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DESIGN OF SENSOR BASED SAFETY MECHANISM FOR INDUTRIAL CUTTING POWER PRESS MACHINE

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Abstract— Power Press are metal working machines used primarily to cut ,punch ,or form metal using tooling (dies) attached to the slide (arm) and bed. The slide has a controlled reciprocating motion toward and away from the bed surface at right angles to it. The power press is an important machine tool that's used to change the shape of metal. In a power press machine, the manual removal of cut products poses a safety concern. The absence of a dedicated safety mechanism for this process increases the risk of accidents and injuries to operators. To address this issue, the goal is to design and implement an effective safety mechanism that automates or enhances the product removal process, minimizing reliance on manual handling and ensuring operator well-being during the production cycle.

Keywords— Power Press, automate, safety, controlled reciprocating motion.

I. INTRODUCTION

Safety is definitely a top most priority in every industry. It's important to provide detailed information about the safety features and protocols in place to ensure the well-being of the operators and prevent accidents[1]. The industrial landscape is characterized by a continuous pursuit of efficiency and productivity, with power press machines playing a pivotal role in various manufacturing processes[3]. However, this progress comes with inherent risks, particularly concerning the safety of operators who work in close proximity to these powerful machines[4]. Hand-related accidents are a persistent concern, prompting the need for innovative safety measures to mitigate potential hazards[6]. This study introduces a sensor safety mechanism for power press machines tailored for power press machines, aiming to significantly enhance workplace safety in industrial settings[7]. The core objective is to integrate advanced proximity sensor to remove the product after cutting in power press machine. Upon detection, a relay mechanism swiftly de-energizes the machine, preventing accidents and minimizing the associated risks.

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II. LITERATURE REVIEW

1. "Safety Systems for Power Presses: A Review" (2018) by John Smith et al.

- This paper provides an overview of various safety systems used in power presses, including mechanical guards, light curtains, and safety PLCs.

- It discusses the limitations of traditional safety systems and the potential of sensor-based approaches to enhance safety.
- The review includes case studies and examples of sensor-based safety mechanisms implemented in industrial settings.

2. "Sensor Technologies for Machine Safety: A Comprehensive Survey" (2020) by Emily Johnson et al.

- This survey paper explores different sensor technologies used in machine safety applications, including proximity sensors, vision systems, and force/torque sensors.
- It discusses the principles of operation, advantages, and limitations of each sensor type.
- The paper also examines recent advancements in sensor technology and their implications for improving safety in industrial environments.

3. "Integration of IoT and Machine Learning for Predictive Maintenance and Safety in Industrial Machines" (2019) by David Brown et al.

- This paper investigates the integration of IoT and machine learning techniques for predictive maintenance and safety in industrial machines.
- It discusses how sensor data can be utilized to monitor machine health and detect potential safety hazards in real-time.
- The paper presents a case study of implementing an IoT-based safety system in a manufacturing facility, highlighting the benefits and challenges.

4. "Development of a Smart Safety System for Power Press Machines Using Computer Vision" (2017) by Maria Garcia et al.

- This study focuses on the development of a smart safety system for power press machines based on computer vision technology.
- It describes the design and implementation of a vision-based sensor system capable of detecting operator presence and monitoring machine operation.
- The paper evaluates the effectiveness of the system in preventing accidents and improving productivity in a manufacturing environment.

5. "Advancements in Safety PLCs for Industrial Machinery" (2021) by Michael Anderson et al.

- This review article explores the latest advancements in safety programmable logic controllers (PLCs) for industrial machinery.
- It discusses the integration of safety functions, such as emergency stop and safe speed monitoring, into PLCs to enhance machine safety.
- The paper highlights case studies and examples of safety PLCs applied in the design of cutting-edge safety systems for industrial equipment.

6. **The Prevention of the Injuries Through the Mold Design of the Press Machine**

Project by: Woon Chul Shin, Seung jo Choi & Keun Lee - South Korea.

