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Design of Pulse Induction Metal Detector for Metal Scanning in Food Integrated with Conveyor System

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ABSTRACT

This research aims to develop a continuous metal detection system for food to prevent metal contamination in food consumed by the public and to determine the performance of a Programmable Logic Controller (PLC) system for controlling a metal detector conveyor. The method employed involves designing a PLC system that integrates a pulse induction metal detector, photosensor, and conveyor system. Functional testing is conducted on each component, followed by an overall performance test of the equipment. The functional testing results indicate that the components used can work properly and normally. The subsequent test is a performance test, which shows that out of 50 food samples tested, including meatballs, spring rolls, lumpia, cenil, and other traditional snacks, the device successfully detected metal in 25 of the food samples.

ABSTRAK

Penelitian ini bertujuan untuk membuat alat deteksi logam pada makanan secara kontinyu untuk mencegah kontaminasi logam pada makanan yang dikonsumsi masyarakat serta mengetahui unjuk kerja sistem Programmable Logic Controller (PLC) untuk kontrol alat konveyor detektor logam. Metode yang digunakan adalah rancang bangun sistem PLC yang mengintegrasikan detektor logam pulse induction, photosensor, dan sistem konveyor. Pengujian dilakukan secara fungsional pada masing-masing komponen dan uji kinerja alat secara keseluruhan. Hasil pengujian fungsional menunjukan bahwa komponen-komponen yang digunakan dapat bekerja dengan baik dan normal. Pengujian yang selanjutnya adalah pengujian kinerja yang menunjukan dari 50 sampel pengujian makanan seperti bakso, risol, lumpia, cenil dan jajanan pasar lainnya, alat berhasil mendeteksi 25 sampel makanan yang mengandung logam.

1. Introduction

In today's modern era, food quality is highly regarded in order to protect human health. Food safety is an important factor in national development and quality of life. In food processing, there is a risk of contamination by objects that can even be hazardous to health. One foreign object that is very dangerous when it enters food is metal, because when a person eats food containing foreign metal, the body, oral cavity, throat, and other parts of the digestive system can be injured. Therefore, it is important to apply metal detection devices in the food industry to prevent metal contamination in food. Rike Fitriani [1] and Steven Jendri Sokop [2] state that there are several reasons for developing a metal-separation device for food, namely the ease of transmitting data to a microcontroller for further development, low cost, flexibility, automatic control, and applicability from small to large scale.

Farhan Muhtarom [3] began with the development of a detection system capable of simultaneously identifying several types of metal. This identification can also make use of a conveyor belt, as in the studies by Livinti Petrua [4] and Catur Budi Waluyo [5]. Another study, by Gurit Pramudhito [6], was developed to create an intelligent algorithm for analyzing sensor data and identifying metal with high accuracy. In general, a metal detector works on the principle of generating a magnetic field through a transmitter coil and monitoring the signal induced in a receiver coil. A magnetic or electrically conductive object passing through the metal detector's magnetic field will alter the received signal, causing the receiver coil to detect the presence of a metal object in the food. To make detection run continuously, the metal detector is integrated with a belt conveyor system that is regulated and controlled using a microcontroller and a Programmable Logic Controller.

Based on prior research related to metal detectors in the food industry, which has been conducted extensively, the reason this study is important, and what distinguishes it from previous research, is the use of a metal detector system based on the pulse induction principle, integrated with a Programmable Logic Controller, thereby producing a system for sorting food that contains metal in the food industry.

2. Problem-Solving Approach

This chapter explains the supporting theory used in the process of designing and building a pulse induction metal detector for scanning metal in food integrated with a conveyor system. The basic theoretical review is tailored to the metal detector on the conveyor system so that it can serve as the methodological foundation for the research in the system design process.

2.1 Programmable Logic Controller

A PLC (Programmable Logic Controller) is a microcontroller-based device with input/output circuits that monitors the status of sensors connected on the input side and controls actuators installed as outputs according to the conditions desired by the user. A PLC has advantages over other computers in that it is protected against harsh operating conditions such as dust, humidity, and cold, and it provides extensive input/output configuration facilities [7].

One application of PLCs in industry is for the automation of conveyor systems. For a conveyor to operate automatically, an instrument and control system suited to the PLC and its programming must be designed. PLC studies and research are essentially dependent on the brand and type of PLC used [8].

