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Design of a sorting device with a barcode system based on Arduino Uno

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ABSTRACT

The development of technology in the industrial sector has experienced very rapid and advanced development at this time. In the production process in the industry, especially the sorting process, optimization is needed both from the performance and the results of the performance so that high work efficiency and maximum results can be obtained. So a goods sorting tool with a barcode system is needed as a tool that can sort goods automatically which is equipped with a barcode system to obtain information about the goods to be sorted so that it can make it easier for users to arrange goods according to what is desired. This goods sorting tool is equipped with a conveyor to move goods to the sorting place. This goods sorting tool method uses a barcode sensor that functions to detect the qr code on the goods, a weight sensor (loadcell) that functions to measure the weight of the goods, and an infrared sensor to detect the presence or absence of goods on the distribution line. After testing and analyzing the goods sorting tool with an Arduino Uno-based barcode system on the goods sorting system, the conclusion is that the goods sorting tool works well and the results achieved are in accordance with the function and work of the tool.

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1. INTRODUCTION

Nowadays, technology has advanced rapidly in both industrial and non-industrial sectors. Companies are beginning to replace conventional tools and machines with modern ones equipped with automated control systems [1]-[3]. This continuous technological innovation has resulted in various new discoveries that significantly support daily activities, both in industrial and non-industrial sectors. In the production process, particularly during the sorting stage, performance optimization is required to ensure more efficient processes and maximize results [4]-[6].

Sorting of goods is widely practiced in the industrial world. Sorting can be done by grouping goods by type, color, weight, or shape. Sorting can be done manually using human labor, using a barcode system, or automated using machines [7]-[10]. In some industries, the sorting process still relies heavily on manual tools and machines. However, because humans have limitations, such as limited energy capacity, this can affect the speed and accuracy of grouping goods, making the process less reliable. Therefore, an automatic sorting system is needed that is able to work without human intervention to increase efficiency and accuracy in the process of sorting goods in industrial environments..

A barcode system is a system in the form of a series of lines or bars that store information that can be read by a machine [11]-[15]. This information contains the type of goods, the purpose of the goods, payment for goods, etc. Goods barcodes are widely used in the retail, manufacturing, and logistics industries to track products, manage inventory, and speed up the transaction process. In this goods sorting system, the barcode system can provide information related to the goods scanned by the barcode scanner, making it easier to sort goods.

2. METHOD

The method used in this study is research and development. The research phase includes a literature review related to the technology and components used in this tool. The literature review conducted includes an analysis of item weight measurements in calculating the amount of goods and barcode sensors as QR code readers on goods. By utilizing data and information from the literature study conducted, various theories emerged that can be tested for validity and applied in this research. The development phase in this research includes planning and managing research to demonstrate the results obtained. The development process consists of three phases, namely system planning, system assembly, and system testing. System planning includes software, hardware, and mechanical development. In software design, block diagrams and flowcharts are created to map the workflow of the tool.

