DESIGN OF AUTOMATIC ELECTRIC BATIK STOVE FOR BATIK INDUSTRY (B13)

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DESIGN OF AUTOMATIC ELECTRIC BATIK STOVE FOR BATIK INDUSTRY

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ABSTRACT

This paper proposes design of automatic electric batik stove in order to increase productivity and maintain a healthy environment in batik industry. Batik is the process of writing a picture or decoration on any media by using wax batik as a color barrier. In the production process of batik, the batik stove is needed. During batik used this stove is still not automated, so in this study designed automatic electric batik stove. The automatic electric batik stoves results of this research work automatically so as to facilitate the batik in batik activities. This stove is a very simple tool in the form of physical or works. This stove utilizes a temperature sensor as an input the data to manage large or small currents so as to produce the necessary heat. This batik stove using dimmer circuit which is used to manage large or small stream on the heating element. The prototype of the batik electric stove uses ATMEGA8 microcontroller with AVR C programming language code. From the test results, the automatic electric stove batik has been working in accordance with the desired design.

Keywords: *Electric Stove, Batik, Automatic, Microcontroller, AVR C.*

1. INTRODUCTION

At this time, the Indonesian government is promoting the diversion program from kerosene to LPG gas as we know called gas conversion [1]-[3]. There are still many people who depend on kerosene for investments other than the price is cheaper too easily obtained. Conversion of kerosene to LPG (Liquefied Petroleum Gas) is performed in conjunction with the policy of reduction of kerosene subsidies gradually in various regions, leaving a fairly complicated problem for entrepreneurs and batik industry in the country. Unprepared infrastructure batik industry to switch to LPG gas and the unavailability of gas cooker appliances that fit the needs of batik industry has caused serious obstacles are troublesome and burdensome liquidity of the craftsmen [4]. Batik artisans who had been accustomed for decades on a kerosene stove in batik activities, especially during the process of affixing wax either by *canting* (the making of batik) and the *cap* (on the making of batik), could not automatically be switching to LPG gas stoves. Meanwhile, the supply of kerosene in the market already began to gradually disappear in some areas even kerosene supplies already scarce. As a result, the price of oil continues to soar as high as tens of thousands of rupiah per liter. This condition is a new burden for batik artisans, as they must remain on a kerosene stove prior to the availability of LPG gas stoves that fit their needs.

On batik producers who use the wax to draw on the fabric. With the conversion of gas so many manufacturers which use solar heat from solar as kerosene. The problem is that when using diesel fuel to melt the night it would be a waste on the axis of the stove, when using kerosene wick stove can be used for two days while the solar can use only be one day [5]-[6]. If using LPG, the batik will too often decrease or increase the fire to get the desired dilution night. Therefore, in order to help provide alternative solutions in the process of disbursement of the night, so in this study will be an innovation development of batik electric stove that is very easy

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to use with a source of electrical energy which works automatically.

In line with batik journey that has been recognized by the world that the nation's batik is Indonesia, the rapidly increasing demand for batik. With circumstances like this then a lot of big companies or individuals who are heavily in the procurement of free assistance to producers in the form of batik electric stove. However, batik stove here still operate manually like a regular electric stove work. With this, the research aimed to facilitate the production of batik in doing, which is making batik automatic electric stove models.

The purpose of the research is to implement the function of the analog inputs on the microcontroller ATMega8 that gets input from LM35 as temperature sensors are converted using the ADC integrated internally on ATMega8. Another aim is to use the programming language C code vision AVR to develop a system that result as the temperature measuring DC motor rotation to control the heat on the stove.

2. FUNDAMENTAL THEORY

2.1. Batik Industry

Batik is the process of writing a picture or decoration on any media by using wax batik as a color barrier. In the manufacture of batik, batik wax was applied to the fabric to prevent the absorption of color during the dyeing process [7]. Batik definition has been agreed at the International Batik Convention in Yogyakarta in 1997. Nonetheless, the common people know batik as a fabric that has a distinctive style and motif. In other words, ordinary people know batik as a motif and not as a technique of making fabric.

There are several versions about the origin of the word batik. Two of the most famous version is that the word batik is derived from the proto-Austronesian language and the Java language. Batik originated from the proto-Austronesian "becik" which means to make tattoos and comes from the Javanese language "amba" or write and "point".