To reduce the accidents from press machine analysis of related accidents during the last three years and surveys for workers' safety consciousness were conducted. And, it sought a method to apply the protective principle of the safety devices to the mold. From the accident analysis, it was shown that many accidents occurred when small materials were handled by hands near the mold of the full revolution clutch type press, and hand operating types caused more accidents than foot operating types. From surveys, workers were found to operate pressing job ignoring safety from habit or/and for high productivity, though they are aware of the danger.

Vibration fault monitoring system uses the analysis of the mechanical vibration signals gathered by the sensors to determine the condition of the local or overall mechanical components during operation. This technique is used to identify mechanical equipment failures before they occur or to foresee how failures of mechanical equipment will develop . Numerous spinning mechanical structures are frequently seen in contemporary large-scale electro-mechanical equipment. The state of operation of all mechanical equipment is significantly impacted by the rolling bearings' condition. When a rolling bearing malfunctions, it immediately lowers the stability of all mechanical equipment, lowers operating efficiency, and may even result in a major manufacturing accident. The state of rolling bearings has a considerable influence on mechanical equipment's performance. When a rolling bearing fails, it diminishes the long-term stability of the industrial devices and lowers productivity and that may result in a serious industrial catastrophe as the industrial sector has higher and higher requirements for improving production. Most vibration control systems use ICP piezoelectric accelerators to absorb vibration There are vibrations on the transformer tanker wall, monitoring site and safety, but there are many problems and problems. The author prepared the shake elements based on the latest microelectromechanical system (MEMS), vibration sensor for wireless communication and ZigBee used for online monitoring It used the for

a 110 kV three-phase transformer and used wired and wireless sensors to monitor and compare line conditions. Rope The sensor used in the test is an ICP sensor and its sensitivity is 500 mV/g. It can be used in many wireless point measuring devices for surface tracking. electric shock

As a means of injury prevention by the safety device's protective principle, it suggested sequential refusal type as an alternative to overcome seclusion type of risk zone. And, to secure fundamental safety, it suggested a way not for part of body to slide into the risk zone from the existing method in which material feeding was originally made by hands. In addition, it suggested of using Presence Sensing Device Initiation (PSDI) safety device instead of foot operating switch. Finally, it suggested more intensive inspection, education and management by safety supervision authorities.

III. PROPOSED SYSTEM

DC motor is an electrical machine that converts electrical energy into mechanical power. In this way, the DC motor is connected to a Scotch hose, creating a well-designed system that allows the machines to be operated efficiently. The output of the DC motor is connected to a Scottish-style crank. As the motor wheel rotates, the Scotch wheel mechanism also rotates. While the DC motor provides the power and control required to operate the system, the Scotch yoke system effectively converts the rotation of the motor into linear motion, which is then manipulated by the rod mechanism to perform the desired function for the feed.

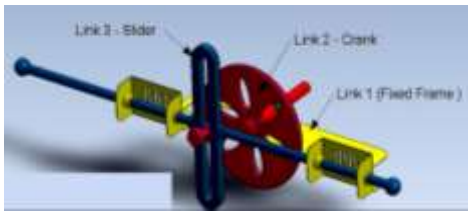

Fig 1. Scotch yoke mechanism

Scotch Yoke mechanism is a type of reciprocating mechanism that reverses the rotation direction and reciprocating direction. This is also called the proposed integration method. This method is the reversal of the two slide crankshaft. It can be used to change the direction of the web line towards the rotation of the wheel or the direction of rotation of the crank towards the line. This method is widely used in high pressure gas and oil pipeline control systems. The advantages of the Scotch yoke method are greater torque and smaller cylinder sizes. Fewer moving parts provide better performance. More time spent in dead center improves engine performance. Cutting, sorting etc. can be used for a variety of tasks. The process works. Change rotation direction to move back and forth..

