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Spreadsheet-Based Automatic Print Cost Calculator

Mokhamad Ariel Fadilah[1)], Izza Anshory[2)], Jamaaluddin[3)], Agus Hayatal Falah[4)]

[1*,2,3,4)] Department of Electrical Engineering, Universitas Muhammadiyah Sidoarjo, East Java, Indonesia
[1)]arieljr140499@gmail.com, [2)]izzaanshory@umsida.ac.id

ABSTRACT

Production cost calculation is a crucial factor that impacts productivity and profitability in the printing industry. This study presents an automatic print costing tool that runs on a spreadsheet and is intended to increase operational efficiency and calculation accuracy in Small and Medium-Sized Printing Enterprises (SMEs). With the use of Esp32 as a microcontroller, TCS3200 and infrared sensors, this project seeks to create an automated print pricing spreadsheet that would help printing SMEs swiftly and precisely determine product prices. This tool's components include an LCD to show the cost computation findings, an infrared sensor to identify the number of printed sheets, a TCS3200 sensor to determine whether or not colored paper is present, and a push button feature to resume the calculation and upload the entire cost to the spreadsheet. The instrument functions effectively and aids users in doing cost calculations in an efficient manner, according to the findings. Despite some challenges, such as slow internet connections that cause delays, to enable effective cost assessment poor internet connection. This strategy should decrease calculation errors and increase manufacturing cost management effectiveness.

Keywords: Spreadsheet; Esp32; TCS 3200; Infrared; Automatic

INTRODUCTION

Small and medium-sized businesses are the primary forces behind the economic growth of our nation. It is anticipated that the utilization of several more desktop and web-based software applications will boost small businesses' profitability(Ulum et al., 2021)(Anshory, 2017). This offset product unit price calculation tool for desktop-based Small and Medium Enterprises is used by Small and Medium Printing Businesses to expedite and lower mistake rates when calculating the cost of items, the quantity of raw materials required, and other procedures(Rochana & Utami, 2021)(Syahrorini & Kurniawan, 2018).

An application for quick pricing determination is required in order to finish the calculation process in SMEs that print. The prior product's drawback was the length of time required to determine the unit pricing because the computation was still done by hand. This led to some errors in determining the cost of goods per unit, the quantity of raw materials required, and other calculations(Zhou et al., 2020)(Solih & Jamaaluddin, 2017). As with Hermawati and Koesdijarto, who created an application to determine the requirements for raw materials, it is anticipated that this software will be able to increase production efficiency in these SMEs(Wulandari & Satria, 2021).

Paper sheet sorting and counting are still typically done by hand in certain organizations. As a result, this work established a method for automatically counting and categorizing paper based on its quality(Nasional et al., 2021). White paper that is spotless and clean is deemed fit for usage(Ibrahim, 2018). On the other hand, paper is deemed unfit for use if strong ink stains show up on it(Suwandahwana, 2019)(Dewantara et al., 2023).

For all circles, printing is an additional option for finishing tasks such as paperwork, reports, payment evidence, and so forth. Printing is therefore crucial to us and can help us finish our task faster(Anshory et al., 2021)(J. Jamaaluddin, 2019). Accuracy and thoroughness are essential in the printing industry to provide good and accurate results yet, in a business that offers print-out services, calculations need to be made quickly and accurately. Then, the computation procedure takes an extremely lengthy time(J. Jamaaluddin & Sumarno, 2017). Consequently, the author's suggestion to create a Price Counter Tool on Print-Out with TCS3200 Color Sensor and Data Logger Storage System can help printing firm owners solve problems(Sulistiyowati et al., 2019)(J. Jamaaluddin & Sumarno, 2017).

Consequently, I used an ESP32 microcontroller linked with an IoT-based Wi-Fi module to develop an autonomous print cost counter in this research, which has a more accurate system than earlier research (Hariyanto & Nasution, 2022). Print shop proprietors can also use spreadsheets for monitoring with a strategy like this(Susanto A et al., 2018)(O. Jamaaluddin et al., 2015).

