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Automatic Heat Dispel System for DINGSON Biscuit Oven using Thermocouple Temperature Sensor

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Key words: DINGSON, oven, thermocouple, dispel

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Abstract: In this study, an automatic heat dispel system for DINGSON Biscuit Oven have been designed and simulated using Proteus program successfully. This system uses thermocouple temperature sensor to sense the oven temperature and automatically open and close the dispel system. The temperature in which the dispel open and close can be adjusted any time the operator needs to adjust it.

INTRODUCTION

Industrial ovens are heated plot used for dozens industrial applications including drying, curing or baking components. Industrial ovens can be used for large or small scale applications in batches or continuously with a conveyor line and a jumble of temperature ranges, sizes and configurations. Such ovens are used in lots different applications including chemical processing, food production and even in the electronics industry where circuit slab are run through a traveler oven to attach surface mount components. The oven contains multiple zones which tins be individually controlled for temperature. Generally, there are many heating belt followed by one or more cooling zones. The Biscuit moves through the furnace on a conveyor belt and is therefore subjected to a controlled time temperature profile. Some of this industrial oven have a heat dispel system manually and automatically[1]. In this study, an automatic heat dispel system for the manual biscuit oven of the DINGSON Biscuit oven have been designed.

Table 1: Material needed

Items	Specification	Quantity
Thermocouple	TCK	1
Resistor R1	1 K	1
Resistor R2	100 K	1
Resistor R3, R4	10 K	2
Potentiometer	5 K	1
Transistor	BC 107	2
Relay switch	2 port, 5 v	2
Amplifier	LM358	1
Comparator	CA3130	1
Battery	5 v	1
Voltage source	100 v DC	1
DC Motor	100 v DC	1
Potentiometer (Rotary)	100 K	1
Jumper Wires	5 v	10
Motor Wire	110 v 500 W	25

System design: The heat dispel door design is shown in Fig. 1. The system circuit design is shown in Fig. 2. The material needed for this projects are shown in Table 1.