Batik Indonesia has been designated by UNESCO as a cultural heritage of humanity's oral and non-material on October 2, 2009 [7]. The UNESCO recognition includes engineering, technology and Indonesian batik motifs. On the batik industry, kerosene is the main fuel in the process of heating the wax that becomes the main ingredient in the process of batik. With the increasing price of kerosene will affect the selling price of batik. Besides, the current batik production increased after the establishment of batik as an Indonesian cultural heritage by UNESCO. It is burdensome to the people of Indonesia could not be separated from the use of batik clothes in a daily routine. Besides implementing government programs for kerosene to LPG gas, much less to lead to increasingly scarce and increasing the high price of kerosene. As an alternative fuel replacement for kerosene, LPG it is still a lot cause problems, especially among medium. In addition to the high price of LPG, the safety factor is also becoming one of the most important things in its use as many news about the explosion of LPG.

To cope with the effects of dwindling and expensive fossil fuels due to various factors, then the alternative fuel is expected to be a solution to overcome these problems. Various studies, use and improvement of production and also in saving fuel use continuing. According to BPH Migas, as a substitute for kerosene fuel, now the center of Yogyakarta batik industry in the area use electricity and gas to make batik, which is generally considered cheaper than using non-subsidized kerosene.

2.2. Microcontroller-based Batik Stove

Microcontroller, as a technological breakthrough microprocessors and microcomputers, was present to meet market needs and new technologies [8]–[9]. As a new technology, the semiconductor technology containing more transistors, but only requires a small space and can be mass produced in quantity to make the price becomes cheaper if compared with microprocessor [10]. As the needs of the market, the microcontroller present to meet the tastes of industry and consumer needs or desires aids toys even better and sophisticated. Types of microcontrollers can be seen in Figure 1.

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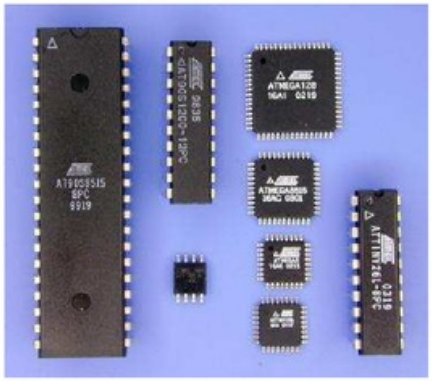

Figure 1. Types Of Microcontrollers

a. AVR Microcontroller Family

Microcontroller AVR RISC microcontroller family is a family of Atmel [8] AVR architecture concept was originally created by two students at the Norwegian Institute of Technology (NTH) that Alf-Egil Bogen and Vegard Wollan were then further developed by Atmel Norway.

b. AVR architecture

AVR microcontroller with a Harvard architecture in which the program code and data is stored in the memory separately. Generally Harvard architecture stores the program code in memory a permanent or semi-permanent (non-volatile) while the data is not permanently stored in memory (volatile). So with this kind of program memory architecture microcontroller being better protected from voltage spikes and other environmental factors that may damage the program code. AVR has several types of Flash memory, EEPROM and SRAM are all integrated into a single IC, so that for certain applications will not require any external memory.

c. memory Program

The program code / instructions are stored in Flash memory, which is non-volatile memory type that the data will not be lost even though the power supply is turned off. Almost all the instructions are 16-bit and consist of Up Code and data or operands which will be processed by those instructions. The flash memory will be addressed 16-bit instructions per cycle. It is certainly different from the microcontroller in general and a bit confusing, since the 8-bit AVR microcontroller has a width of 16-bit program memory but the memory 8-bit RAM data. So each addressing program will take the data width of 16 bits for addressing the data RAM but only 8 bits. The block diagram of ATMega8 microcontroller has shown in Figure 2.

