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Conveyor Control System in Automatic Brick Making

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ABSTRACT

Brick is a building material that is still widely used by people today. Most of the small-scale brick-making industries print bricks in the traditional way. Of the problems encountered by adding a conveyor as a means of carrying soil that has been printed and then running through the conveyor to the brick makers to add security to the brick makers. The stages of the research were carried out by identifying the problem to produce data from the system to be made, then designing the concept for making the tool. In tool making, the most important components are conveyors, dc motors and PLCs as the main controls in running conveyors. This conveyor works to bring the dough quickly to the craftsmen so that the dough can be measured for the speed of time and the level of safety for the craftsmen. This research has succeeded in creating a "Conveyor Control System in Automatic Brick Making". Conveyor time testing in automatic brick making produces 2 seconds per minute when one brick is on the conveyor and in increasing safety for conveyor makers this can provide good security.

1. Introduction

Technological developments play an important role in various aspects of life, including in the field of automation technology which continues to experience rapid development. Ease for convenience continues to be carried out with various development innovations and new discoveries. New discoveries are based on a problem that occurs in the environment around us, giving rise to new ideas and innovations in solving the problem [1][2].

The problem faced by adding a conveyor as a means of conveying soil that has been printed then goes through the conveyor to the brick makers to add security to the brick makers. By developing a tool beforehand that takes bricks by hand in a mold that can be dangerous for craftsmen, so by making this conveyor, brick craftsmen can improve a better level of safety after the bricks have been printed [3]. The production of bricks by manual means yields an average of 3 bricks per minute with the use of an automatic brick carrier to increase brick production [4].

The design of the tool begins with identifying the background of the problem to produce the tool so that a design plan is obtained and then the method for making the tool can be obtained [5]. The working system of this tool design is in the form of an automatic brick carrier controlled by PLC and driven by a dc motor to move the conveyor. The tool will work if the limit switch detects the presence of mixed bricks running on the conveyor and then the PLC acts as a control to drive the dc motor which will rotate the conveyor belt [6]. The research stages that have been carried out resulted in a conveyor control system on an automatic brick making machine [7].

2. Research Method

The Pahl and Beitz method is a design method used in the manufacture of tools, this method consists of elaborating the task, determining the concept of the design that has been made, planning the shape of the tool and finally designing the details so that the original form or form is produced from the form that has been designed [8][9][10].

2.1. Tool Working Principle

The working principle of the tool is that the conveyor will run when there is a mixture of bricks that hits or is touched by a limit switch then after it is detected that there is dough, the dc motor will rotate according to the speed that has been set on the PLC and can be seen in Fig. 1 [11].

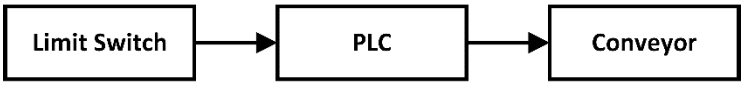

Fig. 1. Block diagram

2.2. Maintaining the Integrity of the Specifications

The design plan has several parts including the control panel on the PLC as a control, the conveyor will run according to the presence of soil detection which will be read by the limit switch can be seen in Fig. 2 [12]. The conveyor control system as a means of conveying dough that has been cut in the form of a frame design to support stones bricks that have been molded so that they can walk up to. The brick carrier design drawings can be seen in Fig. 3 with a length of 60 cm, a width of 15 cm and a height [13].

