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Prototype of Automatic Sorting of Goods in Cosmetics Warehouse

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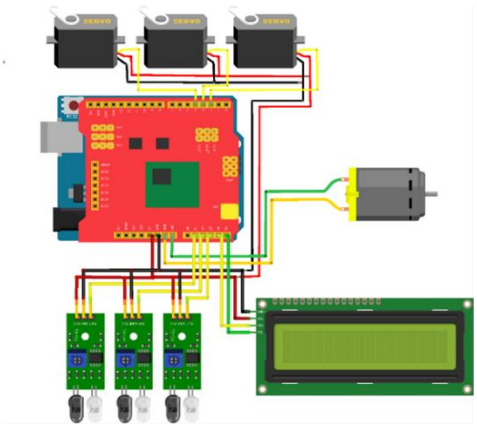
ABSTRACT



One of the tasks of the warehouse as a vital support unit for the distribution process and inventory of goods is sorting. Especially for cosmetic warehouses. Product sorting in warehouses so far is still done manually which can cause negligence and take time when collecting stored product data. A storage system is the process of placing and acquiring goods and products to and from a specific location within an industrial plant or warehouse. To solve this problem, the warehouse needs an automatic sorting tool. This allows employees to easily record products stored in warehouses without using a large number of staff. The method applied to this tool is microcontroller-based automation which includes hardware design in the form of conveyor design, flow charts, and board layouts. Software design includes listing code, block diagram explanations and system flowcharts. Testing system working tools such as barcode scanning, servo angle, infrared sensor and conveyor. The items used as experimental samples totaled 9 pieces with the categories of facial wash, lipstick, and shampoo. Based on the tests that have been carried out, the prototype of automatic sorting of goods is already working as expected.

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1. INTRODUCTION

Warehouses are a vital facility for an industry, because goods coming from suppliers and goods produced by the company will be stored in this facility. Through warehouses, the process of distributing goods and industrial products to consumers becomes easier to do. One of the tasks of the warehouse as a vital support unit for the distribution process and inventory of goods is sorting. In the past, the sorting of products in the warehouse was still manual which could lead to negligence and was time-consuming when collecting product data stored in the warehouse. A storage system is the process of placing and acquiring goods and products to and from a specific location within an industrial plant or warehouse. To solve this problem, the warehouse needs an automatic sorting tool. This allows employees to easily record products stored in warehouses without using a large number of staff.

According to Sultan *et al.,* Inventory is the stock of an item or resource used in a company organization. An inventory system is a set of policies and controls, which monitors inventory levels, and determines which levels to maintain, when stocks need to be replenished and how much to order [1]. One of the problems in this study is that there is no research on automatically sorting goods using a barcode scanner, which is a lack of literacy in this study. Based on these problems, this study will propose automatic sorting of goods using a barcode scanner which can later be used not only in cosmetic warehouses.

Arduino is an open source electronic board. There is one main component, namely the Atmel AVR microcontroller. Arduino is a microcontroller popularly used as a controller of physical computing platforms with relatively simple programming and availability [2]. Arduino is very easy to connect using a USB cable, or power it with an AC-DC adapter [3]. Arduino UNO has enough input and output pins to support other supporting hardware components. The AT328 microcontroller has 14 input pins of the digital output where the 6 input pins can be used as PWM output and 6 analog input pins, 16 MHz crystal oscillator, USB connection, reset button power jack [4]. The controller used in this tool is the Atmega328 microcontroller with an Arduino Uno board [5].

USB host shield allows communicating USB devices to arduino. Arduino host shield is based on the MAX3421E USB controller IC, which is a peripheral USB controller containing digital logic and analog circuitry needed to implement a full-speed peripheral USB or full-/low speed host according to the USB rev 2.0 specification [6].

Arduino IDE is software available on arduino.cc website that is intended to be used as a sketching tool and used to write program listings on Arduino IDE (Integrated Development Environment) is a form of integrated program development tool that offers a variety of needs and is expressed in the form of a menu-based interface [7]. This application has various skills in addition to being a program editor can also compile and upload programs without the need to use additional tools [8].