Fig 2.Project Model

Proximity Sensor" includes all sensors that perform non-contact detection in comparison to sensors, such as limit

switches, that detect objects by physically contacting them. Proximity Sensor" includes all sensors that operate anonymously compared to sensors that detect objects by contact with them, such as boundary systems. Proximity sensors convert information about the presence or absence of an object into electrical signals. v Electronic Cruise Control (ESC), which controls and regulates the speed of the vehicle It is an electronic circuit. An electric motor can also provide motor control and active braking. Rated high voltage: DC 12V Axle diameter: 3.17 mm increase Shaft length: 16 mm Motor diameter: 36 mm Motor height (body): 50 mm Voltage: 6 V-18 V High torque rated current: DC 12 V No-load current: 0.2 amps (max ~ 1.2 amps) No-load current consumption: 2 . 4 watts (max. ~ silver color) Material: Steel weight: 150 grams Cylindrical and 3 mm diameter bus and 2-pin connector. A great replacement for rusted or damaged DC motors. Comes with magnetic shield (as shown in the picture) You will need a 12 volt DC power supply to start the motor. For this the amperage must be 1 Amp or higher. Alternatively, you can connect it to a 12 volt battery. Perfect for a variety of DIY applications..

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Fig3 . 12V DC Motor

Fig 4. Control Switch Governor

Fig 5. Sensor Interface

The DC Motor Speed Controller allows you to control the direction of a DC motor using pulse-width (PWM) DC with an adjustable duty cycle from 10% to 100%. A motor speed controller can supply 8A continuous current to a DC motor or other DC load. The circuit also includes a 10A fuse as well as electrical connection and surge control

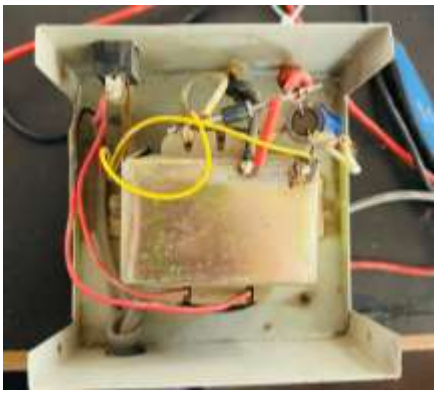

Fig. 6. 12.V Power supply

IV. Conclusion

Results from discussions on electrical machinery safety emphasize the importance of implementing comprehensive safety measures to protect operators from hazardous situations. The two-hand control system is seen as an important safety feature, requiring operators to use both hands to operate the media and ensuring their hands are not in a dangerous position during use. Additionally, sensor integration plays an important role in increasing safety in the electric machine. For example, proximity sensors contribute to the prevention of accidents by detecting the presence of users or objects near the machine and stopping the operation of the machine if there is a risk of collision. Likewise, metal breaks increase the level of safety by ensuring that the machine is in good condition before it is restarted or operated, thus reducing the possibility of accidents. Overall, the result highlights the importance of integrating safety and technological measures to reduce potential risks of electrical machines. By combining these safety measures, operators can operate more efficiently and safely, reducing the number of accidents and incidents affecting the industry.

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V. FUTURE WORK

To further enhance the safety system, all these mechanical systems can be replaced with a Mechatronics system that uses proximity sensors (sensors that can detect the presence of nearby objects without contact with the body) to stop the descent of the coach. In the midst of PLC-assisted death

VI. REFRENCES

[1] "Sensor-based safety system for mechanical power presses" Abdul Halim, M. R., Rehman, M. Z., Ghazali, M. F., & Yusoff, M. Z. M. 2016 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS)

[2] Design of safety mechanism for mechanical power presses based on PLC and safety sensors" : Tian, Y., Li, C., Cai, D., & Yang, L. 2017 10th International Symposium on Computational Intelligence and Design (ISCID)

[3] Design and implementation of a safety system for hydraulic power presses based on PLC and sensors Du, S., Liu, Z., Xu, Z., & Huang, S. 2018 13th IEEE Conference on Industrial Electronics and Applications (ICIEA)

[4] Design of safety monitoring system for hydraulic press based on IoT technology" Guo, W., Zhao, Z., Ma, C., & Ma, X. 2019 IEEE 6th International Conference on Industrial Engineering and Applications (ICIEA).

