ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

SMART CONTROLLER FOR SORTING DIFFERENT PRODUCTS

Arjun Shah*
Department of Mechatronics, Ganpat University, India

ABSTRACT

In this digital age that we are living in, it has become mandatory for the manufacturing procedures to be fully automated. Nowadays, it has become a tedious job for a manufacturing unit to sort and rack their different products. To minimize the error and reduce human labour cost, it is essential that a smart machine performs all the required work for sorting. This paper summarises the development of a Smart Controller For Sorting Different Products within a dynamic knowledge environment. The controller developed, consists of control hardware and software communicating over a Programmable Logic Controller (PLC).

KEYWORDS: Programmable Logic Controller, Smart Controller, Automation

INTRODUCTION

This product is used for sorting various products of a manufacturing unit depending upon different parameters. The main principle used in this system is digital image processing and all the required backend coding is done in Matlab.

A Programmable Logic Controller is the heart of this system developed. The sensors are connected to this PLC, which in turn is connected to the output devices i.e. motors of our system. This controller is capable of sorting any colour coded product with the help of image processing technique. In this system, sensors like Inductive proximity sensor and Capacitive proximity sensor are used. A camera is used along with the sensors and connected to the PLC for image processing to recognize color code on the product.

The proximity sensors at the input line will start the system. When the product reaches the rotating table, a camera above it, captures its image and sends it to the controller. Based on a pre-entered logical program in Matlab, the controller recognizes the colour code and rotates the table accordingly, after which it is sent to its respective output line.

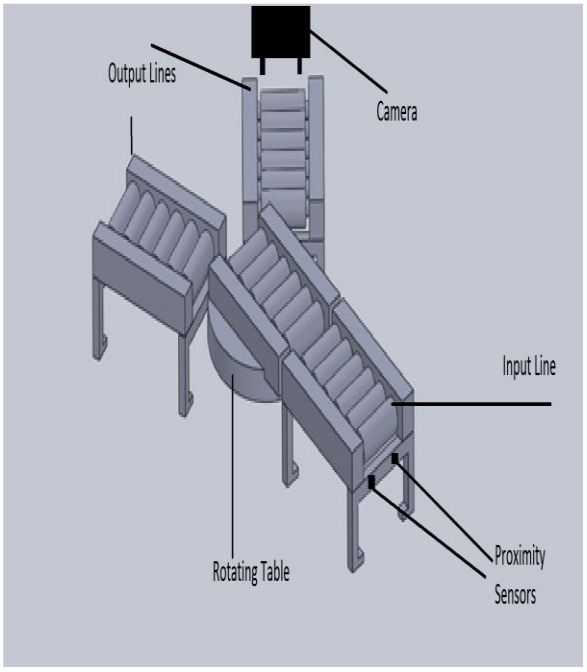

Figure 1. Basic Layout

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

TECHNICAL SPECIFICATIONS

Devices used

- **PLC:**

A PLC is the brain of this system. All the I/O devices such as sensors, motors, motor drives and the camera are connected to the PLC. The PLC is programmed to perform certain output tasks such as turning the power on/off for the motor drives, based on the input status of the sensors. The program is loaded into the PLC through a software provided alongwith the PLC.

- **Inductive/Capacitive Sensors:**

These sensors are of normally open (NO) type, which means there is no output when the product is not in the proximity of the sensor. A capacitive proximity sensor senses any object in this area of range, whereas the inductive proximity sensor only senses metallic objects in its area of range.

- **Motor Drives:**

A PLC works with extremely minimal currents so as to protect its internal circuitry. These currents are highly insufficient to run motors having power of 0.5 HP. Hence, motor drives are required, which step up the voltage and current to make it sufficient to run the motors.

- **AC Motors:**

These motors, having 0.5 HP power, will rotate the conveyor belt, which in turn, will carry the product to its respective line.

- **AC Stepper Motor:**

The stepper motor is mounted below the turn table. It has 4 steps, meaning it will rotate 1 step every time it operates. 1 step is equivalent to 360°/4 = 90°. The rotation angle can be increased or decreased based on the steps provided in the motor. The number of steps required is decided by the number of output lines a manufacturer wants. It also has the advantage of rotating in both, clockwise and anti-clockwise directions.

- **Laptop/Desktop:**

A system running the MATLab software is required. It should be connected to the camera and the PLC. If any changes in the procedure are to be made, one can easily apply it by making the necessary changes in the PLC program and changing the hard wired connections.