2.2 Photosensor

A photosensor is a sensor that functions to detect the presence of an object, working by detecting infrared light or similar light emitted by a transmitter at a specific wavelength [9]. This sensor is often used in industry to provide an input signal or information for further control.

2.3 Metal Detector

Safety in food processing production is highly regarded by business operators in the food sector. This is because small pieces of metal contained in a food product can pose a safety hazard to the health of the consumer. The working principle of a metal detector uses the electromagnetic principle through a transmitter coil and monitors the signal induced by a receiver coil. Therefore, the use of metal detectors in the industrial sector is extensive, such as in the pharmaceutical, food, beverage, textile, and plastics industries, among others. There are several types of metal detectors, including:

2.3.1 VLF (Very Low Frequency) Metal Detector

As the name suggests, this detector uses a low-frequency signal to detect the presence of a metal object. The signal is transmitted through a wire coil, and when the signal approaches a metal object, the signal experiences a fluctuation that is then detected as the presence of metal.

2.3.2 Pulse Induction Metal Detector

This detector works with a high-voltage pulse to generate a magnetic field, which is then used to detect metal in an object. This detector is better at detecting metal at a greater distance compared to VLF.

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2.3.3 BFO (Beat Frequency Oscillation) Metal Detector

This detector uses two oscillating coil sections to detect metal objects. One coil section generates a signal, and the other detects changes in the signal caused by the presence of metal around the coil.

2.3.4 MF (Multi-Frequency) Metal Detector

As the name suggests, this detector uses several frequencies to detect the presence of metal. This detector is more sensitive than a single-frequency detector. This signal is more stable than the signal of other detectors.

2.4 Buzzer

A buzzer consists of a coil mounted on a diaphragm; when the coil is supplied with electric current, it becomes an electromagnet, and the coil moves the diaphragm, thereby producing sound.

2.5 DC Motor

A DC motor is the main component of a variable-speed drive system. A DC motor requires a direct-voltage supply to its coil to convert it into mechanical energy. When a DC motor is supplied with direct voltage, a magnetic field is created in its stator coil [10]. This magnetic field attracts and repels the magnet on the rotor, causing the rotor to rotate. Therefore, DC motors are generally used in applications that require variable speed control, reliable speed regulation, and effective forward and reverse operation [11]. The DC motor in this study functions as the drive for the belt conveyor.

2.6 CX-Programmer Software

In today's modern era, control systems are one of the important areas of focus in industry. An effective and optimal control system is highly needed in industry today. A Programmable Logic Controller is a microprocessor used for industrial automation, such as control and monitoring. The language used in PLC programming is called ladder language, which consists only of input-process-output [12]. CX-Programmer was chosen as one of the software options for creating ladder language programs. Identification in the system takes the form of a High signal from the PLC, represented by the number 1 as an indicator that the I/O is active and the number 0 as an indicator that the I/O is inactive, according to the program.

3. Research Design

The research method used in the making of this final project is the Research and Development method. The stages and design concept of the metal-detection conveyor device in the final project titled "Design of a Pulse Induction Metal Detector for Metal Scanning in Food Integrated with a Conveyor System" are described in the form of a flowchart, as shown in Fig. 1, as follows:

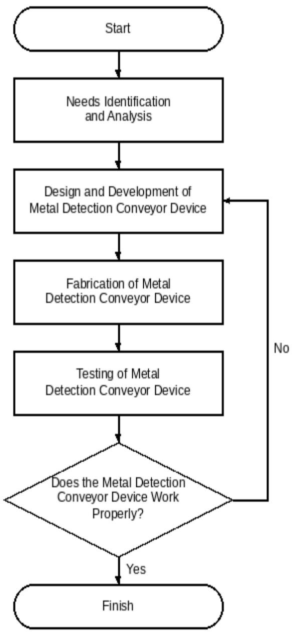

Fig.1 Flowchart of the research design stages and concept

3.1 Needs Identification and Analysis

Needs identification and analysis is the first stage in designing a metal-detection conveyor device. This stage is carried out to determine the conditions and problems in the field. The problems that have been identified are then analyzed to determine the solution to those problems.