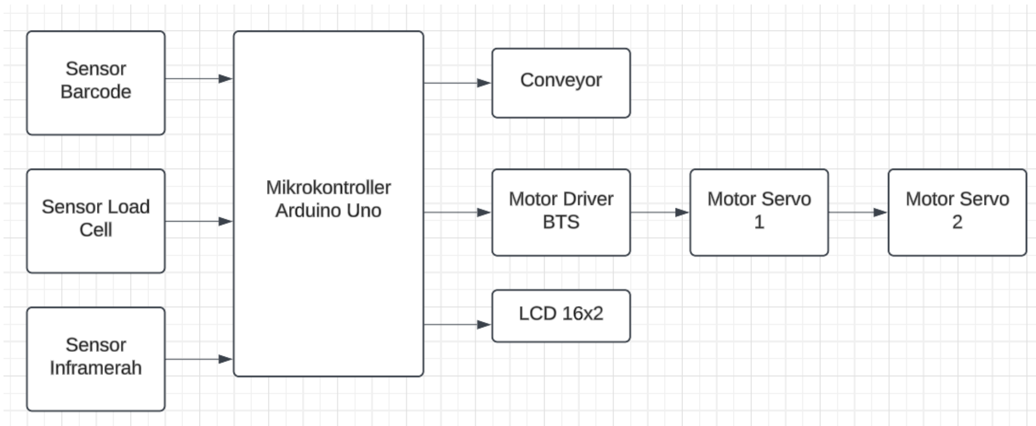

Figure 1. Diagram block of proposed sorting machine

Figure 1 shows the design of a sorting system using an Arduino-based barcode sensor to detect and calculate the weight of items, which is directly connected to an Arduino microcontroller. The weight sensor works by automatically measuring the weight of an item on the scale when it reaches a certain weight. A small metal weight sensor located below the scale is used to measure its weight. Once the item is within the scale, it pushes the scale downwards, allowing the weight to be calculated by the weight sensor below. In addition to the weight sensor, this device also uses a barcode sensor and an infrared sensor. The barcode sensor detects the QR code on the item, and the infrared sensor detects the presence of items on the conveyor belt. Data collected from these three sensors is sent to the microcontroller as a processing component, and then forwarded to the output component. The data received by the system forms the basis for the sorting device.

The image above also shows a conveyor that functions as a material mover. This conveyor moves items from one location to another, distributing them from the initial location to the weighing area. The data contained in the weight sensor is the weight of the item in grams, and the barcode sensor contains information related to the item. The status of the situation can also be seen in real time on the device's 16x2 LCD, which displays the item weight data and QR code information in text form. Once the items have been weighed, they are sorted using a servo motor based on their weight. The entire system has a well-structured workflow, starting with detecting the QR code on the item, measuring the weight of the item scanned by the barcode sensor, sending the data to the microcontroller, sorting the items with a servo motor after being weighed by the weight sensor, and finally displaying the results on the 16x2 LCD. The system workflow is structured and presented in Figure 2.

Figure 2 explains the working principle of this tool, namely to detect the type of goods and measure the weight of an item to see what type and weight of goods pass through this goods sorting system. This tool is equipped with a barcode sensor and also a weight sensor (Load Cell). The function of this tool is always active and will detect the type of goods if detected by the barcode sensor. When the barcode sensor detects the barcode on the goods passing, the type of goods will appear on the LCD screen. If the barcode sensor does not detect the barcode on the goods, the goods will appear unrecognized / the type of goods does not exist on the LCD screen and then the entire goods sorting system will stop. Then when the goods are detected by the infrared sensor, the conveyor continues to run to send the goods to the goods weighing, if not, the conveyor will not run. When the weight sensor (Load Cell) measures goods weighing below 80gr, the servo motor will move and move the goods to the upper box, while if the weight sensor measures the weight of the goods above 80 gr, the servo motor will move and move the goods to the lower box. If the weight sensor does not detect the weight of the goods, the system will stop. Then after the goods have been detected by the weight sensor and barcode sensor, the system will display all data related to the goods on the LCD display screen.

