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Design and Construction of an Automatic Coffee Drink Mixing Machine Based on Arduino

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Abstract: The development of science and technology is growing very rapidly along with the increasing knowledge of technology such as automatic coffee drink mixers. An automatic coffee brewing system is a system that can make human work easier and shorten time. This study aims to design an automatic coffee brewing tool. The methods and materials used are the design of a coffee machine, Arduino, MIT App Inventor, Servo Motor, Atmega328 Microcontroller, and Power Supply. The design is built using an Arduino system connected to Bluetooth so that making coffee drinks is fast, effective, and does not require an internet network. The hardware system uses a block diagram. The ATMega 328 microcontroller is written using Arduino IDE 1.6 software, so the entire contents of the program have been entered into the microcontroller chip via an interface with a computer. The results of the study show (1) The drink mixer system is still carried out using the IOT with an internet system. (2) The process of providing sugar, coffee, water, and stirrers is still done by estimating the ingredients and the stirrer is not good. (3) The measurements are still standardized.

Keywords: Beverage Making; Android; Technology; Robotic.

INTRODUCTION

The advancement of technology today is very rapid and has an impact on sophisticated life, namely with tools that work automatically have high accuracy, and can facilitate the work done by humans. This development is what drives humans to do automatic activities.

The rapid development of automatic technology is currently spreading to all fields, one of which is the culinary field, namely with the emergence of automatic food or beverage-making machines. Automatic machines can be interpreted as a technology designed with the aim of replacing activities carried out by human hands with activities that can work by themselves with the help of machines.

Coffee drinks are in demand at almost all levels of society. Along with the high level of community activity, everything is required to be instant and efficient. In general, when making coffee we have to prepare coffee powder, hot water, sugar, cream, spoons, and glasses. After that, we pour coffee powder, sugar, and creamer into the glass and boil the water. After the water boils, we pour hot water into the glass and then stir until evenly mixed(Arif Kurniawan, 2018).

With the development of coffee oven machines, the demand for technology is also increasing. Therefore, the use of technology is getting higher and higher, especially with the presence of machines, so the industry needs a coffee oven machine to get quality coffee and a good price. Starting from the existing coffee oven machine which is still used without a coffee maker. The temperature control system has been restored(Hardiyansyah, 2021).

How to make coffee manually by mixing all the ingredients such as coffee, milk, sugar, and brewed with warm water. This measurement method is sometimes not appropriate because the taste of the coffee produced is different. Therefore, an automatic coffee maker will be designed. So that the taste measurement in making min (Laksono et al., 2020).

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Temperature is one of the important variables in knowing the change in the state of a substance or object. By knowing the change in temperature, the physical changes can also be known, one way to monitor temperature is to use an infrared sensor. With this sensor, you can monitor the temperature by bringing the sensor closer to the object whose temperature will be measured. So that by knowing the results of measuring the temperature of the object, you can conclude whether the human object is at a normal or abnormal temperature. The advantages of this sensor are sensitive to(Ardiyanto et al., 2021).

This study, it is proposed to create an IoT-Based Automatic Coffee Drink Machine with a control and monitoring system via a smartphone with the aim that the machine can be used as a business medium. Because this machine is only in the early stages of manufacture, the payment system has not been included due to(FURQAN, 2023).

Coffee drinks are usually consumed as drinks to relieve drowsiness during long trips. However, because of the current level of busyness in society, especially in the world of work, this makes them not have much time and only have a relatively short break to drink a cup of coffee(Pratama et al., 2022).

in his research, he created an Arduino-based Automatic Drink Maker with an Android ordering system. By using this system, consumers do not need to order and wait for drinks to be made in front of the machine, just sit on a chair and the machine will do the rest. However, this Arduino-based Automatic Drink Maker does not have a system for monitoring the remaining ingredients and the temperature of the drink. So the seller does not know if the machine can still be used(Pratama et al., 2022).