Although it does not apply to all of them but in general the size of the program memory capacity indicated AVR family. For example ATMega64x means has a memory capacity of 64 Kbyte program.

d. Data Memory and Register

Data memory address space consists of a main register, the register I/O and SRAM. AVR family has 32 bytes of main registers and classified by every 8-bit. 32 registers mapped in the memory address of the earliest is at 0000h address - 001fh. Furthermore, the next 64 bytes are used to register the I/O (0020h - 005Fh). And then SRAM starting from address 0060h until the memory capacity runs out. In some AVR space registers I/O can still be expanded by using the technique of memory mapped I/O to take a certain part of the SRAM address. Although there is a separation between the main register and the register I/O but everything remains accessible and manipulated just like accessing SRAM.

e. Eeprom

Some AVR microcontroller also has an EEPROM (Electrically Erasable Programmable Read Only Memory) internally as semi-permanent data storage. So as well as flash memory, EEPROM can still store data even if the power supply is turned off. The internal EEPROM is not mapped along with the main register, the register I / O and SRAM above. EEPROM can only be accessed through special registers and operation of read / write so that the access time slower than accessing registers or RAM.

f. Execution Program

AVR family has only one groove execution time. The next machine instruction is taken in conjunction with the current instruction is being done. Almost all instruction is conducted in only one or two cycles of rate (clock). This makes AVR relatively faster when compared to other 8-bit microcontrollers.

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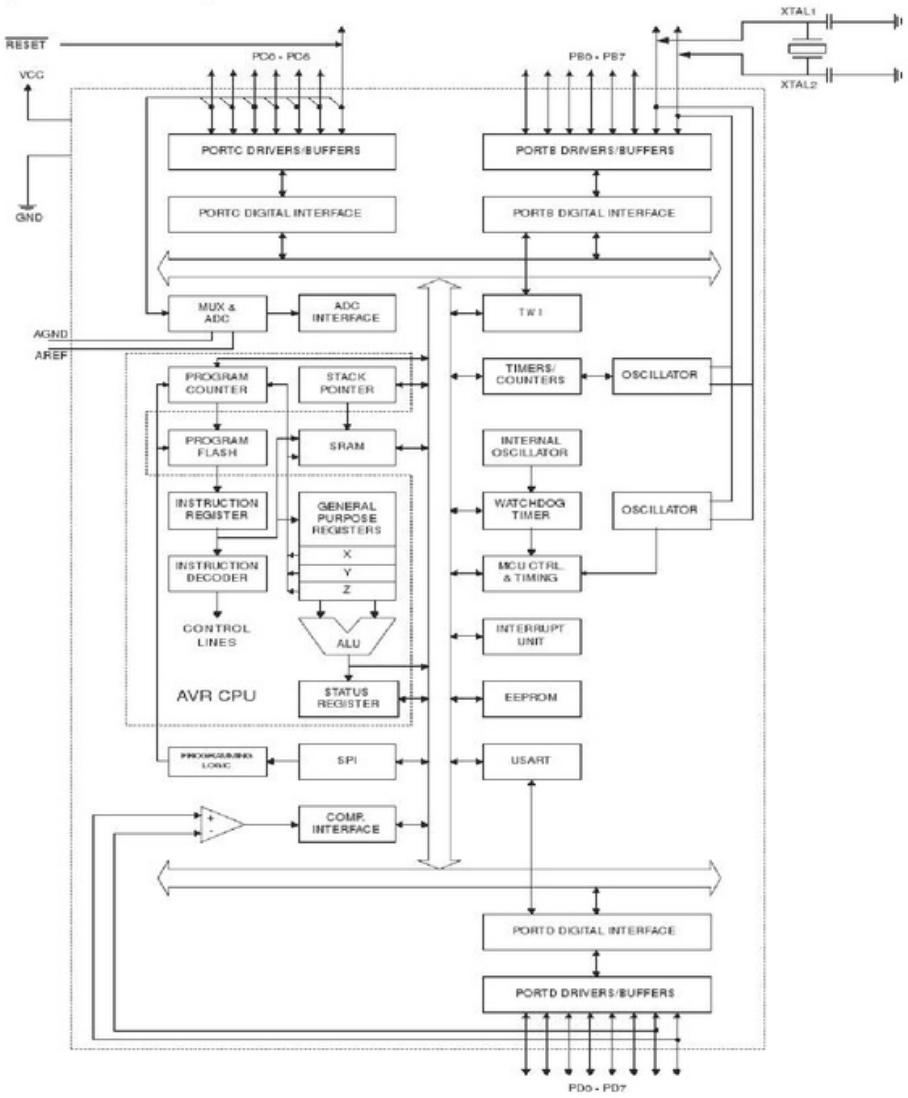