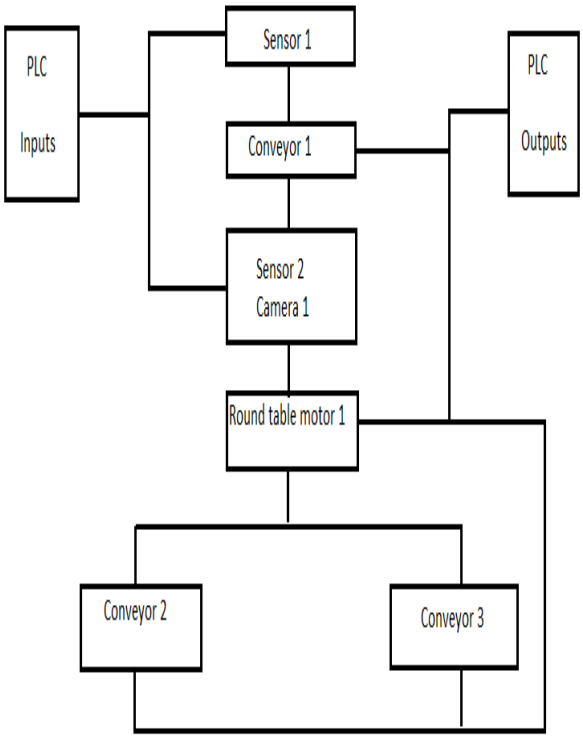

Figure 2. Block Diagram of connections

PROCESS FLOWCHART

Step-by-step execution of the sorting system takes place as follows(see Figure 3. for reference):

- When product is sensed by sensor 1, the conveyor rotates for 3 seconds (the time is calculated beforehand, based on motor speed and length of conveyor belt), after which product will reach the round table and conveyor 1 will stop its motion.
- As soon as sensor 2 senses the product, it triggers the camera to capture an image. This image is sent to the system that runs the MATLab software.
- By the use of the pre-entered program, the software scans the image and recognizes the colour printed on the product. Number of different colours required, is determined by the number of different products. Each different colour is assigned an output line.
- As soon as the colour is recognized, respective step rotations are provided to the stepper motor to align the turn table with the designated output line.

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

- When the product reaches the designated output line, the final conveyor carries it to its respective storage department.

LIMITATIONS OF THIS SYSTEM

- While testing, I found that if black colour is printed on a white background, the camera recognizes white instead of black.
- There is no provision for automatic storage and retrieval of the products. Generally in most industries, there are machines that provide the facility of storing and retrieving the products as and when required.
- The turn table and the output line conveyors should be in perfect alignment after the stepper motor completes its rotation steps. In case the alignment is not precise, the conveyors will not join and the product will either fall off and get damaged, or not get transmitted to its output line.
- My system is not generic; it was designed for a specific weight range. For different weight of product, the motor capacity and the conveyor specifications have to be changed accordingly, based on weight calculations.

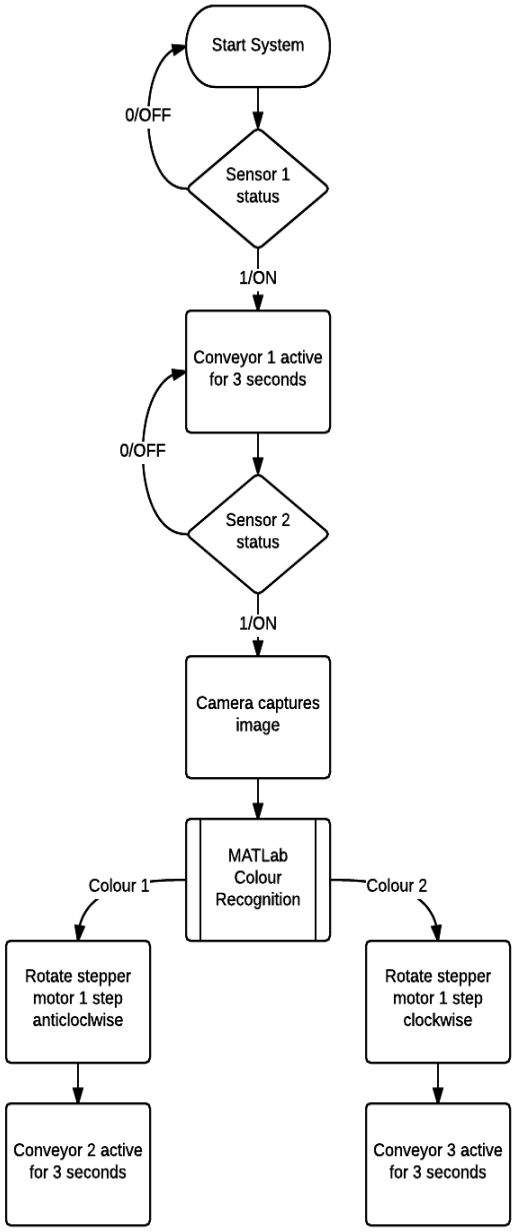

Figure 3. Process Flowchart

CONCLUSION

All in all, this sorting system can be used where there is a heavy traffic of different products, such as manufacturing plants, supermarkets etc. With increase in manual labour, there is always an increase in errors. So, for precision and for saving time, such a sorting system is highly effective.