3.1.1 Field Observation

Field observation was carried out at the Department of Electrical Engineering Education, Faculty of Engineering, UNY, and at CV Rumah Mesin. The observation was carried out by examining an example of how a PLC system works and how a food-sorting conveyor system works. Based on the observation results, the food-sorting system's quality control did not yet use a metal detector. As a result, food contaminated with metal could still occur, which could endanger the consumers of that food.

3.1.2 Needs Analysis

Based on the observation results, it is known that maintaining food quality is important for food producers. This is done to protect the safety of food consumers so that they avoid ingesting metal objects. Therefore, a metal-detector device that can operate continuously is needed to sort food after production, making the process more effective and efficient.

3.1.3 Solution Search

Based on the needs analysis carried out, the solution provided to address the need for a metal detector that can operate continuously, effectively, and efficiently is to build a PLC system on the conveyor that combines a metal detector, a photosensor, and the conveyor system itself.

3.2 Device Planning

This stage is intended to produce the design and planning of the device that will later serve as a reference in the device development process. In addition, the device-planning stage is intended to reduce the possibility of errors in the device development process while also ensuring that the device can operate as expected. This device-planning stage covers the design of the hardware and software. The device-planning process in this final project is as follows:

3.2.1 Device Workflow

The first stage in the device-planning process is designing the device's workflow. The design process for the device's workflow is carried out by creating a flowchart and a system block diagram. The system flowchart for the PLC-based metal detector system for food is shown in Fig. 2, as follows:

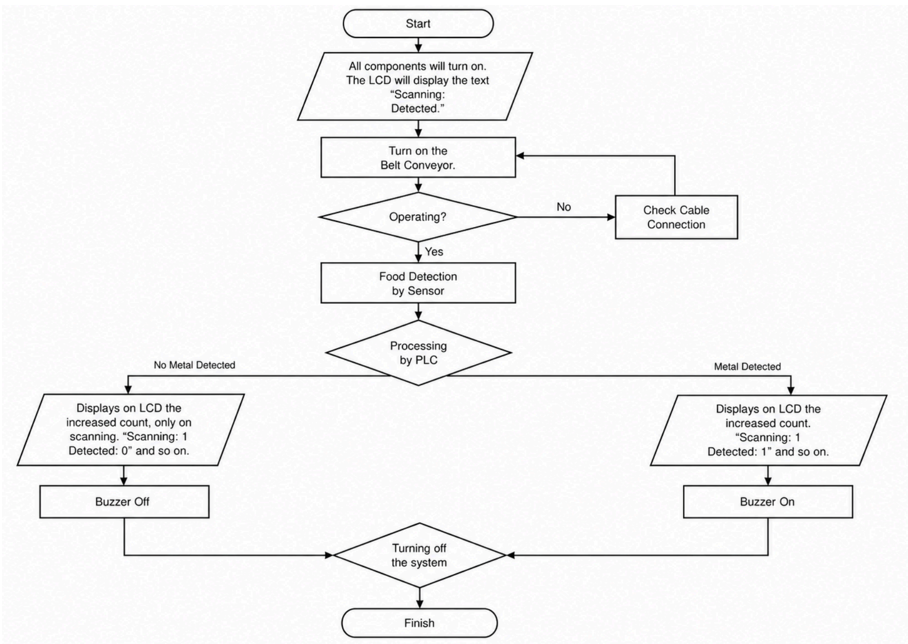

Fig.2 Flowchart system

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The operational process of the metal-detection device for food begins by connecting the single-phase power source, activating the miniature circuit breaker (MCB), and turning on the power supply for the metal-detector module. Next, the belt conveyor is operated by pressing the Start/ON button on the control panel. Food is placed on the operating belt conveyor. The first sensor detects the presence of food, and the dual metal sensor identifies metal contamination in the food. When food is detected to contain metal, a signal is sent to the Programmable Logic Controller (PLC), which activates the warning buzzer. The Liquid Crystal Display (LCD) displays the number of food items scanned and detected as containing metal. The system can be turned off by pressing the Stop/OFF button, disconnecting the MCB, turning off the power supply, and unplugging the cable from the power source.

