Tissue Processor Based Programmable Logic Control

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ABSTRACT-Tissue Processor Tissue Processor consists of several stages of dehydration, clearing, and paraffin infiltration. Phase dehydration to remove water content in tissues by immersion into alcohol. Clearing stage is the process of pulling out the alcohol content in the network by using a liquid xylol. Paraffin infiltration stages are the stage of filling cavities with liquid paraffin tissue. The purpose of this research is to modify the equipment that had broken before became useful equipment that uses basic controlled PLC. This modification tool-making using the one-group posttest design by treatment of the instrument without first measuring the initial state, the results of treatment directly measured without comparison to a control group. Making the modification tool using PLC as the main controller throughout the series. The tool mechanical motion using DC motors and AC motors as well as the use of two sensors limit switch as the controller limits the motor movement. Based on the results obtained temperature measurement error with the largest value of 4.44% in paraffin heater tube 1 and the biggest error of 4.0% in paraffin heater tube 2. While the measurement time of each - each tube obtained the smallest error on the tube-to-one by 0.03%, and the biggest error of measurement contained in the tube to the fourth, fifth, sixth, eighth and tenth of 0.16%.

Keywords-Tissue processor; time; temperature

I. INTRODUCTION

Tissue processor the laboratory equipment for the processing of the network on histo-technic activities (processes for making grain histology) that has been cut and has gone through a chemical process steps, namely fixation (fixation), gross examination (gross examination) and then do the processing of tissue (tissue processing). Tissue processor or network processing aims to cultivate a network so that the process can be done perfectly microtome.[1]

Stages of processing of network consist of several stages of dehydration, clearing, paraffin infiltration.[2] The first stage, the stage of dehydration is a step to remove or pull the water in the tissue by soaking the tissue into a concentration of alcohol ranging from low to high concentrations. Given alcohol can not bind with paraffin, then in the second stage clearing process to draw out the alcohol content in the network by using a liquid xylol. The final stage is a paraffin infiltration which is the stage of filling cavities or pores - pore network with liquid paraffin.[3]

Based on observations of the authors in Surabaya Oncology Hospital in September 2018, found a tissue processor tool still manually operated so the user should monitor the processing of tissue on each - each stage. In addition, these tools were damaged on a timer component, resulting in impaired tissue processing and can hinder the results of the whole process histo-technic. In a previous study, namely, Automatic Tissue Processor impregnation phase (I Wayan Lawrence, 2005), Automatic Tissue Processor Dehydration stage (Amalia Risa Rakhma, 2006), and Automatic Tissue Processor Clearing phase (Tedi Rukhmawan, 2015). Where the tissue processor tool was created at each stage separately so inefficient. The control system used is still in the form of a microcontroller which causes less resilience tool so that its work is still not as a durable tool. Therefore, the author will modify the tool uses a system of control and proper operation using PLC which inputs and outputs have been available in-built in it so easy to be programmed using ladder diagram language.[4]

Based on the identification of the above problems, the authors want to restore both tissue processor tools that were previously not working and want to enhance the tools that have been made previously 3 separate stages into a single stage process by making Modifications Tissue Processor-based PLC (Programmable Logic Controller).

II. MATERIALS AND METHODS

A. Experimental Setup

This study uses the setting time and accuracy on each tube and the temperature setting on the tube paraffin.

1) Materials and Tools

This study uses a limit switch sensor as limit controls the motor movement. The main components of the overall system controller menggunkaan PLC Siemens Logo.

2) Experiment

In this study, researchers conducted measurements of time on each network basket with a stopwatch as a comparison and

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measurement of the temperature setting on the paraffin tube by using a thermometer.