FUTURE INSIGHTS

A good way to put this system to use in the future would be to construct a humanoid robot with the

colour code sorting system to store items on the aisle shelves in a supermarket. For the eyes of the robot, a camera can be used. By providing an obstacle detection program to it, this system can be made completely safe. As the shelves of the supermarket get emptied, this robot can restock the shelves so that there is no need for manual labour at all. This system may prove highly efficient, time-saving and without any errors.

ACKNOWLEDGEMENTS

I duly thank my professors at Ganpat University who have guided me, directly or indirectly, for the completion of my project. I would specially like to thank Prof. N. J. Thakkar, who was my project guide and who helped me thoroughly to understand this entire system. At last, I would like to thank my parents and my family, who have continuously supported me throughout my life. I am indebted to them

REFERENCES

[1] H.C. Garcia, J.R. Villalobos, G.C. Runger, Anautomated feature selection method for visual inspection systems. IEEE Trans. Autom. Sci. Eng. 3(4), 394–406 (2006)

[2] S.M. Bhandarkar, X. Luo, R.F. Daniels, E.W. Tollner, Automated planning and optimization of lumber production using machine vision and computed tomography. IEEE Trans. Autom. Sci. Eng. 5(4), 677–695 (2008)

[3] N.M. Kwok, Q.P. Ha, D. Liu, G. Fang, Contrast enhancement and intensity preservation for gray-level images using multiobjective particle swarm optimization. IEEE Trans. Autom. Sci. Eng. 6(1), 145–155 (2009)

[4] H.Y.T. Ngan, G.K.H. Pang, Regularity analysis for patterned texture inspection. IEEE Trans. Autom. Sci. Eng. 6(1), 131–144 (2009)

[5] Y. Cheng, M.A. Jafari, Vision-based online process control in manufacturing applications. IEEE Trans. Autom. Sci. Eng. 5(1), 140–153 (2008)

[6] W. Qi, F. Li, L. Zhenzhong, Review on camera calibration IEEE, in Chinese Control and Decesion Conference, 2010, pp 3354–3358

[7] X. Jiang, C. Cheng, S. Wachenfeld, K. Rothaus, in Motion Deblurring Seminar: Image Processing and Pattern Recognition, Winter Semester 2004 / 2005

[8] A. Rosenfeld, A.C. Kak, Digital Image Processing, (Academic Press, New York, 1982), cap 11 20. S.D. Kim, J.H. Lee, J.K. Kim, A new chain-coding algorithm for binary images using run-length codes. CVGIP 41, 114–128 (1988)

[9] S. Biswas, C. Koley, B. Chatterjee, S. Chakravorty, A methodology for identification and localization of partial discharge sources using optical sensors, IEEE Trans. Dielectr. Electr. Insulation 19(1), 18–28 (2012)

[10] B. Jarimopas, N. Jaisin, An experimental machine vision system for sorting sweet tamarind. J. Food Eng. 89(3), 291–297 (2008)

[11] Y. Zhao, D. Wang, D. Qian, Machine vision based image analysis, in Second International Conference on Intelligent Computation Technology and Automation, 2009, pp 629–632

[12] D.J. Lee, J.K. Archibald, G. Xiong, Rapid color grading using direct color mapping, IEEE Trans. Autom. Sci. Eng. 8(2), 292–302 (2011)

[13] Z. Varghese, C.T.Morrow, P.H. Heinemann, H.J. Sommer, Y. Tao, R.W. Crassweller, Automated color computer vision, Am. Soc. Agric. Eng. 16, 1682–1689 (1991)

[14] Y. Gejima, H. Zhang, M. Nagata, Judgement L*a*b color image processing, in Proceedings 2003 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2003), 2003

[15] B.K. Miller, M.J. Delwiche, A color vision system for recognition. Trans. ASAE 32(4), 1484–1490 (1989)

[16] Y. Tao, P.H. Heinemann, Z. Varghese, C.T. Morrow, H.J. Sommer, Machine vision for color inspection. Trans. ASAE 38(5), 1555–1561 (1995)

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

AUTHOR BIBLIOGRAPHY

	**Mr. Arjun Shah** He is a 21 year old mechatronics engineer, passed out in June 2015 from Ganpat University, Mehsana, Gujarat. He also has work experience of 6 months in the form of internships and training in various reputed companies.