A conveyor is a type of carrier that serves to transport or move solid industrial goods. Conveyors are widely used in industry for the transportation of many goods and work continuously [9]. Roller Conveyor is the most commonly used conveyor because its trajectory of motion is composed of several tubes (rolls) perpendicular to the direction of the track where a flat plate placed to withstand the load will move according to the direction of rotation of the roll. This conveyor roller can be driven by a chain or belt [10].

A servo motor is a rotating device (actuator) combined with feedback control or closed-loop control. The device can be adjusted (adjusted) to find and determine the angular position of the output shaft of the motor. For servo motors, the rotational position of the motor shaft is informed back to the internal control loop [11]. SG90 servo motor has machine consisting of motor, gear circuit, potentiometer dan controller. The potentiometer works to determine the angle of the servo rotation limit. The magnitude of the servo shaft is seen from the width of the pulse transmitted to the signal pin [12].

A DC motor is a machine that can replace electrical energy into mechanical energy in the form of rotation. The structure of the DC motor comes from two parts. The main part is the stationary component (stator) and the second part moves or the rotating part (rotor) [13].

The left-handed flaming method is used to determine the rotating direction of the motor. The magnetic pole creates a magnetic field with a direction from the north pole to the south pole. When the magnetic field cuts through the conducting channel that flows one way with four fingers, then a unidirectional movement with the thumb occurs. This style is called the Lorenz style and is the same size as F [14].

IR obstacle sensor is a module that functions to recognize obstacles and objects in front of it. The internal components of this sensor consist of an IR transmitter and an IR receiver/phototransistor [15]. When the IR transmitter is turned on, it will emit infrared rays that are not visible and then reflected through the object in front of it. The reflected light is received IR receiver. There is an LM363 act as op-amp as a comparison between the IR receiving p resistor and the trim potentiometer resistor that can adjust the sensitivity [16].

A barcode is a set of codes that define characters and digits, which consists of a combination of lines with different space settings. The rule is how to enter data into a computer. Barcode information includes several digits of encryption [17].

The computer cannot do it directly to read the data that is in the barcode. Therefore, barcodes are an initial tool that must be recorded and translated in a computer-readable data format. A tool that can be read and sent on a computer is called a barcode reader or barcode scanner [18].

LCDs are used to display the output results of electronic circuits. LCD is an electronic device that can be used to display both numbers and writing [19]. LCD I2C/TWI module is used to reduce LCD pin wearer on Arduino. I2C there are 4 pins that the LCD must connect to before use. Arduino uno already supports I2C. I2C can control the two types of 16×2 and 20×4 LCDs used. The pins are analog input pin 4 (SDA) and analog input pin 5 (SCL) [20].

This study proposes the creation of an automated goods sorting tool that is expected to make it easier for employees to record products stored in warehouses without using many staff and reduce negligence and time consuming when collecting product data stored in warehouses.

2. METHODS

2.1 System Design

Designing Tools in this study include designing a hardware block diagram shown by Figure 1.

