Sorting Device Coding Print Quality Machine on Packing Box Prototype Utilizing Optical Character Recognition

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Abstract. The design of a system that can recognize the characters printed by the coding machine so that it can then determine the assessment of very good and bad prints, is the goal of this research. This system is useful as an indicator of a problem with the coding machine which is indicated by the number of products rejected by the system. In addition, this system is an effort to reduce printing errors so that they are sorted and do not pass to the market, thus causing misinformation to the public. This system is in the form of a moving conveyor table that has a firing area box and a reject rod as a product separator. The OCR method is programmed in a computer that is part of the system, to be able to recognize the characters printed by this coding machine. USB to TTL which functions as serial communication from the Laptop to the Microcontroller, is a complement to this tool. Testing as many as 60 times on 12 types of characters, this system has been carried out on this tool. There are six types of good characters and six types of bad characters, which have been provided. Of the 60 tests, the results were four failed tests. That is, the percentage of success of this tool is 93.33%, and the percentage of error is 6.66%.

1. Introduction
The importance of world events cannot be overstated. One of these is in the industrial sector, where presses have expiry dates on their goods. As previously stated, a coding machine is a machine that prints the expiration date on a product. The shelf life of a food product is the date by which it is safe to consume. In addition to the expiration date, the printer can print production machine codes, production codes, and so on. In terms of print history, the stamp is the forerunner of the printing machine. The stamp serves as an expiration date imprinter, which the operator applies directly on the goods.

This Coding machine still has issues in article printing, such as the loss of some writing or the presence of white lines that cover the printed result. Problems like this are harmful to business actors since printed text, particularly writing printed on cardboard media, cannot be rectified. Furthermore, if print errors or poor printouts are circulated on the market, it is expected that consumers would misinterpret information, resulting in losses. In relation to these issues, the idea of developing a system that can recognize characters to choose prints from the coding machine is one alternative. This system is programmed to operate automatically. This is due to the fact that there are several automation system applications in the industry, such as material handling [1], sorting systems [2], and several others application.

Digital image processing is employed in a variety of applications, including leaf categorization [3], obstacle identification [4], pavement damage detection [5] and other applications. The problem with encoding engines must encode digital images using optical character recognition (OCR) technology, which recognizes letters and numbers. Identification of letters or numbers from an image can be done by the Optical Character Recognition system [6] [7]. The results of image identification consisting of
text and background are translated by the OCR method into text or numbers [8] for further processing. Syahri Muharom [9] has recognized room numbers in a building as letters and numbers. The technique used to capture the room number, the researcher uses a video camera (recording) and or a photo camera (pictures/photos). The OCR (Optical Characters Recognition) and Template Matching methods are the room number character recognition methods. The benefit of this research is to make it easier to recognize the room number in a building by using a camera. The camera can detect the room number which is the number and number used by default. The image that has been taken by the camera is converted into ASCII (American Standard Code for Information Interchange) form. Exposure a luminance of 224-230 and shooting angle of 90° are absolute requirements in this capture/shot.

2. Coding Machine
A coding machine is a printing device that prints on product packaging a production code, an expiration date, or indeed the company name. A printing device that can print directly on the product packaging has been used to print the expiry date and manufacture code. This press is ideal for printing high-volume cardboard boxes at fast speeds. In coding systems, there are numerous forms of variants. Coding machines typically print on plastic, paper, bags, and cardboard, among other materials. The first is a thermal inkjet printer press, which works with cartridges and may not require any maintenance. Thermal inkjet printer cartridges consist of two parts: Solu inkjet cartridges for polymeric products and water-based cartridges for cardboard products. A continuous inkjet printer, on the other hand, is a printing machine that employs an inkjet printer to perpetually discharge ink to jet ink with excellent precision and speed. This type is compatible with high operations. Ink options for continuous inkjet presses include Solu ink for plastic paper and water-based ink for cardboard paper.

![Figure 1. Coding Machine](10)

3. Optical Character Recognition (OCR)
Optical Character Recognition (OCR) is a mechanism of converting characters in an image into characters that a machine or computer would recognize. OCR is a tool that recognizes letters and numbers in images before converting information to files for storage. The difficulty of optical character recognition is solved by OCR. Using online character recognition, characters are directly manipulated during capture. Offline character recognition works by digitizing a document, saving it on the computer, and then processing it. Users may also use OCR and handwriting recognition both online and offline. [11]. An autonomous character recognition system is used in this research. The subject of OCR is a subgroup of artificial intelligence and computer vision. OCR systems can improve computer intelligence's versatility and capabilities. This character recognition technology has the potential to assist in the digitalization of data and information.
4. Method