This tool works according to the button commands that have been prepared by the tool designer, so that coffee shop workers only need to press the selected button on the tool and the tool will automatically work according to the selected command or button. The first button will be set with the command to make coffee mixed with sugar, while the second button is set with the command to make coffee mixed with milk, water then stirred, and then the third button is set with the command to make cappuccino coffee water mixed with sugar, water and stirred, then the last fourth button is set with the command to make mochaccino coffee mixed with sugar, water and then stirred(Fikri Alfaridzi & Agustiawan, 2020).

Based on the problems in previous studies, the author in this case wants to create a system that works automatically as a whole, by connecting the system to Android to make it easier to serve coffee drinks by the public.

LITERATURE REVIEW

According to KBBI (Kamus Besar Bahasa Indonesia), the word “plan” is the root word of “design,” which means to arrange everything (before acting, working, or doing something) or planning. Design is a stage of planning (design) that aims to design a new system that can solve the company's problems, which is obtained from the selection of the best system alternatives (Suryanto et al., 2022).

Design Build is the activity of translating the results of analysis into the form of software packages and then creating the system or improving the existing system. (Plan to Build E-Voting Application General Election Informatics Students Association (HTMI) Cokroaminoto Palopo University Based Website (Samania et al., 2020).

A machine is a tool driven by a force or power used to assist humans in working on a particular product. Machines are useful for converting force into energy, which can then be utilized by humans for activities. A coffee machine is a device that works to produce or make processed coffee in the form of coffee drinks of various varieties and flavors (Triana & Sarifah, 2023).

Peracik comes from the root word race. Peracik has a meaning in the class of nouns, so peracik can express the name of a person, place, or all objects and everything that is objectified. According to KBBI (Big Dictionary of Indonesian Language), the meaning of the word pericik is the person who mixes. The word coffee roaster comes from the Italian word for Tender. However, as time went on the word Bartender was changed to coffee brewer as it is now often called (Firmawati et al., 2019).

Drinks are the most important human need. Currently, drinks are sold in a variety of different types of flavors and sizes as well as a variety of attractive, practical, and easy-to-store packaging. Drinks are a substance that a living being desperately needs, which is useful for its survival. To drink etymologically means to swallow a liquid item with the mouth, whereas a drink is anything that is permissible to drink (Janna et al., 2021).

Android is an operating system that was developed as Linux-based mobile devices such as smartphones and tablet computers. Android is an open-source Linux-based mobile phone operating system whose source code is provided free of cost to the developers to create their applications in order to run on Android (Hamzanwadi et al., 2022).

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METHOD

According to KBBI (Big Indonesian Dictionary), the word "ranking" is the basic word of "meaning" which means arranging or planning everything (before doing, working on, or doing something) or planning.

Design and Build is the activity of changing the results of the analysis into a software package to create the system or improve the existing system.

A coffee machine is a tool that can be used to prepare processed coffee in the form of various types and flavors of coffee drinks. The types of machines for making coffee drinks are divided into five types, namely super-automatic, automatic, semi-automatic, manual, and commercial machines.

A semi-automatic system is a manufacturing system that combines human power with automatic machines to produce goods. In this system, some tasks are performed by human operators, while others are completed by machines. For example, a semi-automatic assembly line may use machines to perform repetitive tasks such as welding or cutting, but human workers may be responsible for loading and unloading components, inspecting products, and conducting quality control checks.

A fully automated system, as the name suggests, is a fully automated system. In a fully automated system, machines are used to perform all tasks in the production process, from assembly to quality control. Human workers may be involved in setting up or maintaining the machine, but they are not involved in the day-to-day operation of the system(Naim, 2021).

Arduino is an electronic kit or open-source electronic circuit that contains basic components, namely a microcontroller chip with the AVR type from the Atmel company. The microcontroller itself is a chip or IC (integrated circuit) that can be programmed by a computer(Fahmizal et al., 2021).