B. *The Block Diagram*

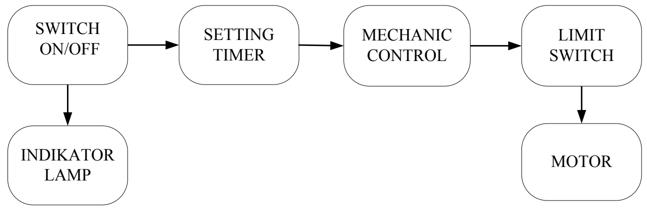


Fig. 1. The block diagram before modification

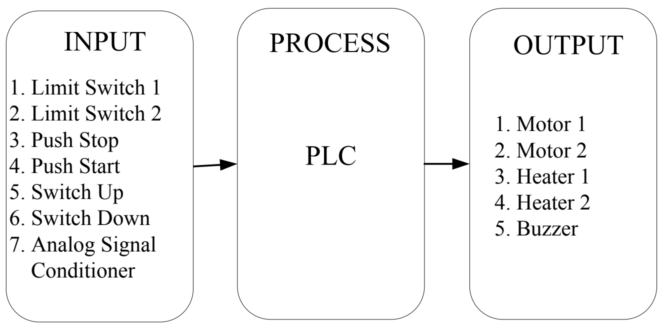
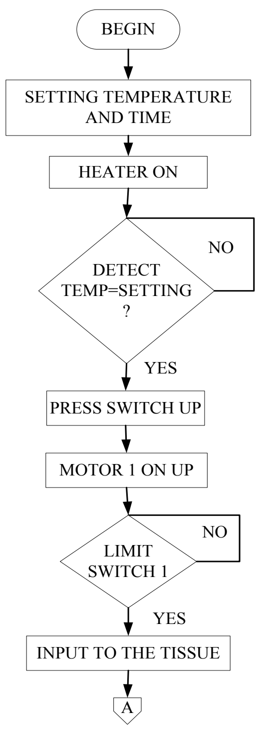


Fig. 2. The block diagram after modification



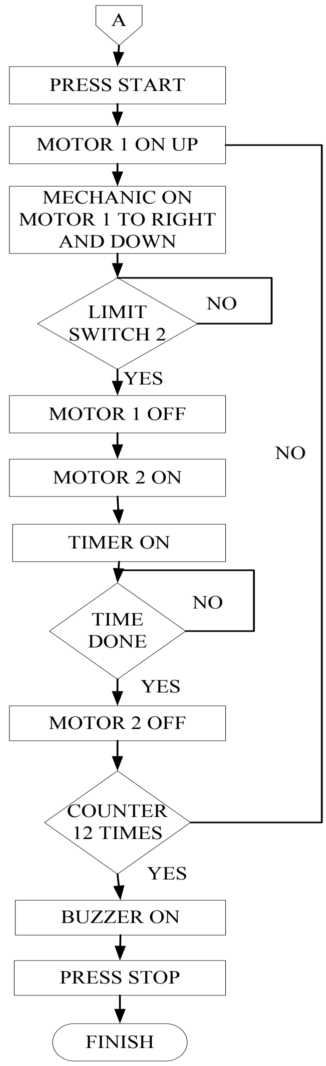


Fig. 3. The Flowchart Process

C. *System Mechanic*

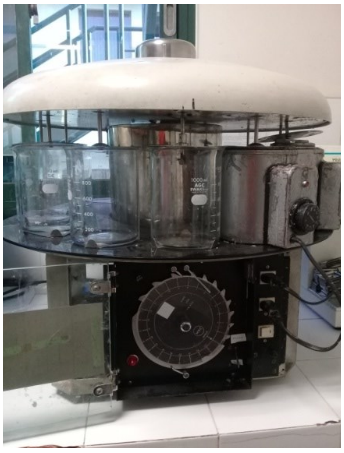


Fig. 4. Mechanic system before modification

Fig. 5. System Mechanic after modification

D. Circuit

Consisting of a series of analog signal conditioner type K thermocouple sensor with a range of OP - 07.

1) Thermocouple Analog Signal conditioner

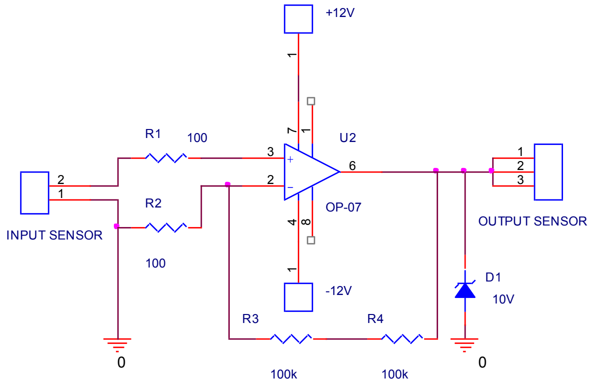


Fig. 6. Thermocouple analog signal conditioner circuit

Thermocouple circuit analog signal conditioner is a joint application between K-type thermocouple sensor components to the circuit OP - 07. The thermocouple sensor output in the form of very small voltage (mV) that is equal to 0.04 mV per 1 ° C rise and that it will be difficult in reading for PLC programming, where the PLC has analog input module that works between the range of 0 to 10 VDC so it is necessary to use IC amplifier circuit OP - 07 with the following calculation.