4.1. Mechanical Design
A conveyor table is the mechanical architecture of a character recognition system for selecting print results from an encoding machine using the OCR (Optical Character Recognition) method. Nylon polyethylene is used to mount the DC motor. As with cardboard, there are also deflecting knives and product dividers. A 3mm thick, 100cm long, 32cm wide, and 9cm high square iron frame supports this conveyor table. Use 5mm thick plywood which is 88cm long and 32cm wide for the conveyor table’s base. This system's camera body is built of 5mm thick plywood that is 35.5cm long, 34cm wide, and 21cm high, while the conveyor belt is made of dark gray Oscarveron fabric. There is also a power supply, an atmega 16 system, and a relay module integrated within a 3mm thick acrylic electrical box.

![Figure 2. Mechanic design side view](image1)

![Figure 3. Realization side view](image2)

This conveyor table is made up of three components. The first component indicates where the object will be placed. The second section is the image capture section, in which the product pauses to take a photograph. The third segment is an optional section with a deflection bar that distinguishes between items with correct machine printing and products with inaccurate machine printing.

![Figure 4. Mechanic design top view](image3)

![Figure 5. Realization top view](image4)

Figures 2, 3, 4 and 5, depict that the E18D80NK proximity sensor is used in a sensor, camera, and cutting blade. The E18D80NK sensor detects the existence of a product; it detects the product before it enters the capture area or camera. This Logitech C270 webcam functions similarly to capturing image. The generated image is further processed by the computer in order for the encoding machine to recognize the printed characters. The reflector is made up of a servomotor and a sorting shaft.

4.2. Electrical circuit design
This classifier's operation is depicted in Flowchart 6. First, when the proximity sensor detects a passing product, the microcontroller instructs the relay to turn off, halting the DC motor for a brief duration to allow the camera to capture an image. OCR is used on a computer to process captured photos. The conveyor is resumed when the system has analyzed the output of the coding machine. The outcomes of the system analysis are used to inspect the rejector blades, and if the printout is accurate,
the product is shipped. If the printout is inaccurate or does not match the reference, the printout will be moved to another incompatible product by the ejector blade.

4.3. Character Recognition Design
Expiration dates and production codes are used to demonstrate how the press capacity selection mechanism works. The initial stage is to collect criteria for creating an OCR (Optical Character Recognition) print selection system for a printing machine. The content entered contains reference data such as the quotation expiry date and production code. Whether or not the encoder output matches, this input character is important for reference data. If they do not match, you can deduce that this press's printing output are erroneous or malfunctioning.

The product is a corrugated cardboard box with HVS paper attached, the expiration date is written, and the manufacturing code is placed on the conveyor table using a coding machine. When the box moves and passes the proximity sensor, the sensor alerts the microcontroller that the product is in the camera box or capture area, causing the conveyor to stop.

The camera image is in real time and in grayscale. The system starts the OCR procedure when the color detecting region is covered with a white base color product. When OCR has finished reading the characters and the reference data has been chosen, the system begins the matching procedure. The product is declared defective if the OCR result differs from the reference character and reads 5 times.
The servo motor's reflector is adjusted using character recognition. When the computer identifies the OCR reading based on the reference data, it sends a signal to the microcontroller, instructing it to transport the product. If the OCR reading does not match the reference data, the computer tells the microcontroller to turn off the product. The servo deflector is rotated 45 degrees by the microcontroller.

5. Result and Discussion

5.1. Servo Motor Angle Calibration
The intention of this servo motor test is to assess the servo motor's performance as a rejector drive by using the Tower Pro MG995R servo motor to categorize good and defective products with machine-coded printing. This servo motor has three wires: VCC (red wire), signal (orange wire), and GND (brown wire). Adjusting the servo eye movement delay to the desired degree is used to test servo motors. Servo motors are tested from 0 to 200 degrees.

![Servo Motor Measured Angle](image)

**Figure 8.** Servo motor angle after calibrated

The servo motor test is depicted in Figure 8. The servo motor has an operating temperature range of 0 to 200 degrees. When tested at temperatures above 200 degrees, the servomotor does not move or react. When the system identifies the product as the desired power, the servo motor comes to a complete halt at 0 degrees. When the system detects an erroneous print, the servo motor adjusts or rotates 45 degrees. When the servo is in standby mode, the microcontroller sends a pulse signal with a duration of 2.1 ms and a low value of 17.9 ms. In the meantime, if the servo motor rejects it, the microcontroller transmits a 2.6ms high and a 17.4ms low pulse.