* Corresponding author

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LITERATURE REVIEW

We may conclude that the research "PROTOTOTIPE PRICE COUNTING TOOL ON PRINTOUT WITH TCS3200 COLOR SENSOR AND DATA LOGGER STORAGE SYSTEM" conducted in 2022 by Muhammad Hariyanto and Mulkan Iskandar Nasution functions as intended. To save logger data, this program still needs the SD-Card module as addition to the RTC, which makes it challenging for people to use(Hariyanto & Nasution, 2022).

A study titled "DESIGN AND MAKING OF A TOOL FOR CONTROLLING THE AMOUNT OF PAPER SHEETS FROM PRINTING PROCESSES" was carried out in 2019 by Ripan Suwandahwana. This research was done for digital independent stalls, the digital independent stall system will determine the deposit value. Members of the automation and robotics laboratory can transact if the deposit amount is sufficient. Members of the automation and robotics lab are required to replenish the deposit amount in the event that it is not(Wisaksono et al., 2020). The deposit amount will be automatically decreased in printing transactions based on the quantity of paper produced. As a result, in order to count the amount of paper sheets printed, a device must be installed on the printer. The installed utility seeks to reduce losses in printer management in digital independent shops. The amount of costs incurred and the number of sheets of paper that have been printed will be displayed on a Liquid Crystal Display (LCD)(Suwandahwana, 2019).

Research conducted by Andreas Lie Alviero and Dimas Setiawan Nugroho (2023), namely the IOT-BASED AUTOMATIC PAPER COUNTING TOOL. This tool uses an IoT (Internet of Things) system, where this tool uses the Nodemcu ESP32 microcontroller and Arduino Uno. The method used in this research is to calibrate the LDR sensor and current with linear regression and Polynomial methods, calculate paper using the LDR sensor, and display the calculation results on the PCT-1 application and 16x2 LCD(Wulandari & Satria, 2021).

Hanna Alifia Putri Riyanto (2021), In the research "SORTIR DESIGN AND AUTOMATIC A4 PAPER SHEET CONTROL USING LDR SENSOR AND BLYNK APPLICATION" LDR sensor is used as a sorting sensor, the resistance value received on the paper reading will be taken into account. When the LDR captures a light resistance value of less than 75 then the paper will be categorized as good quality paper, and vice versa when the LDR captures a light resistance of more than 75 then the paper will be categorized as dirty quality paper. The next process will push the paper to each shelf, this process involves a photodiode as a paper counter(Suprayitno et al., 2015). When the paper passes through the photodiode then the process will count one cycle or one paper. Furthermore, the paper will be separated with different shelves according to the quality of the paper using the MG955 servo motor in testing the servo motor produces an angle movement of 10º for the clean paper shelf and 60º for the dirty paper shelf. After passing the process, the results of all paper data will be sent to the NodeMCU ESP8266 and displayed on the Blynk application(Putri Riyanto, 2021).

METHOD

The main focus of this study is an automatic print cost calculator that uses an infrared sensor and a TCS3200 sensor to determine whether paper is colored or not. The LCD transmits the price to the spreadsheet and shows the entire cost once the price has been determined. The cost computation then resets. The main focus of this study is an automatic print cost calculator that uses an infrared sensor and a TCS3200 sensor to determine whether paper is colored or not. The LCD transmits the price to the spreadsheet and shows the entire cost once the price has been determined. The cost computation then resets(Putri Riyanto, 2021).

System Design

This tool's design is divided into three sections. Wiring design, which describes the components that will be utilized in the system and their connections, is the first step in the system design process. Creating a block diagram, which illustrates the system's input, processing, and output components as well as their relationships, is the second step. The third step entails drawing a flowchart that shows the workflow of the system and the interactions between its various parts. These three sections offer a thorough grasp of the architecture and functioning of the system.

Wiring Design

The hardware circuit of the Spreadsheet-Based Automatic Print Cost Counter control system has an ESP32 module component as a microcontroller, and there are other components such as 16x2 i2c LCD, Infrared Sensor, TCS3200 Sensor and Push Button.