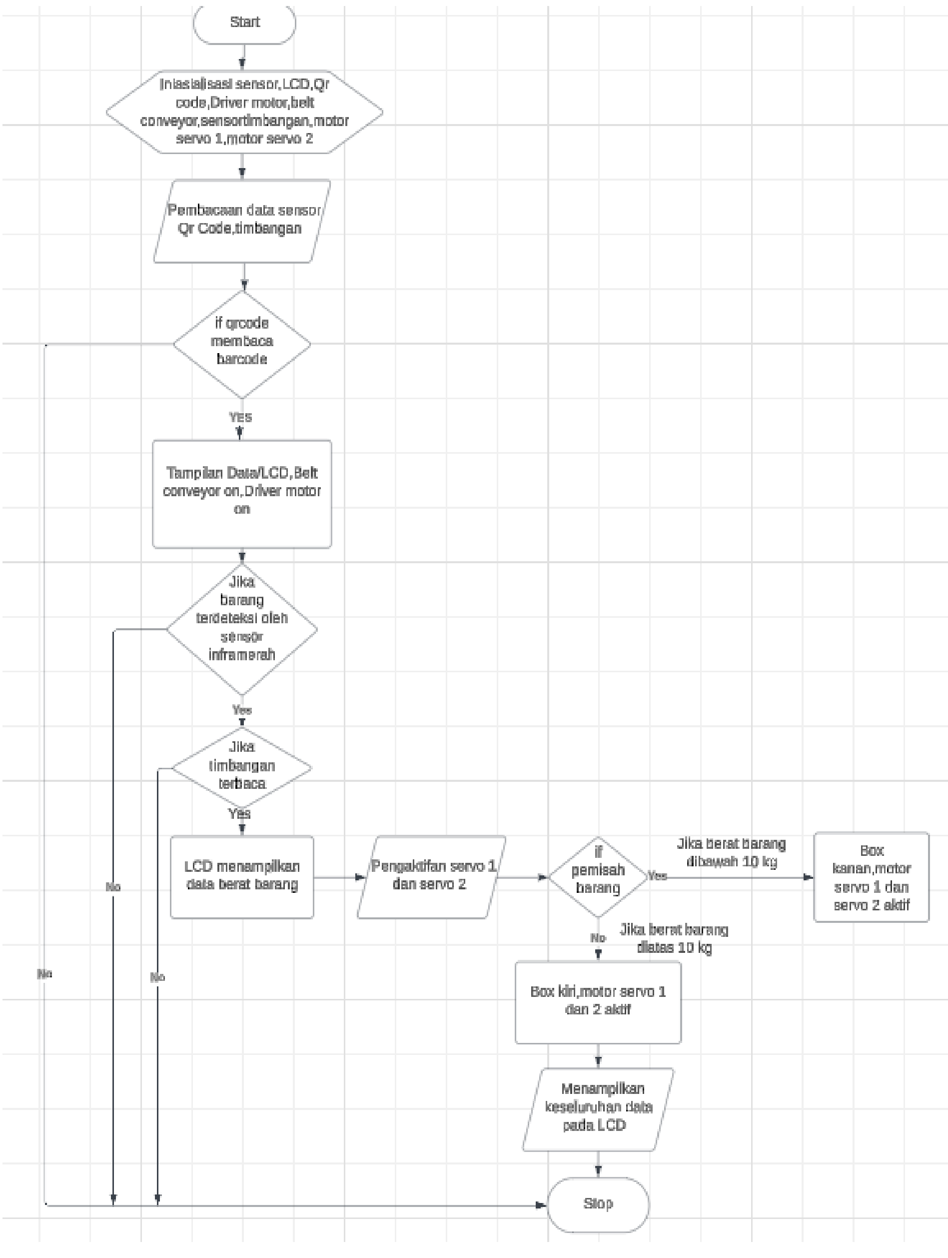

Figure 2. Flowchart of proposed system

Figure 3 shows the overall system circuit used. This circuit includes all the components used, which are visible during system operation. Figure 3 shows that the device's voltage source comes from an AC power supply to drive the conveyor. Furthermore, this device uses three sensors: a barcode sensor, an infrared sensor, and a weight sensor. All data collected by these sensors is sent to the Arduino microcontroller and then displayed on the LCD screen.

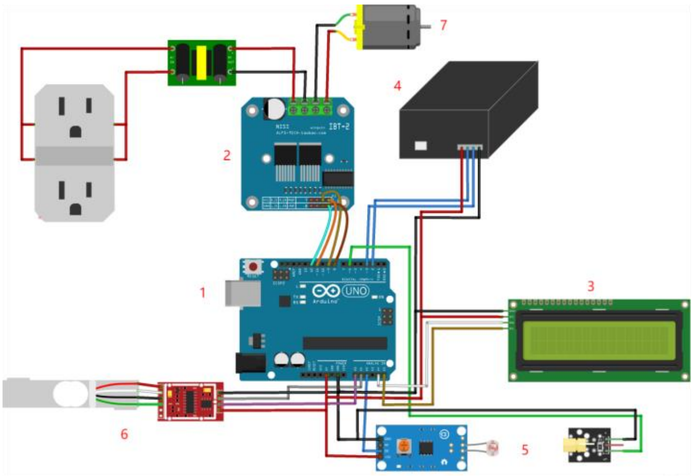

Figure 3. Circuit scheme of proposed system

3. RESULTS AND DISCUSSION

This research was conducted through several experiments, including barcode sensor testing, weight sensor testing, infrared sensor testing, and overall system testing. The purpose of testing the barcode sensor was to ensure its proper operation. The programming of this barcode sensor was designed to detect or scan QR codes on items, allowing for the identification of item information during the implementation and execution of this final assignment.