Figure 2. Block Diagram Of Atmega8 Microcontroller

In addition AVR microcontroller design also has a good execution efficiency of the program code means the results of a C compiler is the program code written in C language once compiled will produce the file sizes are not much different from the program code is written using assembler.

g. Speed

Generally AVR microcontroller family has a clock speed of 0-16 MHz, but there are some that can be up to 20 MHz clock. AVR microcontroller can be set on certain work modes that use low power but to do this it must be followed by a reduction in clock speed. All families AVR feature on-chip oscillator, so it does not require an external clock and almost all AVR instructions are 1 cycle instruction so that the AVR can reach speeds of nearly 1MIPS per MHz.

h. Development

AVR has a lot of development facilities available at low prices, even for free. Besides compatibility

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between chip AVR family is also very good. In this study the authors use artificial ATMega8 Atmel microcontroller type. ATMega8 is a CMOS microcontroller AVR 8-bit RISC architecture which has 8K Bytes in System Programmable Flash. Microcontroller with low power consumption is capable of executing instructions at a maximum speed of 16 MIPS at 16MHz frequency.

Here are the existing facilities within ATMEGA8:

- Channel Input/Output there are 23 pieces, namely Port B, Port C, Port D
- ADC (Analog to Digital Converter) as much as 4 channel 10bit and 8bit much as 2 channel
- Three timer/counter with ABILITY benchmarking
- 130 reliable instructions that generally only need one clock cycle
- Watchdog Timer with internal oscillator
- Two timer / counter 8 bits
- One piece of timer / counter 16 bits
- The operating voltage of 4.5V-5.5V at ATMEGA8
- Internal SRAM for 1KB
- Flash memory of 16 KB with the ability to Read While Write
- Unit internal and external interrupts
- Port SPI interface
- EEPROM of 512 bytes that can be programmed during surgery
- Interface analog comparator
- 3-channel PWM
- 32x8 general purpose registers
- Almost achieve 16 MIPS at 16Mhz crystal
- Port USART programmable for serial communication.

3. METHODOLOGY

To obtain results that are objective, this research carried out by stages from beginning to end as shown in Figure 3.

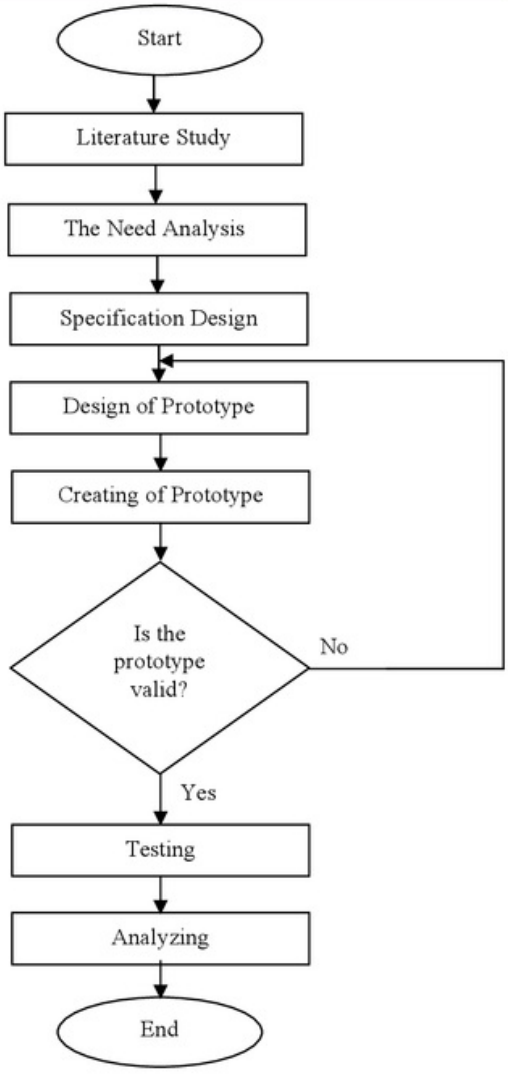

Figure 3. Flow Chart Of The Research Steps

The electric stove which is designed in this research is expected to work automatically. Further, when heating and cooling, then the indicator will light using a green pilot light. Limiting switches are used as the braking system of a DC motor. Specifications automatic cooker is sized: length 25 cm, width 17 cm, and 10 cm in height. This stove is able to adjust the heat required automatically with a temperature range of 0-90 C.