5.2. Character detection with different light illumination
The goal of the multi-light test is to assess the system's character readings. As the setting, the best lighting that produces the greatest results is employed. This test is carried out by placing an object in front of the camera at a distance of 9 cm under illumination of 10 lux, 150 lux, or 300 lux and assessing the character placement in various positions. The test with 300 lux light produced the greatest results, while the one with 10 lux light produced the worst.
5.3. **Overall system testing**

The purpose of this test is to determine the overall success of the system. The labeled packaging box is placed on the coding machine for this test. The characters will then be detected by an OCR program installed on the computer. When the system identifies an error, the conveyor moves and the reject procedure is initiated. If, on the other hand, the system recognizes a character as predicted, the product is shipped. This test was performed 60 times on 12 different samples.

6. **Conclusion**

Based on the results of the tests and analyses, it is possible to conclude that this system can determine the quality of the printing output of the press with a 93.3 percent success rate. These findings came from 60 tests on 12 samples. Some inaccuracies are caused by the similarity of various characters, one of which being the number 0 and the letter "o."
7. References

[1] Prabowo YA, Imaduddin RI, Pambudi WS, Firmansyah RA, Fahruzi A. Identification of automatic guided vehicle (agv) based on magnetic guided sensor for industrial material transfer. IOP Conf Ser Mater Sci Eng 2021;1010:012028. https://doi.org/10.1088/1757-899X/1010/1/012028.

[2] Suheta T, Firmansyah RA, Raharjo BP, Muhamad S. PEMBUATAN ALAT PENYORTIR TERUNG OTOMATIS BERDASARKAN UKURAN BAGI PRODUSEN BAHAN BAKU TERUNG KERING DI KELURAHAN SUKOLILO BARU BULAK SURABAYA. Pros Semin Nas Sains Dan Teknol Terap 2018;0:321–6.

[3] Liantoni F, Perwira RI, Muhamad S, Firmansyah RA, Fahruzi A. Leaf classification with improved image feature based on the seven moment invariant. J Phys Conf Ser 2019;1175:012034. https://doi.org/10.1088/1742-6596/1175/1/012034.

[4] Firmansyah RA, Alfianto E. PEMBUATAN HAAR-CASCADE DAN LOCAL BINARY PATTERN SEBAGAI SISTEM Pendeteksi Halangan pada Automatic Guided Vehicle. Simetris J Tek Mesin Elektro Dan Ilmu Komput 2018;9:1073–82. https://doi.org/10.24176/simet.v9i2.2562.

[5] Sulistyowati R, Suryowinoto A, Sujono HA, Iswahyudi I. Monitoring of road damage detection systems using image processing methods and Google Map. IOP Conf Ser Mater Sci Eng 2021;1010:012017. https://doi.org/10.1088/1757-899X/1010/1/012017.

[6] Shah P, Karamchandani S, Nadkar T, Gulechha N, Koli K, Lad K. OCR-based chassis-number recognition using artificial neural networks. 2009 IEEE Int. Conf. Veh. Electron. Saf. ICVES, 2009, p. 31–4. https://doi.org/10.1109/ICVES.2009.5400240.

[7] Memon J, Sami M, Khan RA, Uddin M. Handwritten Optical Character Recognition (OCR): A Comprehensive Systematic Literature Review (SLR). IEEE Access 2020;8:142642–68. https://doi.org/10.1109/ACCESS.2020.3012542.

[8] Bharath V, Rani NS. A font style classification system for English OCR. 2017 Int. Conf. Intell. Comput. Control I2C2, 2017, p. 1–5. https://doi.org/10.1109/I2C2.2017.8321962.

[9] Muhamad S, Masfufiah I, Purwanto D, Mardiyanto R, Prasetyo B, Asnawi S. Room Searching Robot Based on Door Detection and Room Number Recognition for Automatic Target Shooter Robot Application. In: Triwiyanto, Nugroho HA, Rizal A, Caesarendra W, editors. Proc. 1st Int. Conf. Electron. Biomed. Eng. Health Inform., Singapore: Springer; 2021, p. 43–54. https://doi.org/10.1007/978-981-33-6926-9_4.

[10] Mesin Expired Date | Mesin Coding Terbaik Brand No #1 n.d. https://ramesia.com/mesin-expired-date/ (accessed June 17, 2021).

[11] Kakani BV, Gandhi D, Jani S. Improved OCR based automatic vehicle number plate recognition using features trained neural network. 2017 8th Int. Conf. Comput. Commun. Netw. Technol. ICCCNT, 2017, p. 1–6. https://doi.org/10.1109/ICCCNT.2017.8203916.