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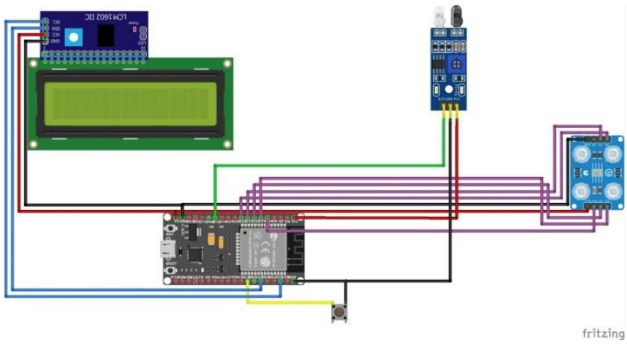

Source: Researcher Property
Fig. 1 Wiring Design

The pin connections between the NodeMCU and the infrared sensor, TCS3200 sensor, push button, LCD, and other system components are displayed in Table 1. The pins of the NodeMCU that are connected to each component's input/output pins and the type of connection (such as digital, analog, I2C, etc.) are most likely displayed in the table. For the system to work correctly, the pin connections need to be made correctly.

Table 1

NodeMCU Port Usage

NO	NodeMCU Port	Usage
1	GND	GND TCS3200 SENSOR
2	5V	VCC TCS3200 SENSOR
3	D5	S0
4	D17	S1
5	D19	S2
6	D23	S3
7	D18	OUTPUT TCS3200 SENSOR
8	3.3V	VCC INFRARED SENSOR
9	A0	OUTPUT INFRARED SENSOR
10	GND	GND INFRARED SENSOR
11	VIN	VCC LCD
12	GND	GND LCD
13	D21	SDA LCD
14	D22	SCL LCD
15	D15	RIGHT FOOT PUSH BUTTON
16	GND	LEFT FOOT PUSH BUTTON

Block Diagram

The block diagram of the entire system is made to simplify the design and production of the tool. The following is a block diagram of the Spreadsheet-Based Automatic Print Cost Counter control system shown in the Figure 2.

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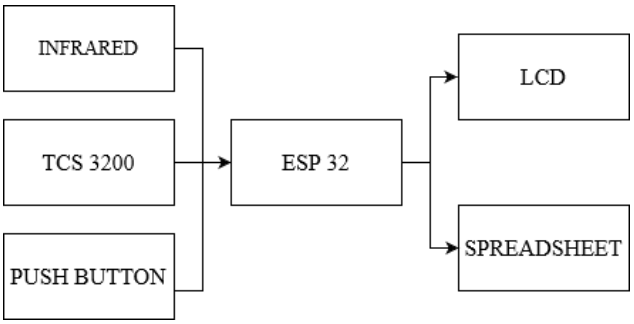

Source: Researcher Property

Fig. 2 Block Diagram

The hardware consists of 5 parts, namely, infrared sensor, TCS3200 color sensor, push button, EPS32, and 16x2 i2c LCD, and also 1 database to accommodate the calculation results in the spreadsheet [9]. The infrared sensor here functions as a paper detector, while the TCS3200 color sensor here functions as a detector whether the print is color or black and white (grayscale), the push button functions as a reset button and also as a data uploader to the spreadsheet, the ESP32 functions as a microcontroller, and the lcd16x2 i2c functions to display the results of the print calculation.

System Flowchart

Flowchart of the Control System for the Spreadsheet-Based Automatic Print Cost Calculator starts with connecting the ESP32 to the internet. If it is online, the TCS3200 sensor and the Infrared sensor read the print. If the print is colored, the cost per sheet is Rp. 1000 if not, it is Rp. 500. The total print cost is then calculated and displayed on the LCD. The calculation results are then reset and the total print cost calculation results are uploaded to spreadsheets by pressing the push button.