$$\mathrm{ACL} = 1+\frac{\mathrm{Rf}}{\mathrm{Rin}} \tag{1}$$

$$\mathrm{ACL} = 1+\frac{200\mathrm{k}}{100}$$

$$= 2.001 \text{ times}$$

2) Wiring Tissue Processor

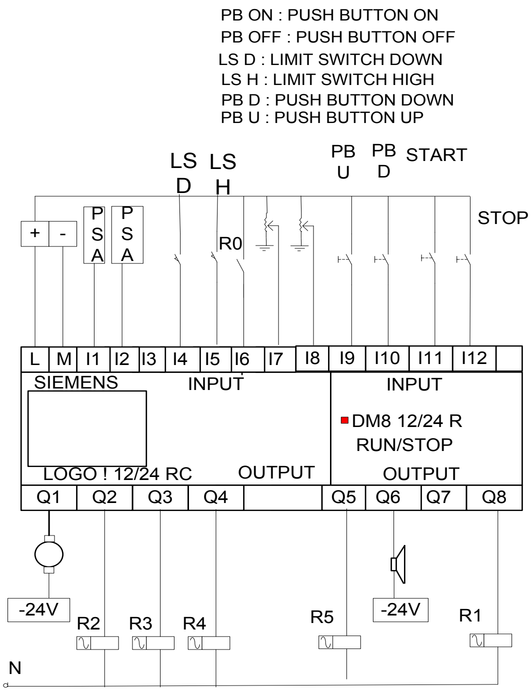


Fig. 7. Electric diagram

This electric circuit using PLC Siemens Logo module. There is 12 input (I1 to I12) and 8 output. PLC Siemens logo the 24 V and 12 V versions are suitable for a supply voltage of 24 VDC, 24 VAC, or 12VDC. Analog input I7 and I8 can be used as normal digital inputs or as analog input. Wiring diagram consists of push-button Up, push-button Down, push-button start, push-button stop. Two limit switch (limit switch up and limit switch down). There are a four relay external to control motor and heater. Analog signal conditioner as input entering address I1 and I2. While the other analog input I7 and I8 have potential potentiometer as temperature setting. Required supply voltage of 24 volts. Using limit switch as a controller of an AC motor movement limit. Using an external relay as much as 6 pieces and using 2 pieces of paraffin heater to heat the tube 1 and tube paraffin heater paraffin 2

III. RESULTS

In this study, measurement of the calibrator consists of two kinds of measurement, the measurement of temperature in the heating tube 1 and tube paraffin heater paraffin 2 using comparator thermometer and measuring time in each tube using a stopwatch to compare the time setting on the tool modification.

1) The results of the PLC Ladder Program (Temperature)

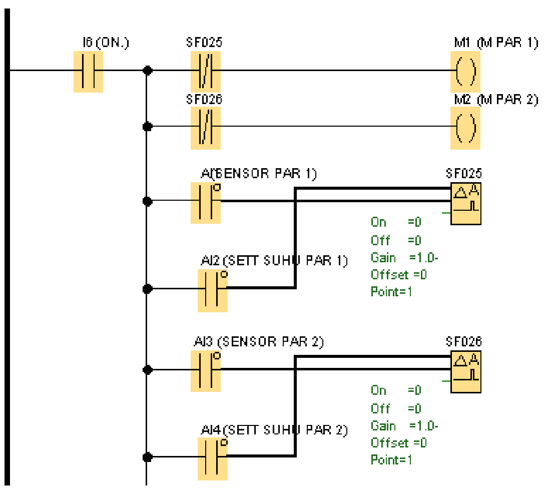


Fig. 8. Ladder temperature

Ladder temperature is used to detect the temperature on the tube 1 and tube paraffin 2. On the ladder, there is a command temperature analog comparator capable of comparing the analog setting with PSA results so as to turn on and turn off the heater.

2) The results of the PLC Ladder Program (Timer and counter)

Ladder timers and counters are used to determine the length of time the network immersion in each - each tube. The length of time can be set by the user as needed through the display cursor PLC.