A system block diagram was also created to represent the relationship between one component and another in the system, in the form of interconnected blocks, as shown in Fig. 3, as follows:

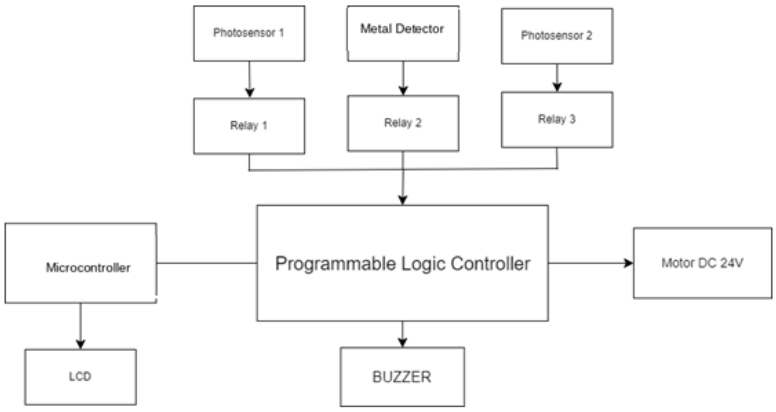

Fig.3 Block diagram

3.2.2 Hardware Design

The second stage of the device design and design process is designing the hardware. This stage involves electrical design. The electrical design stage aims to design the pin or terminal connections between one component and another so as to create a unified device that can operate. This electrical design is shown in Fig. 4, as follows:

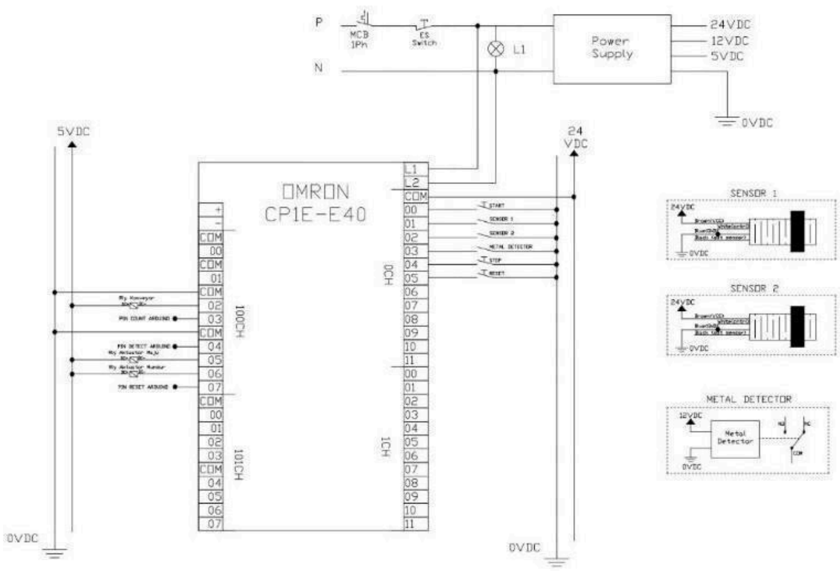

Fig.4 PLC wiring design

3.2.3 Software Design

The second stage of device design is designing the software. This stage covers the series of processes for creating the software for the metal-detection system for food integrated with the conveyor system. This software design stage uses CX-Programmer and Arduino IDE software. The program created using Arduino

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IDE is shown in the program code below:

```
#include <Arduino.h>
#include <LiquidCrystalIO.h>
#include <IoAbstractionWire.h>
#include <Wire.h>
#define counter A0
#define deteksi A1
#define vcc 13

int hasil01, hasil02, pb1=0, pb2=0;
//LiquidCrystal_I2C lcd(0x27,16,2);
LiquidCrystalI2C_RS_EN(lcd, 0x27, false)

void setup()
{
 //lcd.begin();
 Wire.begin();
 lcd.begin(16, 2);
 lcd.configureBacklightPin(3);
 lcd.backlight();

 pinMode(counter, INPUT);
 pinMode(deteksi, INPUT);
 pinMode(vcc, OUTPUT);
}

void loop()
{
 int cnt=digitalRead(counter);
 int det=digitalRead(deteksi);
 digitalWrite(vcc, HIGH);

 if(cnt==HIGH){pb1=1;}
 if(cnt==LOW && pb1==1)
 {hasil01++; pb1=0;}
 if(det==HIGH){pb2=1;}
 if(det==LOW && pb2==1)
 {hasil02++; pb2=0;}

 lcd.setCursor(0,0);
 lcd.print("Scanning =");
 lcd.setCursor(0,1);
 lcd.print("Terdeteksi=");
 lcd.setCursor(12,0);
 lcd.print(hasil01);
 lcd.setCursor(12,1);
 lcd.print(hasil02);
}
```

