Design of Automatic Coffee and Milk-Making Machine Based on Arduino

Sujono[1], Riski Sihab[2], Nurul Yaqin[3]

* Informatics Study Program, Faculty of Information Technology, University of KH. A. Wahab Hasbullah

Correspondence Author: sujono@unwaha.ac.id

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ABSTRACT

Coffee is a popular drink all over the world and comes from the seeds of the coffee plant. The coffee production process includes several stages, such as harvesting, processing, grinding, and roasting. Each stage affects the quality and taste of the coffee produced. This machine is designed to use 2 Arduino Unos as controllers with I2C communication. The purpose of this research is to design and conduct trials on the process of making Arduino-based automatic coffee drink machines. the method in this study uses the waterfall method which includes analysis, design, coding and testing. The machine testing stage is carried out on the servo to measure coffee, milk and sugar, the tool test is also carried out on an electric heater to adjust the water temperature. sugar 3.2 - 3.7 grams, bitter coffee measures between 5.2 - 5.8 coffee with a sugar ratio of 3.0 - 4.0 grams, moderate coffee measures between 2.3 - 2.7 with a sugar ratio of 2, 0 – 2.4 grams, Milk measures between 5.1 – 5.8 gram with sugar ratio between 3.1 – 3.5 gram and coffee milk measure with ratio 4.2 – 4.8 for a coffee measure, 3.2 -3.3 grams for the sugar measure and 3.2 – 3.3 grams for the milk measure

1. INTRODUCTION

Coffee shops are a comfortable place to hang out with friends, family and even people you don't know. Coffee shops now don't only sell coffee, but a variety of drinks are also available. Most of the manufacture of coffee drinks that are sold in coffee shops are still manual or still use human hands in the process of brewing coffee or other drinks, such a manual method usually does not measure according to the desired taste (Laksono et al., 2020), the presence of the industrial revolution 4.0 at this time it provides distinct advantages for small business actors, because the industrial revolution 4.0 almost all fields and sectors have started to use technology to replace human power with machine power (Kom et al., 2021).

According to Dedek Dermawan in previous research, (Dermawan et al., 2021)Automatic coffee maker is a technology created to simplify and speed up the process of making coffee drinks and other drinks The problem in making coffee and milk using a machine when the servo is working to determine the dosage of coffee, sugar and milk to produce the right taste is the time delay of the servo and the diameter of the outlet in the coffee, sugar and milk storage area in research conducted by Bakrie et al (Bakhri et al., 2020).

In research conducted by Deni Tri laksono (Laksono et al., 2020)for water heating in the manufacture of coffee drinks using an Electrical Heating Element, which is usually used daily in the household therefore here the author makes an automatic coffee and milk drink maker machine that can work automatically which later is expected to make it easier to make coffee and milk drinks. This machine for making coffee and milk drinks uses 2 microcontrollers (Arduino uno) which are

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integrated using i2c serial communication, one Arduino as the master and the other as a slave. i2c itself stands for a linear integrated circuit, i2c is a two-way serial communication standard, and i2c uses 2 pins SCL (Serial clock) and SDA (serial data) as a communication line (Sulistyo et al., 2014).

2. METHOD

In this study, the system development method used is the waterfall method. (Wahyudi et al., 2021) The waterfall is method with an application development process which emphasizes methods with an application development process which emphasizes sequential phases. For the development model, it can be analogous to passing through a ladder, where each stage is carried out sequentially from top to bottom. These stages are in the form of system requirements planning, system and software modelling, implementation and coding, and finally the testing phase. The flow of the waterfall method can be seen in Figure 1

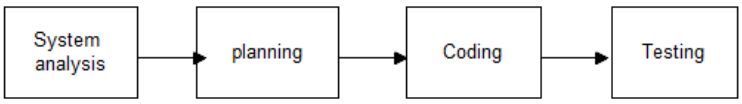

Figure 1. Waterfall Method

The system analysis stage is carried out by researchers to carry out the process of analyzing system requirements which include all system requirements and make complete specifications about the contents of the system. The next step is design stage in this research is to make machine designs, flowchart designs, and electronic system designs. At this coding stage, the researcher uses the Arduino IDE to write programs and uses the default Arduino language with the .ino extension which is derived from the C/C++ language. The last step is testing, the testing phase aims to find out the errors that can be found in automatic coffee and milk brewing machines and ensure the suitability of the running system with the desired concept and plan. In the testing process, the researcher uses the Black Box method, namely by testing the existing tools and systems one by one on automatic coffee and milk brewing machines.