The next stage is designing software. In the

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design of computer software used media as a tool. Designing software is made using CodeVision AVR as a simulation. Designing software is used as a data processor temperature sensor. The software created in the software programming using C language CodeVision. This software will be input into the memory of the microcontroller in accordance with his duties. Programming using this software is easier because it is available with the C programming language in addition to CVAVR facilitated by wizard code which users can just click to make initialization or functions in accordance with the properties that appear.

4. RESULTS AND DISCUSSION

4.1 Hardware Implementation of Automatic Batik Stove

The electronic circuit of automatic batik stove design is shown in Figure 4 while the result of automatic batik stove design is shown in Figure 5. At the time of the electric stove is connected to the source voltage of 220 volts, the voltage will be lowered by the transformer to 12 volts. Then go to the diode bridge to change into a DC voltage which will be divided into two voltage levels. The first voltage regulator go into 7805 which will supply the voltage of 5V DC to several circuit blocks that require 5V DC voltage such as microcontroller, sensor LM35, and to a motor driver or LM293D. While the second voltage of 12V DC will be supplied to the DC motor. After the electric stove is turned on, the microcontroller will read the temperature read by the LM35 sensor which serves to detect the temperature, then the temperature level that has been detected is converted into a digital signal by the ADC have been integrated in a microcontroller ATMega8 then the signal is processed by a microcontroller. Microcontroller functions to process the received signal sensor LM35, then gave input to the DC motor driver to drive the DC motor in which a player potentiometer on the circuit dimmer, which is where the function of the potentiometer as a regulator of large or small current passing so that heat in the heating element can be controlled, When the heating element is illuminated, the green indicator light will be lit as an indicator was no heating. When the DC motor rotates to the right (temperature <80°C), the warming is happening and will hit the right side of the limit switch that serves to stop the DC motor rotation because if it is not stopped, there will be damage to the potentiometer. And when the temperature on the heater reaches >90°C sensor LM35 going and give feedback to the microcontroller, then microcontroller will read and give feedback to the DC motor driver to move to the left or to reduce the flow by turning the potentiometer until the DC motor presses limit switch left side to stop the DC motor back round, after the temperature touched <90°C, the microcontroller will command the DC motor driver (LM293D) to spin to the right to push the switch hit to the right to stop the rotation of the motor and warmed up on the heating element. And so on up to the task of this tool is complete.

This test involves all parts of each of the circuit blocks that have been integrated with each other. In this study, it is using a container to heat the wax of batik. The purpose of this test is to ensure that the device can operate in accordance with the purpose of making a tool that has been set.

4.2 Testing of Automatic Batik Stove

Testing of Automatic Batik Stove is intended to obtain the level of dilution fitting batik wax for batik activities. Preparation is carried out by turning on the stove so that the heating element will get hot and wax batik in a skillet melt. The test steps are as follows:

1. Prepare wax of batik on a frying pan.
2. Prepare a tool that has been created.
3. Place the skillet on the stove and turn on the electric stove burner automatic electric batik.
4. Wait until the wax melts batik.
5. Record the time, the power, and the electric current required to melting the wax in its entirety.

The test results of batik stove has shown in Table 1. From the table it can be seen the comparison between the heat sensor on the stove. The heat sensor is observed by measuring the sensor output voltage using a multi-meter, while the temperature is measured using a thermometer, the temperature early in the furnace is 30°C.

