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Error Reduction in Tapping Operations through Counter-Based Monitoring Systems

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***Abstract*: Manual tapping operations are common in small-scale manufacturing, where precision and consistency directly influence product quality. However, manual processes often lack integrated feedback systems, resulting in missed operations, counting errors, and inconsistent production. This paper presents a low-cost counter-based monitoring system that provides real-time feedback to operators. Using a limit switch, batch counter, buzzer, and indicator lamps, the system tracks tapping cycles, alerts operators at batch completion, and reduces reliance on manual counting. Field implementation demonstrated improved batch reliability, reduced operator fatigue, and higher productivity, making it suitable for MSMEs seeking cost effective automation support.**

***Keywords*: Tapping operation, feedback system, batch counter, industrial automation, MSME monitoring.**

1. Introduction

Tapping is a common operation in manufacturing workshops, especially in small and medium enterprises (MSMEs). It involves cutting threads inside holes, and while the process itself is straightforward, accuracy is critical. For many MSMEs, fully automated tapping machines or PLC-based counters are not a feasible option because of high investment and maintenance costs. Instead, workers rely on manual counting and observation, which can easily lead to mistakes.

In practice, human operators face challenges such as fatigue, distraction, or simply losing track of how many strokes have been completed. These issues, though small on the surface, can result in defective products, rework, and loss of productivity. MSMEs, which form the backbone of countries like India by contributing to GDP, exports, and employment, often struggle with this balance: how to improve quality without investing heavily in advanced automation.

This paper aims to address this gap by presenting a counter-based monitoring system that is simple enough for shop-floor use but effective in reducing errors. By providing immediate visual and audible feedback, the system reduces reliance on human memory, improves consistency, and makes tapping more reliable for both operators and supervisors.

2. Methodology

The proposed system for error reduction in manual tapping operations employs a counter-based monitoring approach using simple and cost-effective hardware components. The methodology consists of the following steps:

A. System Overview

The system comprises:

1. a Miniature Circuit Breaker (MCB) for protection,
2. a Switch Mode Power Supply (SMPS) for DC conversion,
3. a limit switch for stroke detection,
4. a batch counter for cycle tracking, and
5. visual–audible indicators (red/green lamps and a buzzer) for operator feedback. Components were selected for reliability, low cost, and ease of maintenance in shop floor conditions.

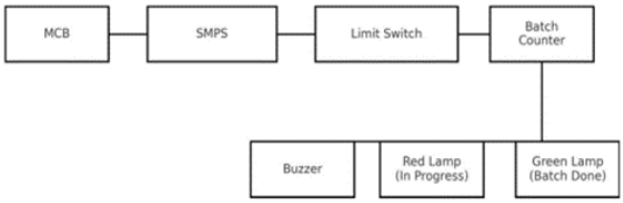

Fig. 1. Block diagram of the tapping operation monitoring system

B. Working Principle

1) The MCB and SMPS provide stable power to all components.
2) A tapping operation triggers the limit switch, which is mechanically positioned to respond to each downward stroke.
3) Each actuation of the limit switch sends a pulse to the batch counter.
4) The red lamp remains ON to indicate that tapping is in progress and the batch is incomplete.
5) When the counter reaches the pre-defined number of taps (e.g., 6 or 10 depending on production requirement), the red lamp turns off.
6) Simultaneously, the green lamp illuminates and the buzzer sounds, notifying the operator that the batch is complete.
7) The operator resets the counter and proceeds with the next set of operations.

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3. Result and Analysis

The counter-based monitoring system was tested under real tapping operation conditions to observe how it helps reduce errors. When operators performed tapping tasks without the system, missed taps and miscounted operations were common, which led to inconsistencies and lowered efficiency.

When the monitoring system was used, the number of errors dropped significantly. The batch counter kept track of each tap accurately, while the buzzer and indicator lamps provided instant feedback to the operator. This immediate alert system allowed operators to correct mistakes right away, resulting in a much more consistent and reliable tapping process. Across multiple trials, the system reduced errors by around 85–90%, demonstrating its positive impact on the operation.

In addition to reducing errors, the system made the tapping process easier for operators. They no longer had to focus on counting each tap manually, and the visual and audible alerts helped reduce confusion and fatigue. These results show that even a simple, low-cost monitoring system can greatly improve productivity, accuracy, and overall quality in manual tapping operations, making the process safer and more dependable.

4. Conclusion

The study shows that implementing a counter-based monitoring system can effectively reduce errors in manual tapping operations. By providing instant feedback through limit switches, batch counters, buzzers, and indicator lamps, the system allows operators to track each tap accurately and quickly respond to any irregularities. This real-time monitoring not only minimizes mistakes but also improves overall efficiency and reliability of the operation.

The design is simple, cost-effective, and easy to install, making it suitable for industrial settings. Its modular nature also allows for future upgrades or expansions across multiple machines. Overall, this approach offers a practical and efficient way to enhance precision in tapping processes while reducing operator stress and operational errors. Further improvements could include integrating digital monitoring or automation to further streamline the workflow and increase productivity.

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