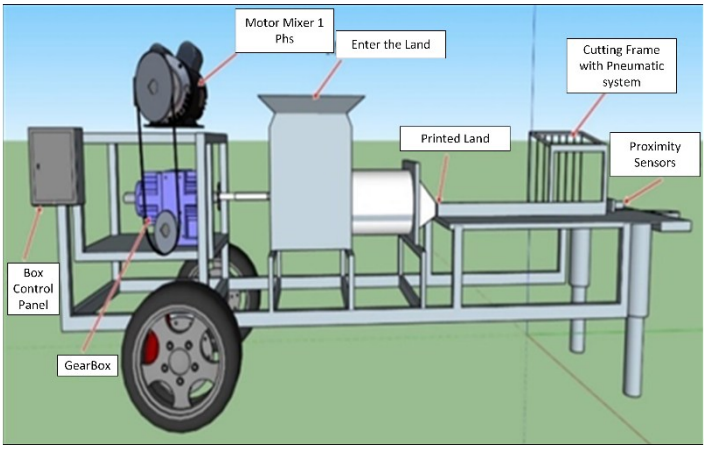

Fig. 2. Gabot tool design

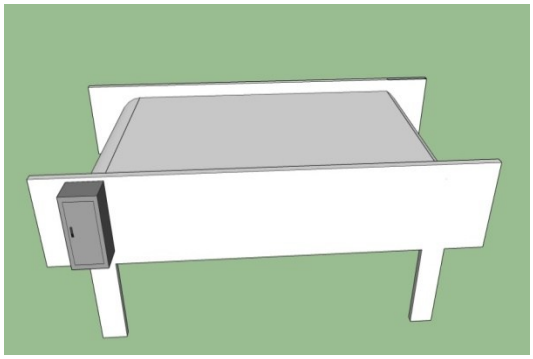

Fig. 3. Brick carrier design

2.3. Software Design

The state diagram in Fig. 4 is the work process of the conveyor control system on an automatic brick making machine where when the soil is finished being cut by the machine, the soil will move towards the conveyor and then the soil will touch the limit switch which will detect if an object is detected then the conveyor will run with a dc motor drive that has been programmed with a plc. The

process is carried out continuously until there is no more ground moving about or being detected by the limit switch, then the conveyor will stop [4]. You can see the working state diagram of the tool in Fig. 4.

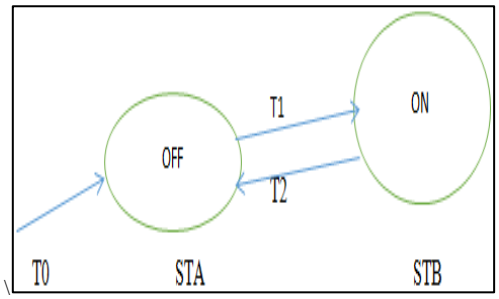

Fig. 4. State diagram of the tool

The working state diagram in Fig. 4 will provide work effectiveness of the system so that the conveyor control system will produce an effective time speed and not endanger the craftsmen when using the conveyor as a means of conveying the printed soil dough.

2.4. System Testing

The tool is tested against errors and functions properly. Testing is carried out after all the process of making the tool is done, the test is carried out in stages to look for errors or deficiencies in the work on the tool. First testing the mechanical components, then testing the control panel, sensors and programs working on the PLC. At the testing stage, the results will be obtained from cutting bricks automatically so that a comparison of the analysis of making bricks automatically and manually can be obtained to produce the final stages of the conclusion.

3. Results and Discussion

In this discussion, it will present the results of research testing tools and the results of a comparison of manual brick making with automatic brick making using a pneumatic system.

3.1. Brick Cutting Equipment Testing

The testing process is carried out by providing a voltage of 12 volts which is controlled through a PLC where the PLC as a control tool can function as the brain to run the conveyor, but when the PLC has been given voltage, the dough that moves after being cut will enter the conveyor then on the conveyor the dough that has been cut is detected by the limit. switch then when it is detected the dc motor will rotate to run the bricks to reach the craftsman, you can see in Fig. 5 the mechanical form of the brick carrier.

Fig. 5. The mechanical form of the brick carrier

The test results that have been carried out in Fig. 5 are the conveyor control system according to what has been expected, the limit switch works according to the program that has been given through the PLC. The respective values for the brick molding time and the carrying time using the conveyor have resulted and discussed in the analysis section of the conveyor control system.

3.2. Manual Print Making Test Results

Manual brick making is the process of making bricks in the traditional way and still uses simple equipment. The average manual method of making is done by three workers. Based on the observations made by the author in the village of Karangmangu, Kec. Purwojati, Kab. Banyumas obtained the results of making bricks manually as shown in Table 1 in one manual print run.

Table 1. Time in one manual print

No	Manufacture of the	Time in One Print (seconds)	Amount of One Print
1	1	42	2
2	2	40	2
3	3	43	2
4	4	40	2
5	5	45	2

Table 1 results of manual printing with the manufacture of five prints and the results obtained in 40 seconds to produce 2 bricks. The average from Table 1 can be obtained by printing bricks for one minute. The calculation of the average value of Thick 1 data produces a value of 42 seconds so that conclusions are obtained in printing bricks manually in one minute approximately 3 bricks. The shape resulting from the manual printing process can be seen in Fig. 6, 13 with a length of approximately 20 cm, a height of about 5 cm and a thickness of 7 cm.