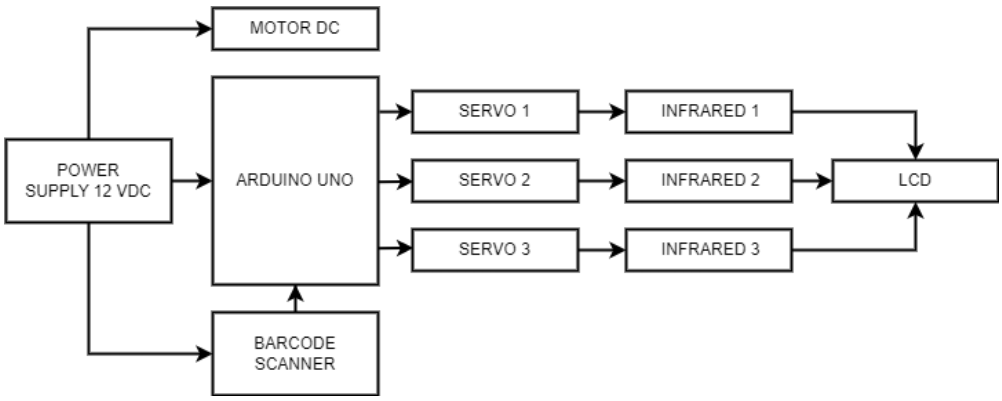

Figure 1. System Block Diagram

There is a system block diagram, the workflow is that power supply provides voltage to the UNO arduino, barcode scanner and DC motor to drive the conveyor. Barcode scanner will read the barcode and transmit the data to arduino. Arduino will process the legible code to drive the servo motor by item category. Goods that have passed through the servo bar will be detected infrared sensors to determine the quantity in each category of goods. The input from the infrared sensor will be displayed on the 16×2 LCD. To make it easier to design the tool, a component design was created to describe the system workflow on the automated goods sorting prototype in the cosmetics warehouse based on Figure 2. In Figure 2, some of the component pins used in the system suite will be described as Table 1.

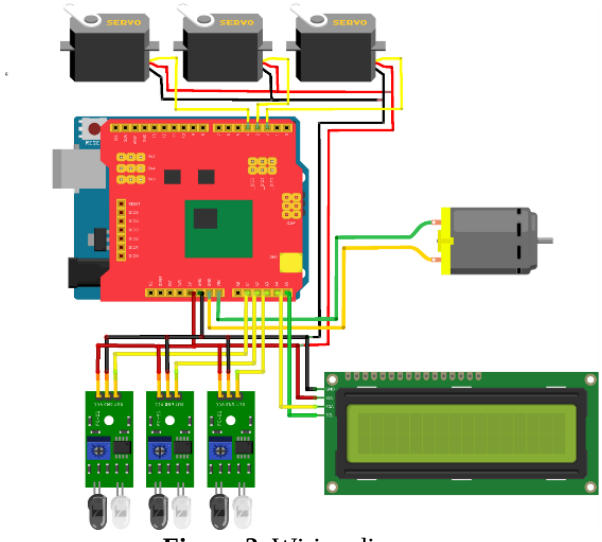

Figure 2. Wiring diagram

Table 1. Pin configuration

Component	Pin	Pin Arduino
Motor DC	(+)	Wine
Servo 1	Out	D2
Servo 2	Out	D3
Servo 3	Out	D4
Infrared 1	Out	A1
Infrared 2	Out	A2
Infrared 3	Out	A3
Lcd 16×2	SDA	A4
	SCL	A5

2.2 Algorithms

The design of the automatic goods sorting prototype software includes a flow chart so that the workflow of this tool can be understood clearly. The flow chart can be seen in Figure 3.