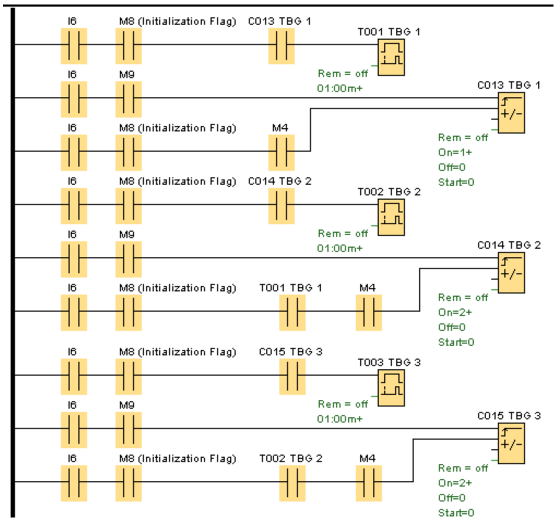


Fig. 9. Ladder timer circuit 1 until the timer 3

The circuit consists of a ladder diagram I6 address as input On / Off with the initial condition of NO, will energize (working) when the tool starts. All contact I6 will change shape into NC. M8 as internal coil relay to switch on when the condition started to start and the process will be automated and run up to twelve times. When the condition is contact M4 (limit switch low must work or have moved) to enable the C013 as a contact address counter tube 1 which will then activate the timer with the T001 address. C014 as a contact address counter tube 2 which then activates the timer with T002 address. C015 as a contact address counter tube 3 which then activates the timer with T003 address.

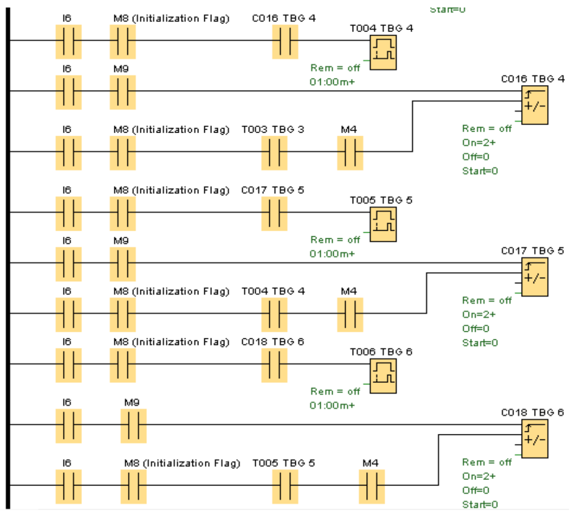


Fig. 10. Ladder timer circuit 4 to 6

C016 as a contact address counter tube 4 which then activates the timer with T004 address. C017 as a contact address counter tube 5 which will then activate the timer with the T005 address. C018 as a contact address counter tube 6 which then activates the timer with T006 address.

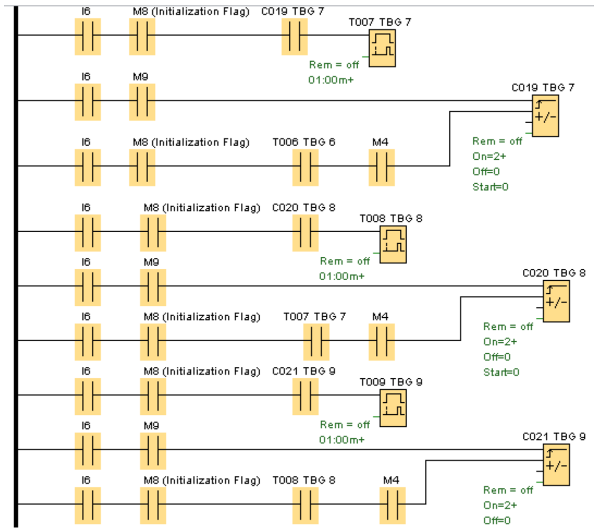


Fig. 11. Ladder timer circuit 7 through 9

C019 as a contact address counter tube 7 which then activates the timer with T007 address. C020 as a contact address counter tube 8 which will then activate the timer with the T008 address. C021 as a contact address counter tube 9 which then activates the timer with T009 address.