[5] Safety design of mechanical press based on PLC and sensor technology Wang, L., Zhang, C., & Wang, Q. 2019 IEEE 3rd Information Technology, Networking, Electronic and Automation Control Conference (ITNEC)

[6] Woon Chul SHINa,*, Seung Ju CHOI a, Keun Oh LEEb, 2012"The prevention of the injuries through the mold design of the press machine in south of Korea

[7]. Cao H, Zhang X, Chen X (2017) The concept and progress of intelligent spindles: a review. Int J Mach Tools Manuf 112:21–52. https:// doi. org/ 10. 1016/j. ijmac htools. 2016. 10. 005

[8]. Chen J, Hu P, Zhou H, Yang J, Xie J, Jiang Y, Gao Z, Zhang C (2019) Toward intelligent machine tool. Engineering 5:679–690. https:// doi. org/ 10. 1016/j. eng. 2019. 07. 018

[9]. Siddhpura M, Paurobally R (2012) A review of chatter vibration research in turning. Int J Mach Tools Manuf 61:27–47. https://doi. org/ 10. 1016/j. ijmac htools. 2012. 05. 007

[10]. Zhou Y, Xue W (2018) Review of tool condition monitoring methods in milling processes. Int J Adv Manuf Technol 96:2509–2523. https:// doi. org/ 10. 1007/ s00170- 018- 1768-5

[11] Weller, E.J.; Scrier, H.M.; Weichbrodt, B. What Sound Can Be Expected from a Worn Tool? *ASME Pap.* **1969**, *91*, 525–534.

[12] McNulty, G.J.; Popplewell, N. Health Monitoring of Cutting Tools Through Noise Spectra. In Proceedings of the 1st Joint Polytechnic Symposium on Manufacturing Engineering, Leicester, UK, 12–16 July 1997.

[13] Lee, L.C. A study of noise emission for tool failure prediction. *Int. J. Mach. Tool Des. Res.* **1986**, *26*, 205–215.

[14] Ya, W.; Shiqiu, K.; Shuzi, Y.; Qilin, Z.; Shanxiang, X.; Yaozu, W. An Experimental Study of Cutting Noise Dynamics. *Mach. Dyn. Elem. Vib.* **1991**, *36*, 313–318.

[15] Dimla, D.; Lister, P. On-line metal cutting tool condition monitoring. *Int. J. Mach. Tools Manuf.* **2000**, *40*, 769–781.

[16] Huang, P.M.; Lee, C.H. Estimation of tool wear and surface roughness development using deep learning and sensors fusion. *Sensors* **2021**, *21*, 5338.

[17] Ferrando Chacón, J.L.; de Fernández Barrena, T.; García, A.; de Sáez Buruaga, M.; Badiola, X.; Vicente, J. A Novel Machine Learning-Based Methodology for Tool Wear Prediction Using Acoustic Emission Signals. *Sensors* **2021**, *21*, 59.

[18] Orellana, R.; Carvajal, R.; Escárate, P.; Agüero, J.C. On the uncertainty identification for linear dynamic systems using stochastic embedding approach with gaussian mixture models. *Sensors* **2021**, *21*, 3837.

[19]. Parlos, A.G.; Rais, O.T.; Atiya, A.F. Multi-step-ahead prediction using dynamic recurrent neural networks. *Neural Netw.* **2000**, *13*, 765–786.

[20] Li, X. A brief review: Acoustic emission method for tool wear monitoring during turning. *Int. J. Mach. Tools Manuf.* **2002**, *42*, 157–165.