The PLC program created using CX-Programmer is shown in Fig. 5 below:

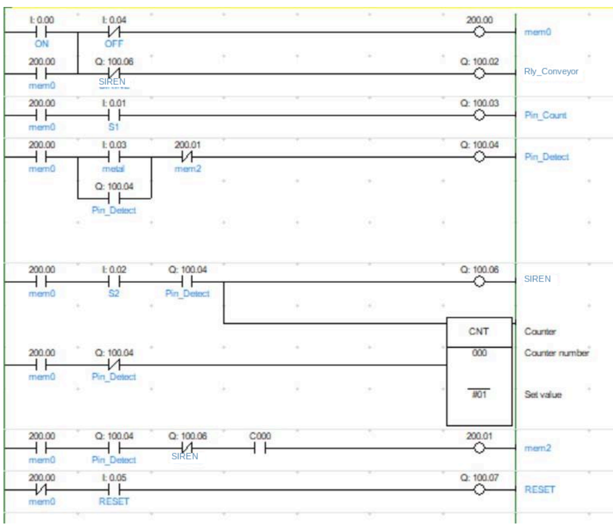

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Fig. 5 PLC Program using CX-Programmer software

4. Research Results

This chapter discusses the results of the research that has been conducted, as well as the test results of the device that has been built.

4.1 Hardware Fabrication Results

The fabrication of the hardware in this final project involves building and installing the components and wiring according to the planning design. The results of this hardware fabrication can be seen in Fig. 6 and Fig. 7, as follows:

Fig. 6 Installation of electrical components

Fig.7 Metal detector conveyor device

4.2 Test Results

The first test conducted was the functional test of the device. This test was carried out by testing all the electronic components in the system with the aim of ensuring that each component in the system can function and operate according to the plan.

The second test was the performance test of the device. This test was carried out with the aim of testing and ensuring that the entire metal-detector conveyor device can operate properly, reliably, and accurately in detecting metal in food. The results of the final project testing are as follows:

4.2.1 Functional Test

The functional test in this final project aims to ensure the function and accuracy of each component used.

The test results then become considerations for whether the component is suitable for use. The following are the test results for each component tested:

Table 1. Functional Test Results of Photosensor 1

No	Food Name	Test Result (Distance 0–25 cm)
1	Meatballs	Detected
2	Nugget	Detected
3	Lemper	Detected
4	Arem-arem	Detected
5	Spring Rolls	Detected
6	Fried Snacks	Detected
7	Lumpia	Detected
8	Martabak	Detected
9	Steamed Cake	Detected
10	Boiled Egg	Detected

Table 2. Functional Test Results of Photosensor 2

No	Food Name	Test Result (Distance 0–25 cm)
1	Meatballs	Detected
2	Nugget	Detected
3	Lemper	Detected
4	Arem-arem	Detected
5	Spring Rolls	Detected
6	Fried Snacks	Detected
7	Lumpia	Detected
8	Martabak	Detected
9	Steamed Cake	Detected
10	Boiled Egg	Detected

Table 3. Metal Detector Test Results

No	Food Name	Staple Metal Present	Metal Detector Result
1	Meatballs	Present	Detected
2	Nugget	Absent	Not Detected
3	Lemper	Present	Detected
4	Arem-arem	Absent	Not Detected
5	Spring Rolls	Present	Detected
6	Fried Snacks	Absent	Not Detected
7	Lumpia	Present	Detected
8	Martabak	Absent	Not Detected
9	Steamed Cake	Present	Detected
10	Boiled Egg	Absent	Not Detected

Table 4. PLC Input Pin Test Results

No	Output Signal (Program)	Input PIN	Result
1	-	L1	Normal
2	-	L2	Normal
3	-	COM	Normal
4	0	00 – 11 (0CH)	0
5	1	00 (0CH)	1
6	1	01 (0CH)	1
7	1	02 (0CH)	1
8	1	03 (0CH)	1
9	1	04 (0CH)	1
10	1	05 (0CH)	1
11	1	06 (0CH)	1
12	1	07 (0CH)	1
13	1	08 (0CH)	1
14	1	09 (0CH)	1
15	1	10 (0CH)	1
16	1	11 (0CH)	1
17	0	00 – 11 (1CH)	0
18	1	00 (1CH)	1
19	1	01 (1CH)	1
20	1	02 (1CH)	1
21	1	03 (1CH)	1
22	1	04 (1CH)	1
23	1	05 (1CH)	1