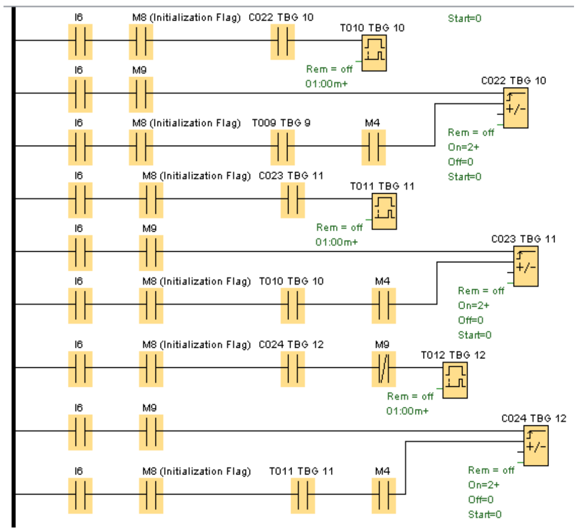


Fig. 12. Ladder timer circuit 10 to the timer 12

C022 as a contact address counter tube 10 which will then activate the timer with the T010 address. C023 as a contact address counter tube 11 which will then activate the timer with the T011 address. C024 as a contact address counter tube 12 which will then activate the timer with the T012 address. When the timer has counted on the last position of the tube all twelve then the counter will stop and a buzzer will sound indicating the process has been finished and the stop button can be pressed.

3) Results Ladder Program PLC (control limit switch)

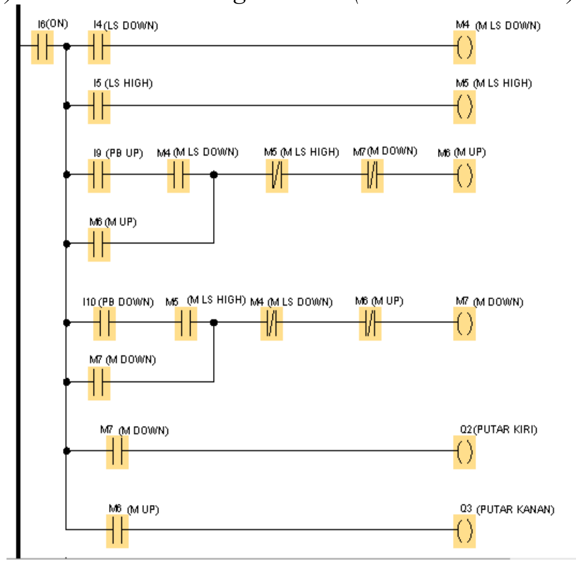


Fig. 13. Ladder control limit switch

Uses 2 limit switches. Limit switch 1 (limit switch down) as a mechanical sensor which serves to stop the motor if the position down (limit switch touched) are met. Limit switches 2 (limit switch up) as a mechanical sensor which serves to stop the motor if the position up (limit switch touched) are met.

4) Results Ladder Program PLC (when conditions start)

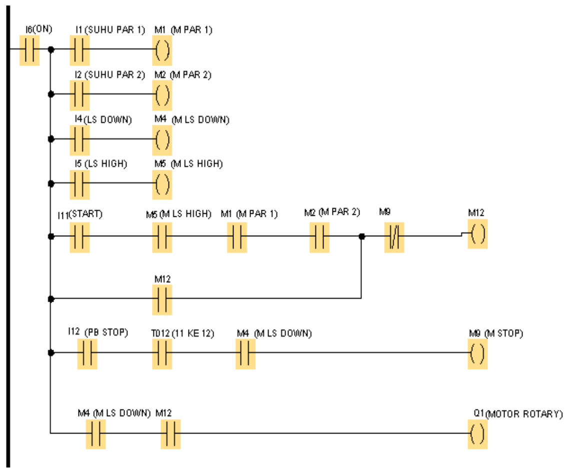


Fig. 14. Ladder when conditions start

The circuit will work when they start process starts, the terms of the process start by activating I5 (LS High) so that the internal relay contacts M5 (M LS High) enabled. The process begins when you press the start push-button start so that the input I11 (start) is active and turning on M12 internal relay contacts. When the motor has touched the low limit switch, then the I4 input will be active and ignite internal relay contact M4 (M LS Down) and Q1 will work powering the DC motor so that the motor can rotate.

5) Measurement results

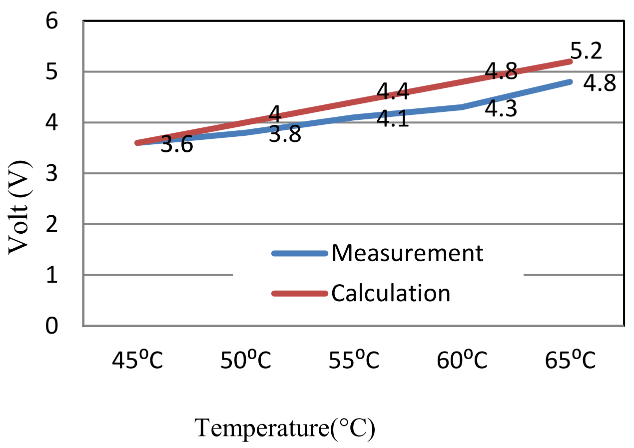


Fig. 15. Temperature and voltage relationship graphs on the tube paraffin 1

In the graph of temperature and output voltage of PSA in paraffin tube, 1 made four attempts then averaged - average yield curve graph linear in each experiment. The rise in temperature is proportional to the increase in the value of the output voltage of the PSA.