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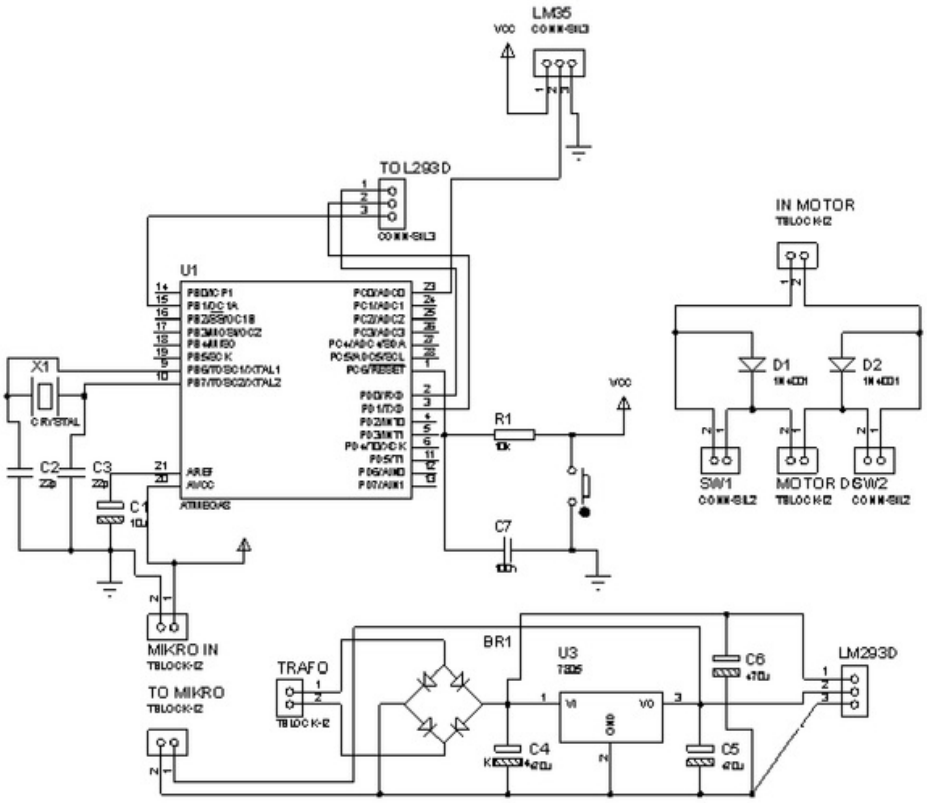

Figure 4. The Electronic Circuit Of Automatic Batik Stove Design

Figure 5. Automatic Batik Stove Design

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Table 1. Results Of Testing Of Automatic Batik Stove

No. of Testing	Initial Tempera-ture (°C)	Operation Temperature (°C)		Time (minutes)
		Initial	End	
1	29	92	88	14
2	30	91	90	13
3	30	91	89	13
4	30	93	91	13
5	30	93	91	13

The first experimental data obtained from the initial temperature of the furnace at 29°C, and when the instrument is turned on, the stopwatch immediately turned on to calculate the time required to melt wax of batik as a whole, and obtained the time required for ± 14 minutes. When going off cooling on the tool then read on multimeter temperatures of 92°C and 88°C of the temperature on the thermometer. From the second experiment, the stove awaited to obtain the initial temperature of the furnace at 30°C and a wax of batik re-solidifies, and when the instrument is turned on again, the stopwatch immediately turned on to calculate the time required to melt wax batik as a whole, and obtained the time required for ± 13 minutes. When going off cooling on the tool then read on multimeter temperatures of 91°C and 90°C of the temperature on the thermometer.

From the third experiment, the stove back off until the initial temperature of the furnace at 30°C and wax of batik re-solidifies. When the tool is revived then immediately turned stopwatch to calculate the time required to melt the wax of batik as a whole, and obtained the time required for ± 13 minutes. When going off cooling on the tool then read on multi-meter temperatures of 91°C and 89°C of the temperature on the thermometer. From the fourth experiments, the tool back off in order to get the data the initial temperature of the furnace at 30°C and wax of batik re-solidifies, and when the appliance is turned back and stopwatch immediately turned to calculate the time required to melt the wax of batik as a whole, and gained time needed for ± 13 minutes. When going off cooling on the tool then read on multi-meter temperatures of 93°C and 91°C of the temperature on the thermometer.

Finally, on the fifth experiment, the stove back off and obtain the initial temperature of the furnace at 30°C and wax of re-solidifies, and when the instrument is turned on, the stopwatch immediately turned to recalculate the time required to melt the wax of batik as a whole, and gained time needed for ± 13 minutes. When going off cooling on the tool then read on multi-meter temperatures of 93°C and 91°C of the temperature on the thermometer.

5. CONCLUSION

Automatic electric batik stoves results of this research work automatically so as to facilitate the batik in batik activities. This stove is a very simple tool in the form of physical or works. This stove utilizes a temperature sensor as an input the data to manage large or small currents so as to produce the necessary heat. This batik stove using dimmer circuit which is used to manage large or small stream on the heating element. The prototype of the batik electric stove uses ATMEGA8 microcontroller with AVR C programming language code. Automatic electric stove batik has been working in accordance with the desired design.

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