24	1	06 (1CH)	1
25	1	07 (1CH)	1
26	1	08 (1CH)	1
27	1	09 (1CH)	1
28	1	10 (1CH)	1
29	1	11 (1CH)	1

Table 5. PLC Output Pin Test Results

No	Output Signal (Program)	Output PIN	Result
1.	-	+	Normal
2.	-	-	Normal
3.	-	COM (100CH)	Normal
4.	-	COM (100CH)	Normal
5.	-	COM (100CH)	Normal
6.	-	COM (100CH)	Normal
7.	0	00 – 07 (100CH)	0
8.	1	00 (100CH)	1
9.	1	01 (100CH)	1
10.	1	02 (100CH)	1
11.	1	03 (100CH)	1
12.	1	04 (100CH)	1
13.	1	05 (100CH)	1
14.	1	06 (100CH)	1
15.	1	07 (100CH)	1
16.	-	COM (101CH)	Normal
17.	-	COM (101CH)	Normal
18.	0	00 – 07 (101CH)	0
19.	1	00 (101CH)	1
20.	1	01 (101CH)	1
21.	1	02 (101CH)	1
22.	1	03 (101CH)	1
23.	1	04 (101CH)	1
24.	1	05 (101CH)	1
25.	1	06 (101CH)	1
26.	1	07 (101CH)	1

Table 6. Relay 1 Test Results

No	Input Voltage (Volt)	Initial Relay Condition	Final Relay Condition
1	5	NC	NO
2	0	NO	NC

Table 7. Relay 2 Test Results

No	Input Voltage (Volt)	Initial Relay Condition	Final Relay Condition
1	5	NC	NO
2	0	NO	NC

Table 8. Relay 3 Test Results

No	Input Voltage (Volt)	Initial Relay Condition	Final Relay Condition
1	5	NC	NO
2	0	NO	NC

Table 9. Push Button Test Results

No	Push Button Condition	Active	Inactive
1	Normal / Not Pressed	x	✓
2	Pressed Once	✓	x

Table 10. Buzzer Test Results

No	Input Voltage (Volt)	Buzzer Condition
1	12	Active
2	0	Inactive

Based on the functional testing conducted, it can be determined that the electronic components used can run or operate normally and accurately. This functional testing also serves to ensure that the electronic components used in this final project can be properly integrated and produce a device that can operate normally as planned.

4.2.2 Performance Test

The performance test in this final project aims to determine the overall function of the system in this metal-detector conveyor. The performance test in this final project was carried out 50 times using various types of food. Meanwhile, 25 of the 50 food types used for the performance test contained staple metal. The testing process was carried out by monitoring the sensors, buzzer, and LCD. The results of the performance test in this final project can be seen in Table 11 below:

