracy, precision, and speed** during the packaging of 180 ml bottles. This reduces manual effort, minimizes human error, and ensures uniformity across production batches.

The proposed design can also save time by streamlining the workflow and reducing bottlenecks in the packaging area. Although the implementation of this system will require investment and depends largely on the interest and decision of the company's management, it offers a strong foundation for future upgrades in automation.

Overall, the adoption of this proposed system would not only solve existing issues but also create a **scalable platform** for further automation and digitalization of the plant in the coming years.

5.3 Conclusion

The case study at **Nepal Distilleries Pvt. Ltd. (NDPL)** provided us with valuable insights into the application of instrumentation in a real industrial environment. We observed that while most of the production processes such as rinsing, filling, capping, and inspection are semi-automated, the **packaging stage** still relies partly on manual operation, which limits efficiency and consistency.

Our proposed **automated packaging system** addresses this issue by introducing conveyor integration, PLC-based control, precise sensors, and automated carton sealing mechanisms. This design ensures higher accuracy, reduces manpower requirements, improves hygiene, and significantly enhances production efficiency.

Although the implementation of the proposed system depends on the company's management and investment considerations, it offers a **practical and scalable solution** that aligns with modern industrial practices. In the long run, automation in packaging will strengthen NDPL's competitiveness in the distillery industry while ensuring consistency, safety, and cost-effectiveness in its operations.

5.4 Future Enhancement

In the future, this system can be further improved by integrating full automation with AI-driven monitoring, predictive maintenance to prevent machine downtime, and real-time quality inspection using machine vision. Additional enhancements like energy optimization, advanced data analytics for better decision-making, scalability for new product lines, and remote monitoring can increase efficiency, reduce costs, and ensure consistent high-quality production.

6. LIST OF FIGURES


KHUKRI XXX RUM
Khukri Story


The evolution of Khukri Rum packaging
From 1959 to today, reflecting our timeless heritage and innovation
2021
2018
2009
1998
1959

7. REFERENCES

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- D. V. Hall, *Microprocessors and Interfacing*, 2nd ed. New Delhi: Tata McGraw-Hill Publishing Company Limited.