A flowchart is a medium for describing the process logic flow in a system design or a series of devices on a machine. The logic flow of this machine begins with detecting the condition of the water whether it is in the hot category or not, if not, then it is given a timeframe to wait for the water to be ready first. When the water is hot, it requires the input of ordering data which includes a choice between coffee, milk or coffee milk. After inserting the coin as a means of payment, when the coin has been inserted then it is detected whether the coin is by the price of the product, if it is appropriate then the machine will carry out the process of preparing the product ordered. The flowchart of this coffee mixer machine is presented in Figure 2 below:

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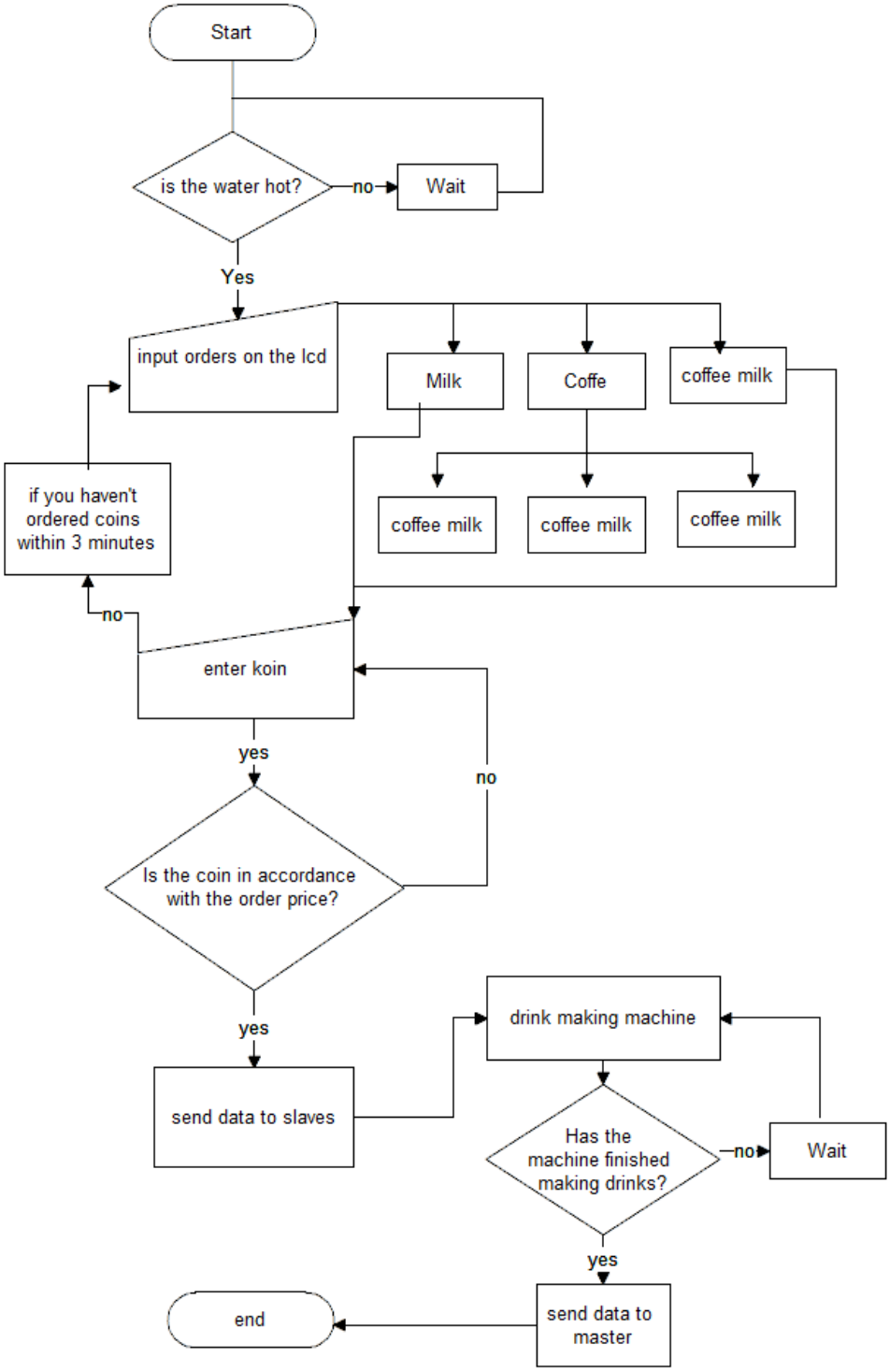