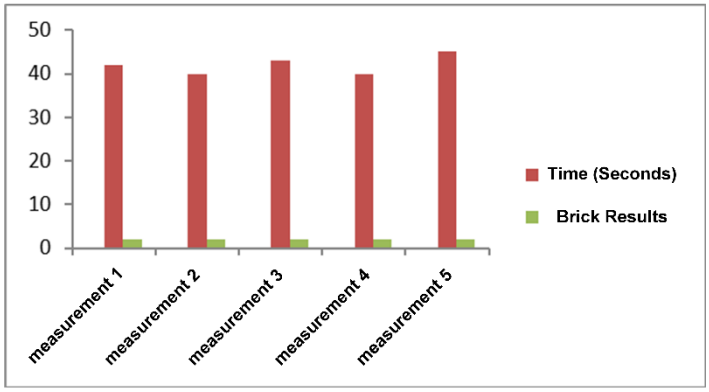

Fig. 6. Graph of manual production time

3.3. Auto Print Creation Test Results

Printing bricks is done with the help of a machine that is driven using an electric motor, this electric motor drives a screw mixer in a tube to then mix the soil. pneumatic automatic and produce bricks. The results obtained from the automatic printing process using a pneumatic system can be seen in Table 2.

Table 2. Time in one automatic cut

No	Manufacture of the	Time in One Print (seconds)	Amount of One Print
1	1	5	2
2	2	5	2
3	3	5	2
4	4	5	2
5	5	5	2

The average from Table 2 can be obtained by printing bricks for one minute. The calculation of the average value of Thick 2 data produces a value of 5 seconds so that it is concluded that in 1 minute printing bricks automatically with a pneumatic cutting system produces 24 bricks can be seen in Fig. 7.

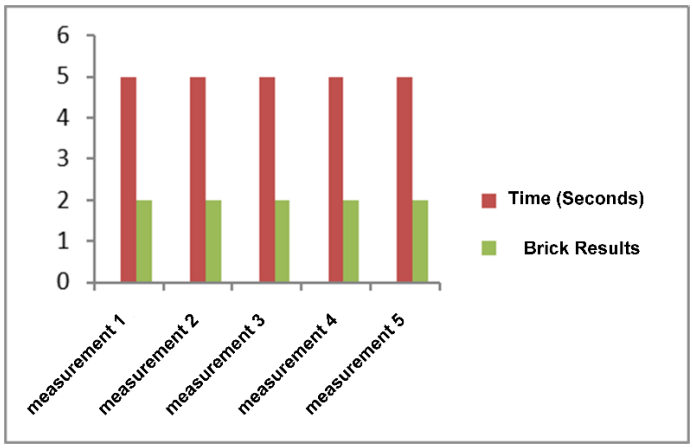

Fig. 7. Graph of automatic production time

3.4. Analysis Results Using Conveyors

In manual printing, the time needed is one minute, which is 42 seconds and in an automatic way, it takes 5 seconds when compared to the automatic method which is more effective than the manual method which can consume a lot of energy, then after seeing the comparison, the results of the time using the conveyor can be seen in the Table 3 is the time the bricks run on the conveyor.

Table 3. Bricks running time with conveyor

No	Measurement to	Travel Time (Seconds)
1	1	2
2	2	2
3	3	2
4.	4	2
5.	5	2

In Table 3 is the data from the results of taking 1 brick using a conveyor if in 2 seconds the stone runs on the conveyor then in one minute it can produce 60 bricks and it does not endanger the craftsman to take a brick in the mold which is at risk of being pinched by the cutter which is moved by pneumatic system.

3.5. Limit Switch Testing

The limit switch test when applied to a conveyor that works to detect the presence of bricks to run a conveyor with a dc motor drive controlled using a PLC can then be seen as in Table 4.

Table 4. Limit switch testing

No	Test	Situation	Information
1.	1	Pressed	Connected
2.	2	pressed	Connected
3.	3	Not Pressed	Disconnected
4.	4	Not Pressed	Disconnected

Table 4 can be seen that the limit switch will work to move the conveyor when the bricks move about the limit switch, the limit switch will connect the current to the dc motor to move the conveyor but if no bricks pass through the limit switch then the conveyor will be silent and the motor will not move.