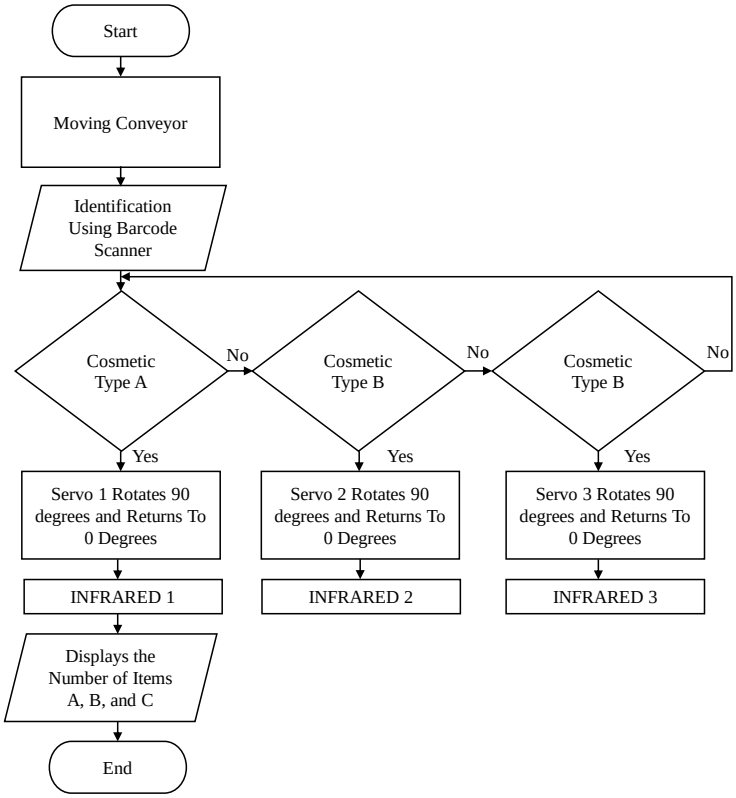

Figure 3. Flowchart system

In this flow chart, it starts from turning on the conveyor and then reading the barcode using a barcode scanner on the bottle cap. Arduino will process the barcode reading results and will input the servo to sort out. The results of the barcode reading determine whether the cosmetic item is a facial wash (A), shampoo (B), or lipstick (C) category. If the barcode detects the cosmetic of the facial wash category, the servo will move the bar of the servo motor 1 by 90 degrees, when it is detected infrared sensor 1 will return to the starting position. If the barcode detects the cosmetic of the shampoo category, the servo will move the bar of the servo 2 motor by 90 degrees, when detected the infrared sensor 2 will return to the initial position. If the barcode detects the cosmetic of the lipstick category, then the servo will move the bar of the servo motor 3 by 90 degrees, when the item is detected infrared sensor 3 will return to the starting position. After the goods pass through the servo bar, the infrared sensor will detect to determine the amount in each category A, B, and C and displayed on the LCD screen.

3. RESULTS AND DISCUSSION

The prototype of an automatic sorting tool for cosmetic items has been designed with results such as Figure 5. This test is run to determine the performance of the system that is designed to work as planned.

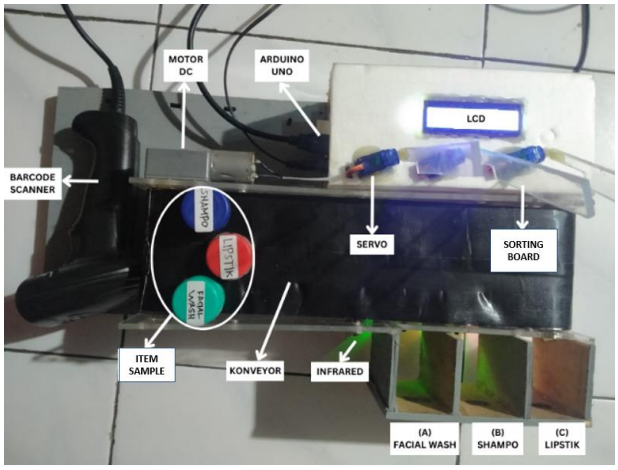

Figure 5. Tool prototype

3.1. Testing Infrared Sensors

The test is carried out on an infrared sensor, namely if the object passes through the sensor, it will read logic "1" which indicates the presence of the object and becomes a trigger servo barrier to return to the initial position. Here are the test points to be carried out as shown in Figure 6. The results showed that the sensor was running according to specifications with a legible working voltage of 4.62 V when the logical condition was "0" and 0.32 V when the logical condition was "1" which can be seen in Table 2.