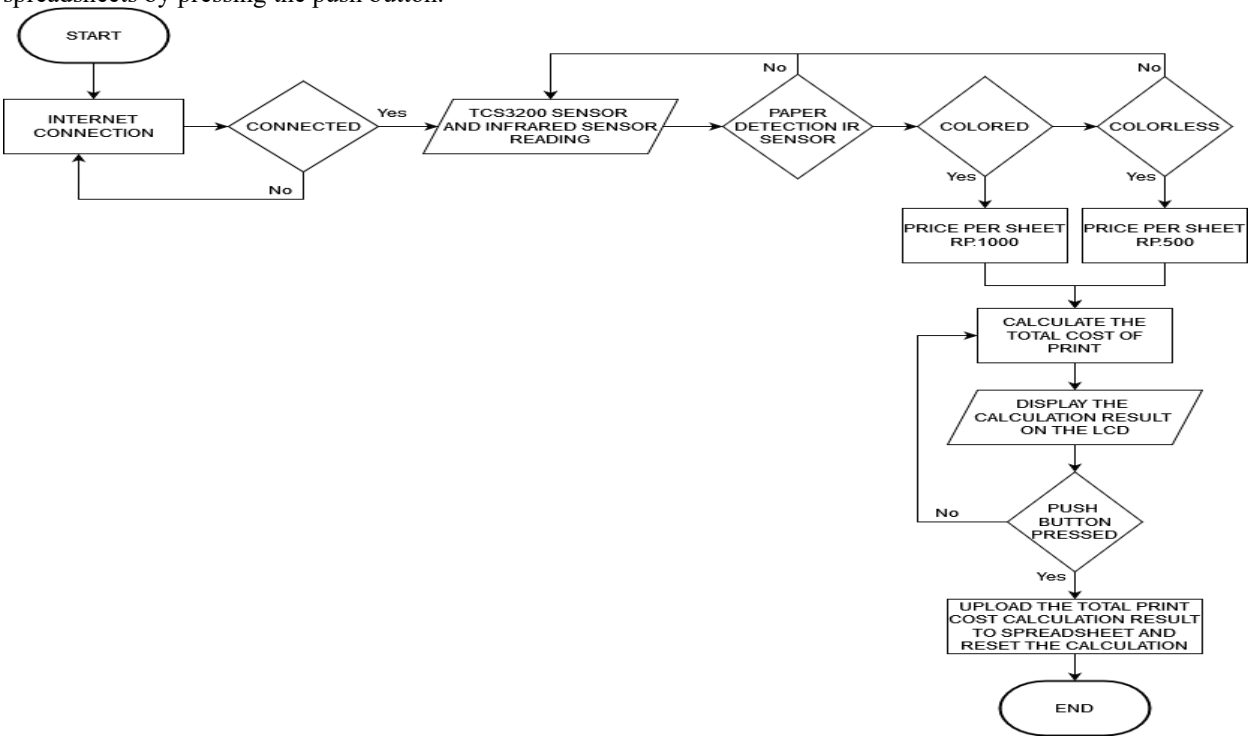

Fig. 3 System Flowchart

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RESULT

These are the outcomes of the tool's realization. Figure 4 shows the tool's realization. The following numbering will be used to explain the tool's components: 1. ESP32, 2. LCD 16x2 i2c, 3. Push-Button, 4. Infrared Sensor, 5. TCS3200 Sensor

How to use this tool is as follow :
1. Connect the ESP32 to the internet
2. if it is connected, the TCS3200 sensor and Infrared Sensor read if the print is in color, the price per sheet is Rp.1000 if the print is not in color, the price per sheet is Rp.500
3. After that, calculate the total print cost and display it on the LCD, then the push button is pressed to upload the total print cost calculation results to spreadsheets and reset the calculation results.

ESP32 to Spreadsheet connection testing

Testing the Wi-Fi connection to the NodeMCU ESP32 was tested with a waiting time of 5 and 6 seconds, and the test results are shown in Table 2. The test results show that the ESP32 can establish a medium-speed Wi-Fi connection. establish a medium-speed Wi-Fi connection.

Table 2. Wifi ESP32

Testing to-	Condition	Waiting Time (s)	Speed
1st Test	Connected	5	Medium
2nd Test	Connected	6	Medium
3rd Test	Connected	5	Medium
4th Test	Connected	5	Medium
5th Test	Connected	6	Medium
6th Test	Connected	5	Medium
7th Test	Connected	6	Medium
8th Test	Connected	5	Medium
9th Test	Connected	5	Medium
10th Test	Connected	6	Medium

5v power supply testing

Table 3 shows 10 tests of 5 volt voltage with a multitester. This test obtained a deviation of 0.0 and 100% accuracy, and it can be concluded that the voltage used of 5 volts in this tool is accurate. This 5 volt voltage will be used for the power supply of the output control circuit.