Figure 2. The Flowchart of Machine

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The schematic circuit used to make this machine can be described in Figure 3 below:

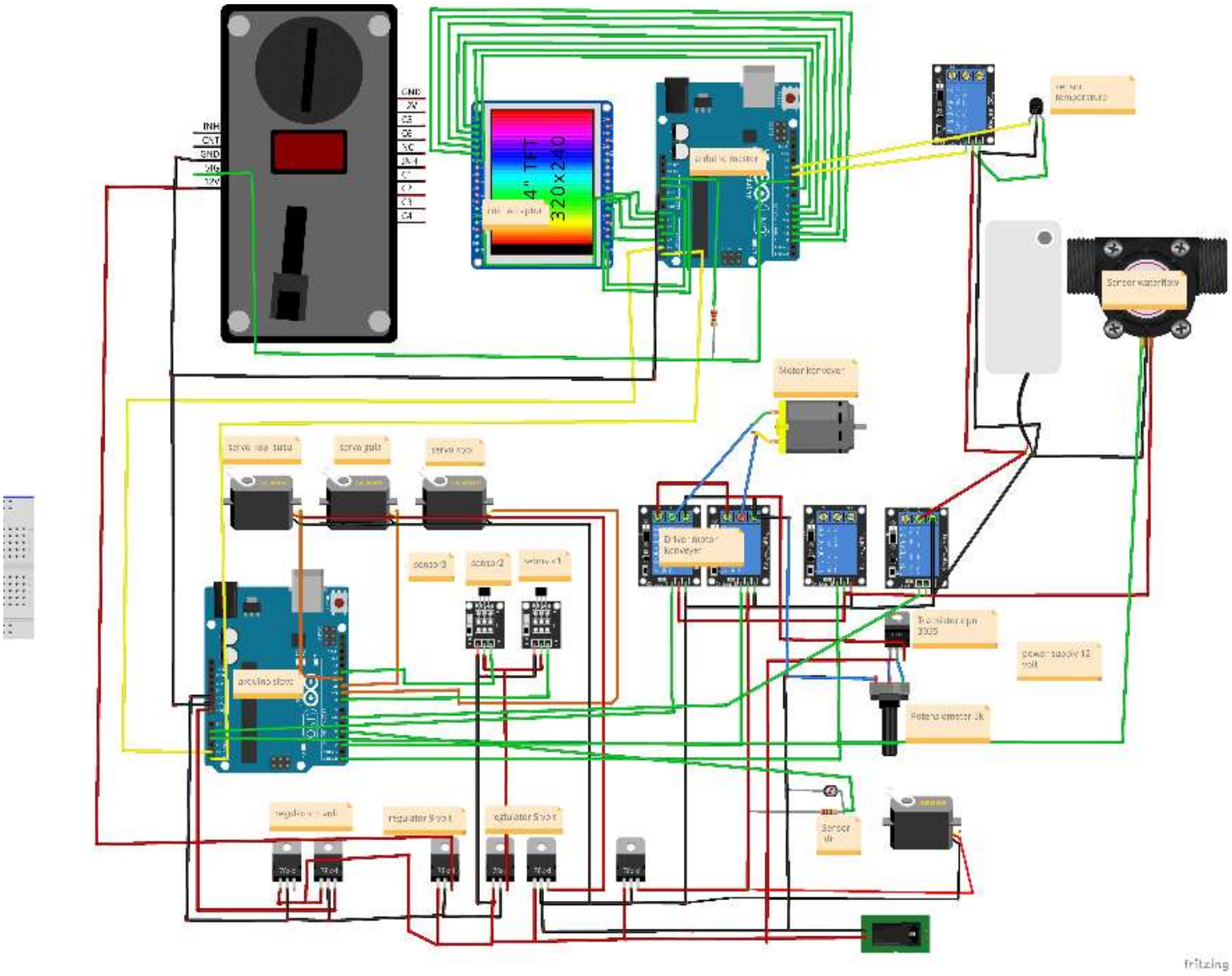

Figure 3. The whole range of arduino-based automatic coffee and milk makers.

3. RESULTS AND ANALYSIS

The results and discussion regarding the planning test of the tool to be made, the purpose of testing this tool is to prove whether the designed system meets the expected expectations or not, this test includes:

3.1. Tool Analysis and Testing

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Conveyer Motor Test Analysis

Table 1 Data analysis of conveyor motors

Testing	Voltage	Results
1	11 volt Dc	The motor is too fast, and the water in the glass is spilled
2	9 volt Dc	The motor slowed down a bit, the water in the glass was still spilt
3	8 volt Dc	The motor slowed down a bit, the water in the glass was still spilt
4	7 volt Dc	The motor slows down a little, the water in it shakes a little
5	5 volt Dc	The motor slows down a bit, the water in the glass is stable and doesn't spill

From the results above for the voltage used so that the dc motor on the conveyor runs stable and the water in the glass does not spill as much as 5 volts

Analysis Results of Servo Motor Testing for Sweet Coffee

Table 2 Data Analysis of Sweet Coffee Servo Motor Testing

Testing	Rotation 70°	sugar volume (gram)	Coffe volume (gram)
1	3 Period	3,3	3,6
2	3 Period	3,7	3,3
3	3 Period	3,5	3,0
4	3 Period	3,6	3.5
5	3 Period	3,5	3,2