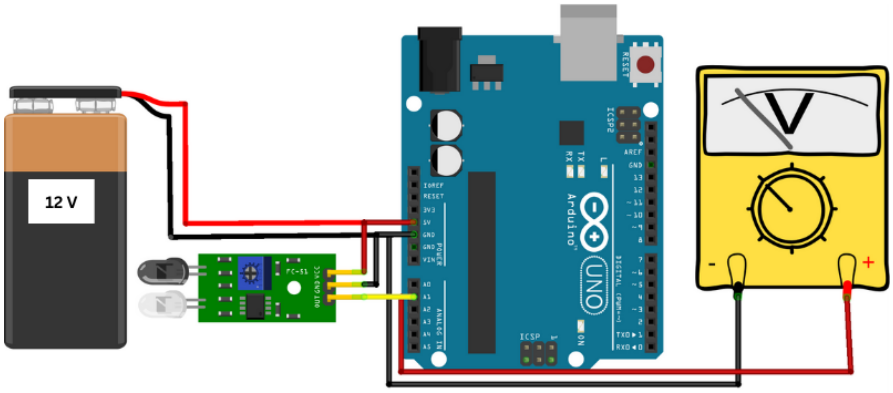

Figure 6. Infrared sensor testing

Table 2. Infrared sensor voltage test results

Pin sensor	Voltage	Picture
Out High (1)	0.32 V	
Out Low (0)	4.62 V	

3.2. Testing of Servo Motor

At this stage it is carried out by applying a voltage from the VCC port of the arduino to the VCC pin of the servo motor. Measurements are carried out with a multimeter connected with GND and OUT pins. The test points are shown in Figure 7. From Figure 7, the test to obtain the results of voltage measurement on the servo motor will be described in more detail in Table 3.

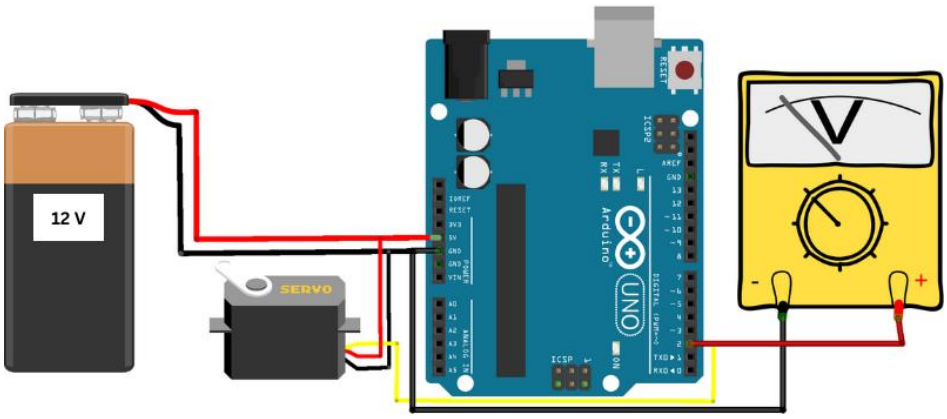

Figure 7. Testing of servo motor

Table 3. Servo motor voltage test results

Corner	Voltage	Picture
0	0.07 V	
90	0.25 V	

3.3. DC Motor Testing

This component is used to run conveyors at a constant speed. Measurements using a Vizero multimeter with test points as follows. From the measurements with test points in Figure 8, the working results of the DC motor measurements were obtained of 11.39 VDC. The result of measuring the voltage of the DC motor shown in Figure 9.

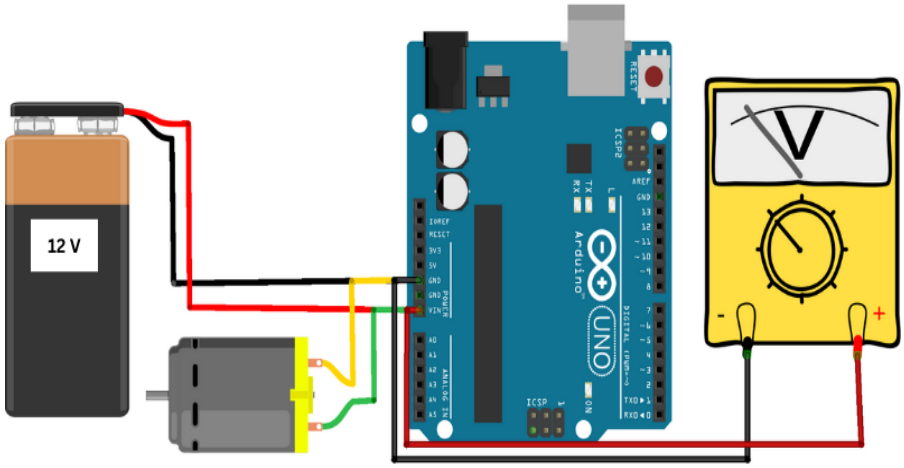

Figure 8. DC motor testing

Figure 9. The result of measuring the voltage of the DC motor

3.4. Overall Tool Testing

Testing is carried out to find out whether this tool is already operating to sort goods according to the desired type. The samples tested were 9 items with different barcodes. The test results are addressed in Table 4. In this automatic item sorting tool, the type of item labeled facial wash will move the servo bar 1, for items labeled with shampoo will move the servo bar 2, and the item labeled lipstick will move the servo bar 3. Photos during sorting are shown in Figure 10, Figure 11, and Figure 12.