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Table 3. 5v power supply testing

Testing to -	Voltage needed (V)	Multimeter (V)	Deviation (V)	Accuracy (%)
1	5	5	0	100
2	5	5	0	100
3	5	5	0	100
4	5	5	0	100
5	5	5	0	100
6	5	5	0	100
7	5	5	0	100
8	5	5	0	100
9	5	5	0	100
10	5	5	0	100
Average	5	5	0	100

Testing TCS3200 Sensor

The outcomes of 10 tests clearly show that the TCS3200 sensor operated as intended and adhered to the guidelines. observing the guidelines provided. The accuracy of the TCS3200 sensor commands and readings for both color and black and white paper is demonstrated by the test results in Table 4. This suggests that there has been enough testing and validation done on the TCS3200 sensor.

Table 4. Testing TCS3200 Sensor

Testing to-	Number of Tests	Read		Description
		Color	Black	
1st Test	5 sheet	2	3	Success
2nd test	2 sheet	2	0	Success
3rd test	4 sheet	3	1	Success
4th test	9 sheet	8	1	Success
5th Test	11 sheet	8	3	Success
6th test	8 sheet	1	7	Success
7th test	4 sheet	0	4	Success
8th test	5 sheet	2	3	Success
9th test	6 sheet	1	5	Success
10th Test	5 sheet	2	3	Success

Testing Infrared Sensor

The results of the ten experiments using infrared sensors matched the commands. Good results were frequently seen in the tool test findings displayed in Table 5. All of the infrared sensor tests were accurate and matched the commands, meaning that every one of them functioned properly.

Table 5. Testing Infrared Sensor

Testing to-	Number of Tests	Read	Description
1st Test	5 sheet	5 sheet	Success
2nd test	2 sheet	2 sheet	Success
3rd test	4 sheet	4 sheet	Success

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4th test	9 sheet	9 sheet	Success
5th Test	11 sheet	11 sheet	Success
6th test	8 sheet	8 sheet	Success
7th test	4 sheet	4 sheet	Success
8th test	5 sheet	5 sheet	Success
9th test	6 sheet	6 sheet	Success
10th Test	5 sheet	5 sheet	Success

Overall Testing

Ten testing of spreadsheet apps and print prices with ten distinct individuals are displayed in Table 6. It is clear from the test results that the spreadsheet-based automatic print cost calculator can be used effectively.

Table 6. Overall Testing

Testing to-	Printer		Read IR Sensor	Read TCS Sensor		Price	Spreadsheet
	Color	Black		Color	Black		
1st Test	2	3	5 sheet	2	3	3500	Uploaded
2nd test	2	0	2 sheet	2	0	2000	Uploaded
3rd test	3	1	4 sheet	3	1	3500	Uploaded
4th test	8	1	9 sheet	8	1	8500	Uploaded
5th Test	8	3	11 sheet	8	3	9500	Uploaded
6th test	1	7	8 sheet	1	7	4500	Uploaded
7th test	0	4	4 sheet	0	4	2000	Uploaded
8th test	2	3	5 sheet	2	3	3500	Uploaded
9th test	1	5	6 sheet	1	5	3500	Uploaded
10th Test	2	3	5 sheet	2	3	3500	Uploaded

DISCUSSION

In the research above, the results are very good with the criteria needed by SMEs, but for further research, the spreadsheet can be changed to a more universal one such as telegram or blynk so that many can use this tool. we know that not many people understand spreadsheets and can use them.

CONCLUSION

The internet connection test appears to be operating at peak efficiency, and the device can be linked in order to transfer the spreadsheet with the findings of the cost calculation. despite the fact that the average wait time for a connection is still five seconds. According to the TCS3200 sensor test findings, it can read both black and white and colorful paper. This sensor is highly accurate for testing infrared sensors and can determine how many sheets of paper exit the printer.

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