Table 11. Performance Test Results

No	Food Variation	Contains Metal (Staples)	Photosensor 1	Metal Detector	Photosensor 2	Buzzer	Scanning	Detected
1	Meatballs	Present	Detected	Detected	Detected	Active	1	1
2	Martabak	Absent	Not Detected	Not Detected	Not Detected	Inactive	2	1
3	Fried Snacks	Absent	Not Detected	Not Detected	Not Detected	Inactive	3	1
4	Soto	Absent	Not Detected	Not Detected	Not Detected	Inactive	4	1
5	Carabikang	Absent	Not Detected	Not Detected	Not Detected	Inactive	5	1
6	Spring Rolls	Present	Detected	Detected	Detected	Active	6	2
7	Lontong	Present	Detected	Detected	Detected	Active	7	3
8	Nasi Kucing	Absent	Not Detected	Not Detected	Not Detected	Inactive	8	3
9	Lemper	Absent	Not Detected	Not Detected	Not Detected	Inactive	9	3
10	Fried Tofu	Present	Detected	Detected	Detected	Active	10	4
11	Kue Ku	Present	Detected	Detected	Detected	Active	11	5
12	Serabi	Present	Detected	Detected	Detected	Active	12	6
13	Empek-empek	Present	Detected	Detected	Detected	Active	13	7
14	Fried Noodles	Absent	Not Detected	Not Detected	Not Detected	Inactive	14	7
15	Pastel	Absent	Not Detected	Not Detected	Not Detected	Inactive	15	7
16	Toasted Bread	Absent	Not Detected	Not Detected	Not Detected	Inactive	16	7
17	Tiwul	Absent	Not Detected	Not Detected	Not Detected	Inactive	17	7
18	Yangko	Absent	Not Detected	Not Detected	Not Detected	Inactive	18	7
19	Dadar Gulung	Present	Detected	Detected	Detected	Active	19	8
20	Otak-otak	Absent	Not Detected	Not Detected	Not Detected	Inactive	20	8
21	Bakwan	Present	Detected	Detected	Detected	Active	21	9
22	Cilok	Absent	Not Detected	Not Detected	Not Detected	Inactive	22	9
23	Satay	Present	Detected	Detected	Detected	Active	23	10
24	Combro	Absent	Not Detected	Not Detected	Not Detected	Inactive	24	10
25	Kue Lumpur	Present	Detected	Detected	Detected	Active	25	11
26	Getuk	Absent	Not Detected	Not Detected	Not Detected	Inactive	26	11
27	Nagasari	Absent	Not Detected	Not Detected	Not Detected	Inactive	27	11
28	Putu	Absent	Not Detected	Not Detected	Not Detected	Inactive	28	11
29	Kue Talam	Present	Detected	Detected	Detected	Active	29	12
30	Bolu Kukus	Present	Detected	Detected	Detected	Active	30	13
31	Monte	Absent	Not Detected	Not Detected	Not Detected	Inactive	31	13
32	Terang Bulan	Absent	Not Detected	Not Detected	Not Detected	Inactive	32	13
33	Kue Pancong	Absent	Not Detected	Not Detected	Not Detected	Inactive	33	13
34	Kue Mangkok	Present	Detected	Detected	Detected	Active	34	14
35	Pukis	Present	Detected	Detected	Detected	Active	35	15
36	Cireng	Absent	Not Detected	Not Detected	Not Detected	Inactive	36	15
37	Wingko Babat	Present	Detected	Detected	Detected	Active	37	16
38	Kue Cubit	Absent	Not Detected	Not Detected	Not Detected	Inactive	38	16

39	Jenang	Present	Detected	Detected	Detected	Active	39	17
40	Lapis Legit	Absent	Not Detected	Not Detected	Not Detected	Inactive	40	17
41	Crackers	Present	Detected	Detected	Detected	Active	41	18
42	Kue Sus	Absent	Not Detected	Not Detected	Not Detected	Inactive	42	18
43	Gemblong	Present	Detected	Detected	Detected	Active	43	19
44	Kue Rangi	Present	Detected	Detected	Detected	Active	44	20
45	Klepon	Present	Detected	Detected	Detected	Active	45	21
46	Kue Mangkok	Absent	Not Detected	Not Detected	Not Detected	Inactive	46	21
47	Onde-onde	Present	Detected	Detected	Detected	Active	47	22
48	Kue Cucur	Present	Detected	Detected	Detected	Active	48	23
49	Lupis	Present	Detected	Detected	Detected	Active	49	24
50	Kue Cenil	Present	Detected	Detected	Detected	Active	50	25

The test results shown in Table 11 indicate that the overall system works normally and accurately because, when the food contains metal, the metal detector detects it, and the photosensors also detect the presence of food passing along the belt conveyor. When the metal detector detects metal in the food, the food then passes the second photosensor, which causes the buzzer to turn on, serving as an indicator to the operator that the food contains metal. The LCD also displays the scanning and detected count according to the data.

5. Conclusion

Based on the results of the testing and discussion in this final project on the design and construction of a pulse induction metal detector for scanning metal in food integrated with a conveyor system, the conclusions are as followings

The development of this final project on the design and construction of a pulse induction metal detector for scanning metal in food integrated with a conveyor system began with needs identification and analysis. The components required in the development of this final project are a conveyor, an Omron CP1E-E40 PLC, relays, a photosensor, a pulse induction metal detector, a buzzer, an Arduino Uno, an LCD, and a power supply. After determining the system requirements, the next process is the design and planning of the device, device development, and device testing until the PLC system for scanning food with the photosensor and PI metal detector integrated with the conveyor system can operate properly, reliably, and accurately according to the initial plan.