Figure 10. Sorting of items labeled "Facial Wash"

Figure 11. Sorting of goods labeled “Shampoo”

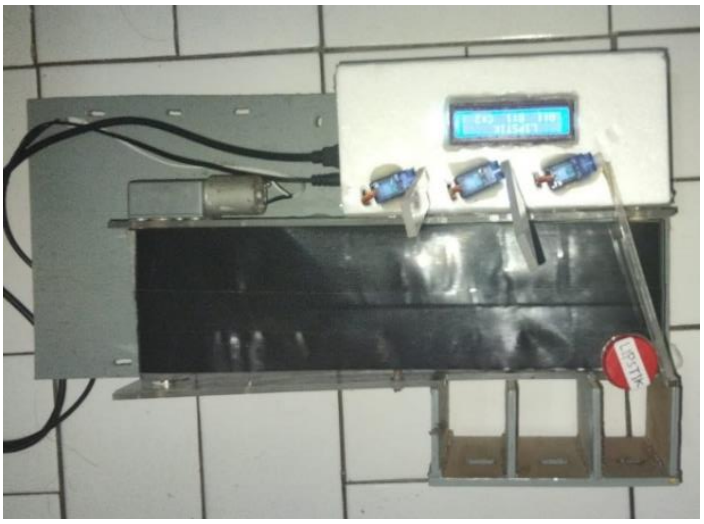

Figure 12. Sorting of items labeled “Lipstick”

Samples of goods have different barcodes. Hasil summary of testing of the entire sample carried out 3 times with different scan queue placements. The result of the data test in Table 4 is the summary testing tool. The results show that the “8991102308892”, “8992775001653”, and “8993989311279” barcodes will close the servo bar 1 and fall into the facial wash category. The “9312412515012”, “8886008101053”, and “749921006110” barcodes will close the servo 2 bars that belong to the shampoo category. The “8996001600375”, “8992775001011”, and “8993989311699” barcodes will close the servo 3 bars that belong to the lipstick category. The automatic item sorting prototype can already sort according to its category precisely and all sensors work properly as expected.

Table 4. Overall test summary

Category	Barcode	Condition of the sorting board			Infrared Conditions		
		Cross 1	Cross 2	Cross 3	AND 1	AND 2	AND 3
Facial Wash	8991102308892	In	-	-	In	-	-
	8992775001653	In	-	-	In	-	-
	8993989311279	In	-	-	In	-	-
Shampoo	9312412515012	-	In	-	-	In	-
	8886008101053	-	In	-	-	In	-
	749921006110	-	In	-	-	In	-
Lipstick	8996001600375	-	-	In	-	-	In
	8992775001011	-	-	In	-	-	In
	8993989311699	-	-	In	-	-	In

4. CONCLUSION

Based on the results of research and discussion, it can be concluded that the automatic goods sorting prototype can run according to its purpose. The items used as experimental samples totaled 9 pieces with the following categories. The "8991102308892", "8992775001653", and "8993989311279" barcodes fall into the facial wash category. Barcodes "9312412515012", "8886008101053", and "749921006110" belong to the category of shampoos. The "8996001600375", "8992775001011", and "8993989311699" barcodes belong to the lipstick category. The sorting servo will close by 90 degrees when one of the categories is detected and return to the 0 degree position if the item has entered its place. The infrared sensor functions as a trigger that the goods have entered and sends data to the Arduino to be displayed on the LCD. This research is still not perfect. For this reason, the author gives some suggestions for further development, namely a better and structured design and sorting mechanism is needed, it is recommended to replace the DC motor with a larger torque, the sorting pan can be made neater and more study, and the Internet of Thing (IOT) can be added so that the interface display is more flexible.

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