Arduino is a microcontroller board based on Atmega32 which has 14 I/O pins with 6 pins that can be used as PWM output, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP head, and a research button. Arduino can be connected to a computer using a USB cable and is able to support microcontrollers, an example of an Arduino image can be seen in Figure 1 below.

Figure 1. Arduino board

MIT App Inventor is a web-based software used to create Android-based applications without coding because this app inventory has a visual programming feature. App Inventor uses a graphical interface that allows users to drag and drop a visual object to create applications that can run on the Android system, which is currently used by many mobile devices. A servo motor is a device or rotary drive (motor) designed with a closed control system (loop) (servo) so that it can be adjusted or set to determine and ensure the angular position of the motor output shaft, an example of a servo motor image can be seen in the following image.

Figure 2. Servo Motor

Some of the supporting components of a process in designing an automatic coffee brewing machine can be explained as follows(Suhartono et al., 2023):

1. Resistor
   Resistors or resistance are components that are useful for inhibiting electric current with the aim of regulating the electric current that regulates a circuit.
2. Capacitors

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Capacitors are components that are commonly used to store electric charge and the size of the electricity that can be accommodated is called capacity.

3. Transistors
   Transistors are semiconductor devices that are used as amplifiers, circuit breakers and current connectors (switching), voltage stabilization, and signal modulation.
4. Step Down
   Step-down transformers function to reduce AC voltage. In the simple part of a step-down transformer, the number of primary turns is more than the number of secondary turns.

A physical system is a system whose components are real objects that can be seen. For example, hardware systems, memory, monitors, keyboards, CPUs (central processing units), and others.

An abstract system is a system whose components cannot be seen. For example, an operating system (OS). A computer consisting of a set of instructions in a language understood by a computer machine(Arifin et al., 2021).

The Atmega328 microcontroller is a chip that functions as a controller or controller of electronic circuits and can generally store programs in it, programs in the Atmega328 microcontroller can be erased and rewritten(Khakim, 2023). An example of Atmega328 we can see in the following Figure 3:

Figure 3. Atmega328

The power supply is a tool or hardware that is able to supply power or electrical voltage directly from another source of electrical voltage. This device provides direct current (DC) voltage needed by computer hardware (such as devices). Fan, hard disk, motherboard, and so on. Power Power supply also has a connector in the form of a cable, and each cable connector has different functions and capabilities that are needed by the computer, and an example of a power supply can be seen in Figure 4 below.

Figure 4. Power Supply

In this writing, the author analyzes previous research work as a reference source that can help the author to analyze the current system and analyze the system to be built.

The system currently used to make coffee drinks uses an online network system (internet) to run the coffee drink program. However, the application used to order drinks can only be used around the machine or within the machine network, and the measurements used are only in milliliters. Based on the analysis of the results of the ongoing system testing, it can be seen that the system performance, coffee drinks are slightly less efficient and do not function properly and still require the development of a more effective and efficient system.

The design that will be built is a design using an Arduino system connected to Bluetooth as a program process for making coffee drinks, so that the process of sending data for this coffee drink-making program is faster, more effective, and does not require an internet network for the manufacturing process, just by using Bluetooth we can make it. The system to be developed uses Arduino Atmega328 as a logic control center and data processing for

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both input and output based on Android Bluetooth. This Arduino Atmega328 will regulate all the work of the tool, then the system will work according to the commands that come out through the server.

From the results of the analysis above, the author continues to create a picture or design that will be built as follows, which can be seen in Figure 5 below:

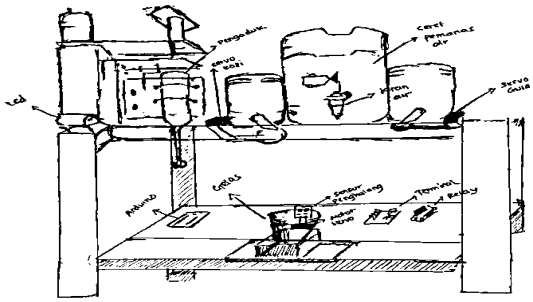

Figure 5. Initial Design of System Design.