Table 1Barcode sensor testing

No	Barcode Types	Barcode Code	Experiment 1	Experiment 2	Results
1	Box	Farid 1234	Farid 1234	Farid 1234	In accordance
2	8 Bars	96385074	96385074	96385074	In accordance

Based on table 1 above, this test is carried out by placing an item that has a QR code under the barcode sensor. It can be seen that if the QR code on the item is detected, the information contained in the QR code will appear. From the barcode sensor test above, we can see that the barcode sensor can function properly. This barcode sensor can display data or the type of item contained in the QR code. This barcode sensor can scan 2 types of QR codes, namely the box type and 8 bars. This can make it easier for users to find out the type of item they want to weigh without opening the packaging of the item.

The overall system testing was conducted by testing the working process of the device from the beginning, namely when the item is scanned by the barcode sensor until the item is weighed and sorted. In this test, two types of barcodes were used, where the first type of barcode, namely the box type, will have a weight range of items from 80g to 170g, while the second type of barcode, the 8 bar type, will have a weight range of items from 20g to 80g. Figure 4 shows the entire testing process of the device. Table 2 shows the experimental results.

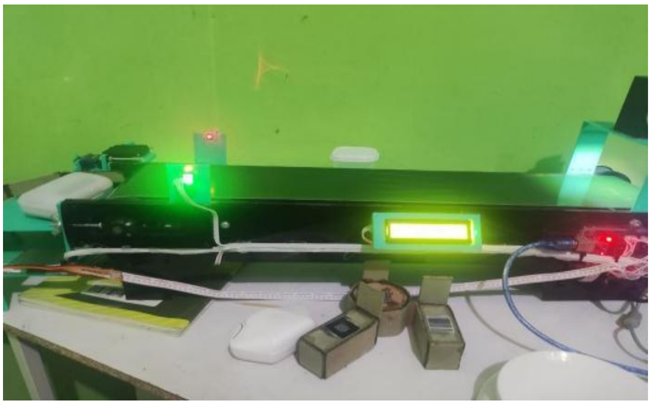

Figure 4. Installation of the testing tool hardware

Table 2Experimental results

No	Item Weight (gr)	scale weight (gr)	Test weight of the tool			Average (gr)	Error(%)
			1	2	3		
1	20	20	20.38	20.95	20.71	20.68	3.4
2	44	44	44.40	44.54	44.22	44.38	0.8
3	60	60	60.31	60.11	60.14	60.18	0.3
4	88	88	88.38	88.86	88.57	88.60	0.6
5	100	100	100.89	100.72	100.91	120.36	0.3
6	120	120	120.52	120.25	120.31	120.36	0.3
7	143	143	143.57	143.31	143.48	143.45	0.3
8	173	173	173.22	173.12	173.31	173.21	0.1

From the experiment with the tool above, it can be seen that the measurement of the weight of the item using the weight sensor almost matches the weight of the item being weighed. We can see this in the very small percentage of error in the item, which can prove that the weight sensor can measure items with a low percentage of error (the weight of the item is almost the same as the item being weighed).

4. CONCLUSION

Based on data collection and direct tool testing, it can be concluded that the weight sensor can measure the weight of the item almost the same as the weight of the original item even though the weight of the item being measured is not too heavy (small). The load cell sensor functions almost the same as a digital scale because the measurements of the two tools are not much different, this can be proven by the very small% error between the two. The infrared sensor detects objects by obtaining a measured voltage value when inactive, which is 4.82 VDC. Meanwhile, when it detects an object in its path, the measured voltage value increases to 4.97 VDC. The barcode sensor can scan various types of QR codes very well and will display the contents of the QR code on the LCD screen. Then the LCD screen will display the weight of the item after the item is weighed by the load cell sensor.

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