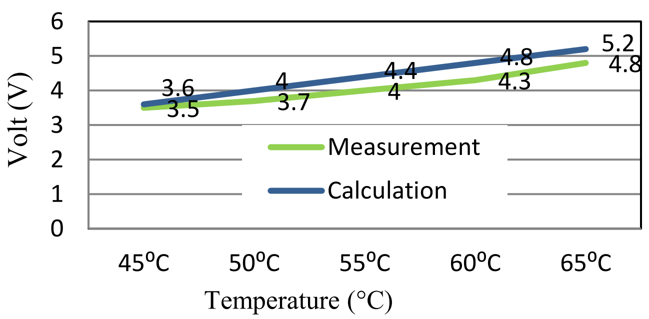


Fig. 16. Graph of temperature and voltage relationship in paraffin tube 2

In the graph of temperature and output voltage on the tube paraffin second PSA done as much as four times the experiment then averaged - average yield curve graph linear in each experiment. The rise in temperature is proportional to the increase in the value of the output voltage PSA

6) Error value of measurement

The error value obtained from measurements of temperature based on the data display on the temperature of tissue processor and calculation errors in each tube using a stopwatch comparator. The following table and a temperature measurement error

TABLE I. THE ERROR OF MEASUREMENT OF TEMPERATURE 1

Time-temperature	Average	Deviation	*Error* (%)
45 ° C	43	2	4.44
50 ° C	49.25	0.75	1.5
55 ° C	54	1	1.8
60 ° C	59	1	1.6
65 ° C	63.25	1.75	2.6

TABLE II. THE ERROR OF MEASUREMENT OF TEMPERATURE 2

Time-temperature	Average	Deviation	*Error* (%)
45 ° C	44	1	2.2
50 ° C	48.5	1.5	3
55 ° C	52.75	2.25	4.0
60 ° C	58	1.5	2.5
65 ° C	64	1	1.5

TABLE III. , THE ERROR OF MEASUREMENT OF TIME

Tube	Setting time (s)	Average	Deviation	*Error* (%)
1	3600	3598.8	1.2	0.03
2	600	598.8	1.2	0.2
3	600	599.2	0.8	0.13
4	600	599	1	0.16
5	600	599	1	0.16
6	600	599	1	0.16
7	600	599.2	0.8	0.13
8	600	599	1	0.16
9	600	599.4	0.6	0.1
10	600	599	1	0.16
11	600	598.8	1.2	0.2
12	1200	1198.8	1.2	0.1

IV. DISCUSSION

Tissue processor-based PLC consists of a series of thermocouple temperature with PSA for detecting the temperature of the paraffin heater tubes which have the highest error in the setting of a temperature of 45 ° C at 4.44% in paraffin tube 1, and the highest reading error in the setting of a temperature of 55 ° C at 4.0 %

Setting the timer is used to determine the length of time the network immersion in each - each tube that goes into the PLC program, Based on the measurement of time of each - each tube obtained the smallest error on the tube-to-one at 0.03% and the biggest error of measurement contained in the tube to four, fifth, sixth, eighth and tenth of 0.16%.

V. CONCLUSION

This research is used to optimize tool Tissue Processor is still working manually and there is damage to the appliance. After using the Modified Logo Siemens PLC control right obtained temperature measurement results and measurement of time corresponding to the desired system, so that the processor-based tissue modification tool PLC (programmable logic controller) unfit for use and can be used in tissue processing.

This processor tissue tool has a weakness in the thermocouple circuit analog signal conditioner that is less stable, therefore, the value of error can be reduced by using a sensor that has a high accuracy rate and uses the analog signal conditioner circuit more stable. Aside from the PSA circuit, the appliance needs to be added to the display at a larger size and improve the appearance of the menu for the tool is still using the display of the PLC which tend to be small so that the look of the menu becomes less and less effective.

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