In the hardware system design process, a block diagram is used which is a basic description of the system to be designed. Each block diagram has its own function. The following can be seen in Figure 6 below:

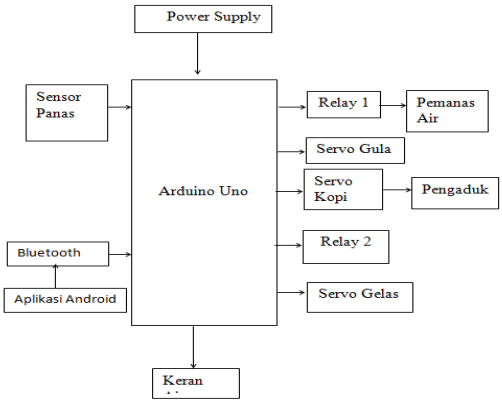

Figure 6. Block Circuit Diagram

Below is an explanation of each of the block diagrams of the coffee maker, namely:

1. Arduino is the main processing component tool that controls the work. The components included become an overall system as a center for processing Output and Input data.
2. Relay 1 as turning the water heater on and off.
3. Relay 2 as a regulator for raising and lowering the coffee stirrer.
4. Water Heater as a container where water is heated.
5. Sugar Servo is a place to remove sugar from its container.
6. Coffee Servo as a place to remove coffee powder from its container.
7. Glass Servo as a container to the right or left to accommodate the fall of sugar or coffee powder.
8. Stirrer as a tool for stirring the coffee that has been made.
9. Power Supply as a source of voltage to supply the entire circuit so that it can work.
10. Heat Sensor a tool used to convert heat quantities into electrical quantities that can more easily analyze the magnitude in other words regulating the temperature of the hot water.
11. Water Tap Functions as a water discharge process.
12. Android applications are used to control the running settings of a system.
13. Bluetooth functions to connect peripherals to mobile phones, desktops, Arduinos, and laptops wirelessly.

The design stage is a step in determining the course of a system that has been built. The manufacturing flow of the designed system is shown in Figure 7 below.

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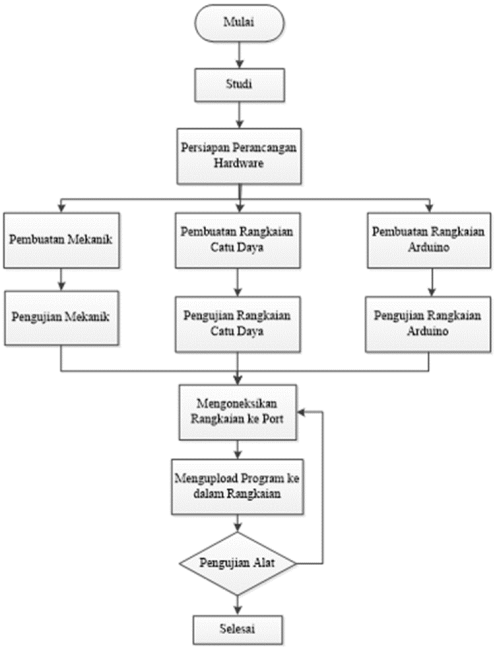

Figure 7. Flowchart Flow Diagram

The ATMega 328 microcontroller is written using the Arduino IDE 1.6 software, after the program has been written, the entire contents of the program have been entered into the microcontroller chip via an interface with the computer. So that the entire program has been entered and can be read by the microcontroller and then from the program the microcontroller can control the system according to the program instructions given/entered.

A microcontroller is an IC (Integrated Circuit) that contains a complex logic circuit that performs processing. The microcontroller has a memory so that it can store programs to perform control. On Arduino there is a special program for data communication as well as for translating the Arduino programming language, this program is called a bootloader. The bootloader functions to bridge the Arduino program created with ATMega hardware like the operating system on a computer that bridges the hardware and software. Therefore, in order for a microcontroller to function as an Arduino, the appropriate bootloader must first be entered. The bootloader can automatically be entered into the microcontroller using the Arduino IDE.