The first stage of testing was the functional test. The results of the functional test on the pulse induction metal detector system for scanning metal in food integrated with a conveyor system show that each component used can function normally. The test results for the three main sensors, namely the two photosensors and one metal detector, show that these sensors work accurately.

The performance test results show that the system can work according to the plan, namely being able to detect metal contained in food. The test was carried out with 50 trials using various types of traditional market snacks, such as meatballs, martabak, fried snacks, klepon, etc. The test was carried out at least 50 times to ensure that the device built can work normally, reliably, and accurately. The performance test results show that photosensor 1, photosensor 2, the metal detector, the Arduino Uno, the LCD, and the buzzer can be properly integrated and work well.

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The authors declare no conflict of interest.

References

[1] R. Fitriani and N. Paramytha, “Robot pendeteksi logam dengan mikrokontroler,” in Bina Darma Conference on Engineering Science (BDCES), vol. 2, no. 1, pp. 165–173, 2020. Metadata penulis, volume, nomor, dan halaman ini juga tercantum dalam daftar rujukan artikel terkait di ORBITH.

[2] S. J. Sokop, D. J. Mamahit, and S. R. U. A. Sompie, “Trainer periferal antarmuka berbasis mikrokontroler Arduino Uno,” Jurnal Teknik Elektro dan Komputer, vol. 5, no. 3, pp. 13–23, 2016, doi: 10.35793/jtek.v5i3.11999.

[3] F. Muhtarom and H. Effendi, “Alat pendeteksi logam pada makanan berbasis Arduino Uno,” JTEIN: Jurnal Teknik Elektro Indonesia, vol. 1, no. 2, pp. 43–48, 2020, doi: 10.24036/jtein.v1i2.14.

[4] P. Livinti and M. Ghandour, “PWM control of a DC motor used to drive a conveyor belt,” Procedia Engineering, vol. 100, pp. 299–304, 2015, doi: 10.1016/j.proeng.2015.01.371.

[5] C. B. Waluyo, A. F. Maksum, and P. Setiawan, “Rancang bangun alat pemilah makanan mengandung logam berbasis Arduino,” ORBITH: Majalah Ilmiah Pengembangan Rekayasa dan Sosial, vol. 19, no. 3, pp. 273–279, 2023, doi: 10.32497/orbith.v19i3.5259.

[6] G. Pramudhito, “Prototipe conveyor belt penyortir objek berdasarkan warna menggunakan kamera Pixy2 dan Arduino ATmega328 dengan aplikasi Visual Basic,” undergraduate thesis, Universitas Diponegoro, Semarang, Indonesia, 2021.

[7] S. Chitra and V. Raghavan, “Conveyor control using programmable logic controller,” International Journal of Advancements in Research & Technology, vol. 3, no. 8, pp. 25–31, 2014.

[8] Z. F. Ikatrinasari, H. Herlambang, and K. Kosasih, “Design and implementation of intelligent electronic component inspection based on PLC and vision system,” Jurnal Sistem dan Manajemen Industri, vol. 7, no. 2, pp. 155–168, 2023, doi: 10.30656/jsmi.v7i2.6511.

[9] G. M. Gu, Y. K. Shin, J. Son, and J. Kim, “Design and characterization of a photo-sensor based force measurement unit (FMU),” Sensors and Actuators A: Physical, vol. 182, pp. 49–56, 2012, doi: 10.1016/j.sna.2012.05.018.

[10] Y. Cheng, X. Lyu, and S. Mao, “Optimization design of brushless DC motor based on improved JAYA algorithm,” Scientific Reports, vol. 14, Art. no. 5427, 2024, doi: 10.1038/s41598-024-54582-z.

[11] R. A. Ahmed and E. D. Hassan, “Modeling, design and control of speed DC motor using chopper,” International Journal of Electrical and Electronics Research (IJEER), vol. 11, no. 4, pp. 1162–1166, 2023, doi: 10.37391/ijeer.110437.

[12] B. Setiawan, “Rancang bangun sistem simulasi pemasangan tutup botol berdasarkan warna terkendali PLC,” unpublished manuscript, Universitas Sebelas Maret, Surakarta, Indonesia, 2022. [Online]. Available: ResearchGate.