The results of the table data above from the servo motor test at the sweet coffee measure are 3.2 – 3.6 grams for the coffee servo motor and 3.3 – 3.7 for the sugar servo motor.

Servo Motor Test Analysis Results for Bitter Coffee

Table 3 Data analysis of bitter coffee servo motor testing

Testing	Rotation 70°	Sugar Volume (gram)	Coffe volume (gram)
1	3 Period	3,0	5,6
2	3 Period	3,3	5,2
3	3 Period	3,9	5,8
4	3 Period	3,5	5.3
5	3 Period	4,0	5,4

The results from the data table above testing the servo motor at a bitter coffee dose are different from the tests carried out for sweet coffee, in the experiment to determine the coffee dose a

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little more around 2 grams, namely 5.2 – 5.8 grams for coffee servo motors and 3 .3 for sugar servo motors

Results of Medium Coffee Servo Motor Test Analysis

Table 4 Data analysis of sweet coffee servo motor testing

Testing	Rotation 70°	Sugar Volume (gram)	Sugar Volume (gram)
1	2 Period	2,3	2,4
2	2 Period	2,5	2,3
3	2 Period	2,8	2,0
4	2 Period	2,3	2.5
5	3 Period	3,7	3,2

The results of the table data above from testing the servo motor at medium coffee doses are 2.3 – 2.7 grams for coffee servo motors and 2.0 – 2.4 for sugar servo motors

Servo Motor Test Analysis Results for Milk

Table 5 Analysis of Milk Servo Motor Testing Data

Testing	Rotation 70°	Sugar Volume(gram)	Rotastion 140°	Milk Volume (gram)
1	3 period	3,2	3 period	5,6
2	3 period	3,1	3 period	5,2
3	3 period	3,3	3 period	5,8
4	3 period	3,2	3 period	5.3
5	3 period	3,5	3 period	5,4

The results of the table data above from testing the servo motor at the milk dose are 5.2 – 5.8 grams for the sugar servo motor and 3.2 – 3.3 for the sugar servo motor