The software used in the design of an automatic coffee maker machine based on Arduino is:

1. Software Arduino Uno IDE 1.6
   Arduino IDE 1.6 software is an IDE compiler for the Arduino microcontroller family, where the language used is C language which is easier to understand and very suitable for hardware design needs. This compiler is also very effective because it will provide information messages to one if there is a wrong language or program list. This Arduino has 14 I/O pins with 6 pins that can be used as PWM Output, 6 analog Inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP head, and a research button. Below can be seen in figure 8 and figure 9 of the following Arduino software:

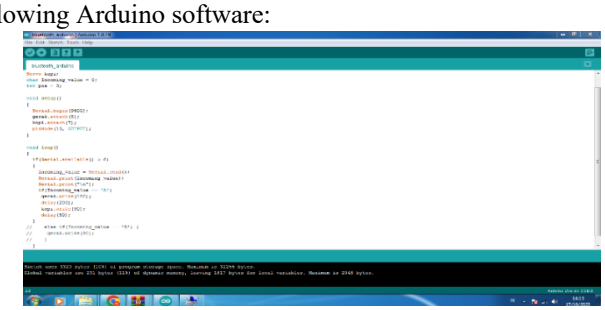

Figure 8. Arduino program display.

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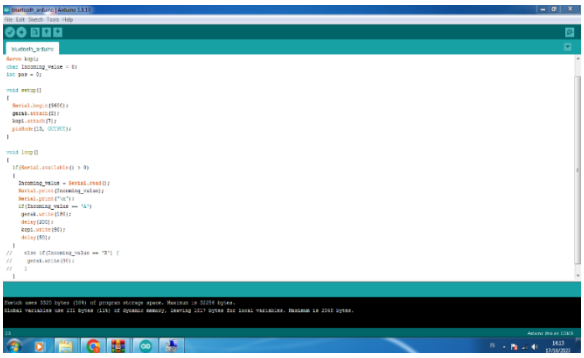

Figure 9. Arduino program display.

2. MIT App Inventor
   MIT App Inventor is a program offered by MIT, with the help of this web program the author designs and creates an Android program for the user interface, which is then installed on a tablet or smartphone with an Android-based operating system. This program is designed to facilitate the creation of simple programs without having to do too many programming languages. We can design Android applications according to different layouts with available components. Before using the App Inventor software, make sure to first access MIT App Inventor online, by visiting the appinventore.mit.edu site. by entering your Google account username and password, creating a new project by clicking the Start New Project button or via the project menu >> start new project >> to provide a name >> adding components as needed and setting the block editor >> start coding using blocks >> test the application that has been created and requires a Smartphone connected to the internet. Below you can see image 9 of the following MIT App Inventor Application:

Figure 9. MIT App Inventor Application View.

RESULT

Based on the design analysis from the system analysis stage, system design, and system testing as well as the overall working system of the tool, both hardware and software, have been tested in one of the Robotics Lab rooms of the Indonesian Institute of Technology and Business, Deli Serdang and can function as desired, with the following results:

1. Bluetooth Vivo V20 which functions as connectivity between Android-based HandPhones and the designed system.
2. The designed Servo Motor functions as an automatic valve or tap opener on each raw material container as a right and left driver for the glass container and as a process for raising and lowering the stirrer.
3. The design of the software system on Arduino functions to convert the results of reading the code on the Android software into commands that are executed by the system.

Based on the design results above, for more details, the overall test results of the design of the Arduino-based automatic coffee drink mixer system can be explained as follows. Below can be seen in the following 10 coffee drink mixer images:

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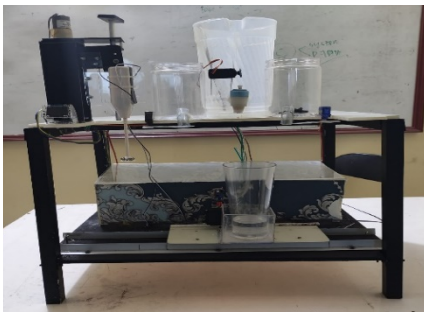

Figure 10. Front View of the Arduino-Based Automatic Coffee Drink Mixing Machine Design System.