4. Conclusion

The implementation of research activities entitled "Conveyor control system for brick making machines" has been completed, a brick carrier was produced as one of the innovations to increase security for brick craftsmen, the use of conveyors for brick making machines can result in delivery

processing time bricks to get to the craftsmen is faster and safer than picking them manually which can be dangerous for the craftsmen, the time obtained by using the conveyor is 2 seconds to get to the craftsmen. This tool can also reduce the burden on brick craftsmen and this tool can speed up brick production which will have an impact on maximum sales results.

References

[1] L. D. Xu, E. L. Xu and L. Li, "Industry 4.0: state of the art and future trends," *International journal of production research*, vol. 56, no. 8, pp. 2941-2962, 2018.

[2] F. Korthagen, "Inconvenient truths about teacher learning: Towards professional development 3.0," *Teachers and teaching*, vol. 23, no. 4, pp.387-405, 2017.

[3] F. Campuzano, R. C. Brown and J. D. Martínez, "Auger reactors for pyrolysis of biomass and wastes," *Renewable and Sustainable Energy Reviews*, vol. 102, pp. 372-409, 2019.

[4] N. Salnaia, Y. Gallet, A. Genevey and I. Antipov, "New archeointensity data from Novgorod (North-Western Russia) between c. 1100 and 1700 AD. Implications for the European intensity secular variation," *Physics of the Earth and Planetary Interiors*, vol. 269, pp. 18-28, 2017.

[5] D. Morrison *et al*., "Cartman: The Low-Cost Cartesian Manipulator that Won the Amazon Robotics Challenge," *2018 IEEE International Conference on Robotics and Automation (ICRA)*, Brisbane, QLD, Australia, 2018, pp. 7757-7764, doi: 10.1109/ICRA.2018.8463191.

[6] M. Conti, D. Donadel and F. Turrin, "A Survey on Industrial Control System Testbeds and Datasets for Security Research," in *IEEE Communications Surveys & Tutorials*, vol. 23, no. 4, pp. 2248-2294, Fourthquarter 2021, doi: 10.1109/COMST.2021.3094360.

[7] R. Saravanan, S. H. Jayanth, R. Vigneshwaran and V. Prakashraja, "Retrofitting of PLC in Fly Ash Brick Making Machine for Increased Productivity," *2021 International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA)*, Coimbatore, India, 2021, pp. 1-6, doi: 10.1109/ICAECA52838.2021.9675694.

[8] F. Ore, J. L. Jiménez Sánchez, M. Wiktorsson and L. Hanson, "Design method of human–industrial robot collaborative workstation with industrial application," *International Journal of Computer Integrated Manufacturing*, vol. 33, no. 9, pp. 911-924, 2020.

[9] F. Ore, L. Hansson and M. Wiktorsson, "Method for design of human-industrial robot collaboration workstations," *Procedia Manufacturing*, vol. 11, pp. 4-12, 2017.

[10] C. Renzi, F. Leali and L. Di Angelo, "A review on decision-making methods in engineering design for the automotive industry," *Journal of Engineering Design*, vol. 28, no. 2, pp. 118-143, 2017.

[11] B. Wiesmayr, L. Sonnleithner and A. Zoitl, "Structuring Distributed Control Applications for Adaptability," *2020 IEEE Conference on Industrial Cyberphysical Systems (ICPS)*, Tampere, Finland, 2020, pp. 236-241, doi: 10.1109/ICPS48405.2020.9274744.

[12] J. Lee, S. D. Noh, H. J. Kim and Y. S. Kang, "Implementation of cyber-physical production systems for quality prediction and operation control in metal casting," *Sensors*, vol. 18, no. 5, pp. 1428, 2018.

[13] J. Wan *et al*., "Reconfigurable Smart Factory for Drug Packing in Healthcare Industry 4.0," in *IEEE Transactions on Industrial Informatics*, vol. 15, no. 1, pp. 507-516, Jan. 2019, doi: 10.1109/TII.2018.2843811.

[14] M. M. Mohamed and J. Gu, "PLC controller for hydraulic pressing machine," *The 27th Chinese Control and Decision Conference (2015 CCDC)*, Qingdao, China, 2015, pp. 564-568, doi: 10.1109/CCDC.2015.7161755.