Servo Motor Test Analysis Results for Milk Coffee

Table 6 Data analysis of coffee milk servo motor testing

Testing	Rotation70°	Sugar Volume(gram)	Coffe Volume(gram)	Rotation140°	Milk Volume(gram)
1	3 period	2,2	4,6	3 period	3,3
2	3 period	2,1	4,2	3 period	3,2
3	3 period	2,3	4,8	3 period	3,2
4	3 period	2,2	4.3	3 period	3,2
5	3 period	2,5	4,4	3 period	3, 3

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The results of the data table above from testing the servo motor at coffee and milk measurements are 4.2 - 4.8 grams for coffee servo motors, 2.1 - 2.5 grams for sugar servo motors and 3.2 - 3.3 grams for coffee servo motors. milk servo motors

Coin Acceptor Test Analysis Results

Table 7 Coin Acceptor Test Analysis Data

Experiment	Coin testing (Rupiah)	Coin condition	Results
1	500	Good	coin detected
2	1000	Good	coin detected
3	200	Good	coin not detected
4	100	Good	coin not detected
5	500	Damaged	coin not detected
6	500	Damaged	coin not detected
7	1000	Damaged	coin not detected
8	200	Damaged	coin not detected
9	100	Damaged	coin not detected

In the data table above the use of 500 and 1000 coins can be detected, this is because the 500 and 1000 coins have been registered and can be recognized by the Coin Acceptor. Apart from coins 500 and 1000 Coin acceptor cannot detect coins, Coin Acceptor can only detect coins in good condition, coins in damaged condition cannot be detected by tools

3.2. Display Results On Lcd Screen

Initial Display When the Machine is Started

When the machine is running, the system will check whether the water is hot, if NO then the system will heat the water first, the estimated waiting time is around 26 minutes and will not continue to display the menu, if YES (the water is already hot), then the system will display the menu. and continue to the next process. The heat temperature used in this study was 80°

Figure 4. Notification Display if the water is not hot

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Menu Display

This initial display is a display for selecting types of drinks such as coffee, milk and mixed (coffee and milk).

Figure 5. Display Menu.

Display Selecting Coffee Flavor

In this view the user can choose the level of taste in the coffee blend including sweet coffee, bitter coffee and medium coffee.

Figure 6. Choosing the Type of Coffee.

Display To Pay

In Figure 7 the LCD displays the drinks ordered, displays the total price according to the order

Figure 7. Display To Pay

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Waiting Order Display and Display Thank you.

In figure 8, the system will display a message that the drink ordered by the user is being made

Figure 8. Display Wait and Display Thank You

Beverage Making Machine Results Display

Final installation of the entire machine as presented in Figure 9 below:

Figure 9. The Display of Whole Machine

4. CONCLUSION

Based on the results and discussion, the authors can conclude as follows:

a) The machine is built using 2 Arduinos with i2c communication

b) Using coin acceptor as a payment medium.

c) TouchScreen TFT LCD is used as a user interface to display menus, total prices and as input sent to Arduino Uno.

The results of making coffee are as follows:

a) The dc motor for the conveyor requires a voltage of 5v to prevent water from spilling

b) Results From a sweet coffee measure between 3.1 – 3.6 grams with a sugar ratio

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between 3.2 – 3.7 grams

c) Results From a measure of bitter coffee between 5.2 – 5.8 grams with a sugar ratio between 3.0 – 4.0 grams

d) Results From a moderate coffee measure between 2.3 – 2.7 grams with a sugar ratio between 2.0 – 2.4 grams

e) Results From a milk measure between 5.1 – 5.8 grams with a sugar ratio between 3.1 – 3.5 grams

f) The results of measuring coffee milk are 4.2 - 4.8 grams for coffee servo motors, 2.1 - 2.5 grams for sugar servo motors and 3.2 - 3.3 grams for milk servo motor measurements

g) Coin Acceptor can only detect Rp. 500 and Rp. 1,000 coins in good condition

5. ACKNOWLEDGEMENTS

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6. DECLARATION OF COMPETING INTEREST

We declare that we have no conflict of interest.

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