The automatic coffee drink maker system through Arduino-based Android control uses a smartphone based on the Android operating system as an interface media. The menu for serving this drink is a hot drink with a sweet, medium (not too sweet and not too bitter), and bitter taste and this system also uses Bluetooth connectivity to connect the Android smartphone with the automatic coffee drink maker system. Some tests of the Arduino-based automatic coffee drink maker tool as a whole are as follows:

1. Servo motor testing
   When removing sugar and coffee powder from the jar, the servo motor used works automatically. Below you can see a picture of the servo test. An example of a sevo test picture can be seen in the following picture 11.

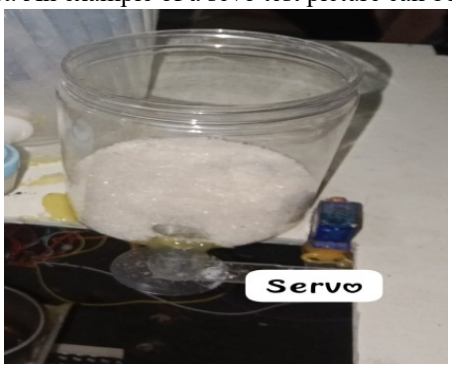

Figure 11. Servo motor test view.

2. DC motor testing
   Moving the stirrer up and down when the stirrer stops right in the bottom glass. Example of a stirrer test image using the following DC motor. An example image can be seen in the following image 12.

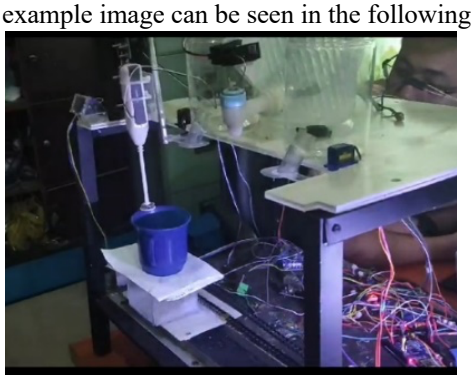

Figure 12. Display of the mixer test using a DC motor.

DISCUSSIONS

At this stage, a discussion is carried out on the working process of the automatic coffee drink mixer system via Android control, as follows:

1. An Android smartphone that has installed software designed as an interface will display what types of flavors can be presented by the system.
2. Bluetooth Vivo V20 as a connectivity medium between Android and the system will give commands to the system according to the previous design.
3. The Arduino software design will receive commands and convert them according to the previously programmed commands and send them to the hardware that has previously programmed tasks.

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4. The DC motor shifts the glass to the right and left to accommodate the fall of coffee, water, sugar, and drink stirrer.
5. The servo motor works as an automatic opener and closeer of the sugar and coffee valves which will work if the DC motor shifts the glass according to the command and will open to pour coffee powder and sugar.
6. The water tap functions as the water outlet process.
7. 2 DC motors function as stirrers, when the coaster is at the bottom of the stirrer, the DC motor that functions as a lift moves down and the stirrer acts as a stirrer for a while, when finished, the DC motor will move back up to its place.
8. The relay functions as a hot water temperature guard so that it remains in the position of heating the water until the temperature is maintained.

CONCLUSION

After conducting an analysis and evaluation of the Design of an Automatic Coffee Drink Mixing Machine Based on Arduino, the author can draw several conclusions. The conclusions are as follows: (1) The drink mixing system is still carried out using the IOT with an internet system. (2) The process of providing sugar, coffee, water, and stirrers is still carried out by estimating the ingredients and the stirrer is not good. (3) The measurements are still standardized. (4) This system is not yet effective and efficient.

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