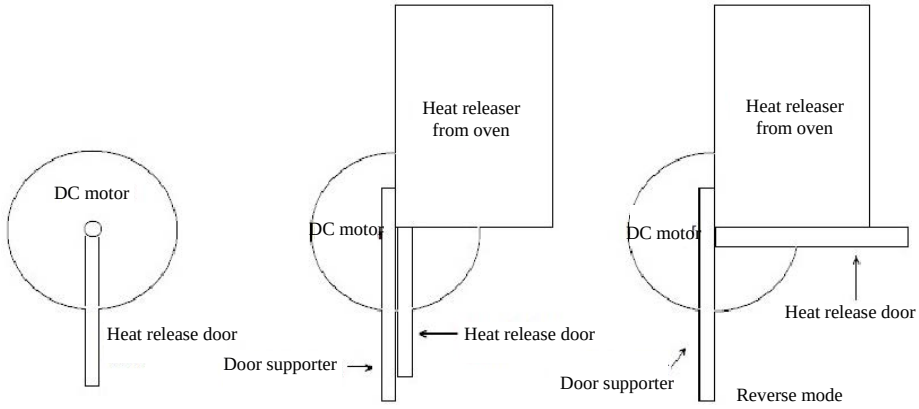

Fig. 1: Heat dispel system door design

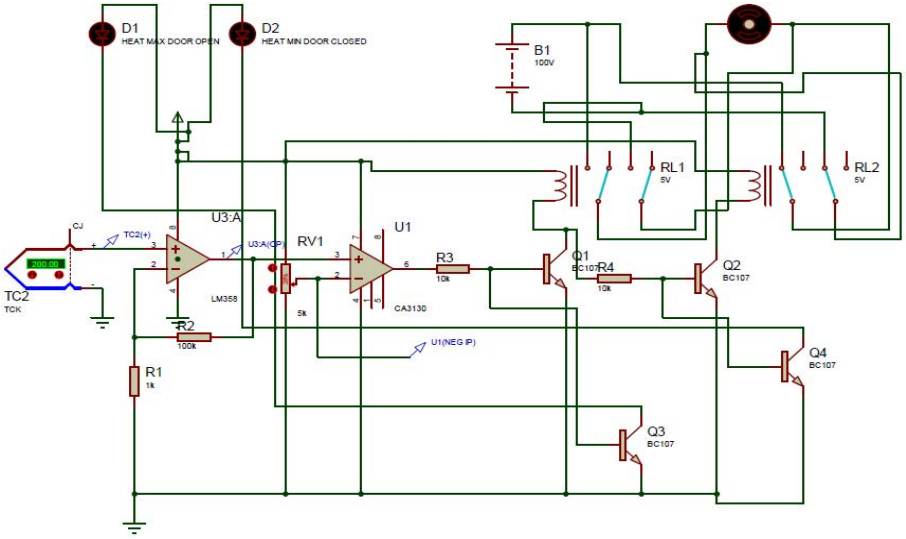

Fig. 2: System circuit design

MATERIALS AND METHODS

Operation of the system: The thermocouple senses the temperature of the system. Since, there is no bias voltage to the thermocouple the output voltage is very small. This output voltage is amplified using the amplifier and given to the comparator[2]. The comparator compares the input voltage and the reference voltage given by the potentiometer and outputted a logic 1 or logic 0 depending on the given voltage. Then the transistors are used like a switch system. Depending on the transistors outputs, the two pole relays will have switched on or off. If the required oven temperature of the oven is 300° or above, the heat dispel system door will open. This means the door of the dispel is controlled by a DC motor rotating in open direction and the reverse will happen if the temperature is <300°. The flow chart of the system is shown in Fig. 3.

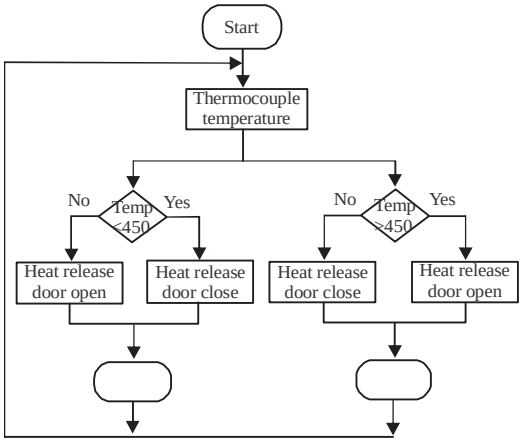

Fig. 3: Flowchart of the system

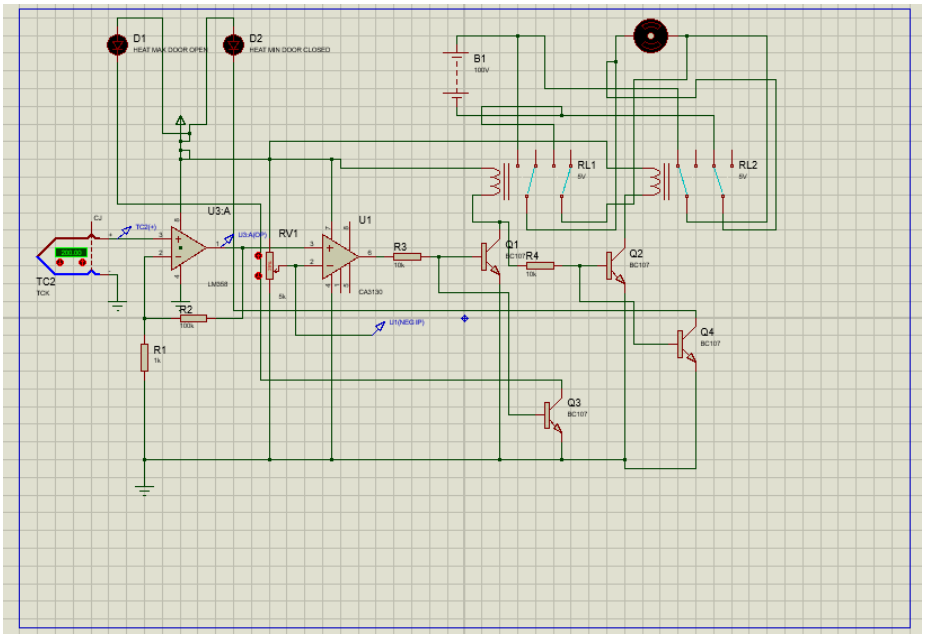

Fig. 4: Proteus model

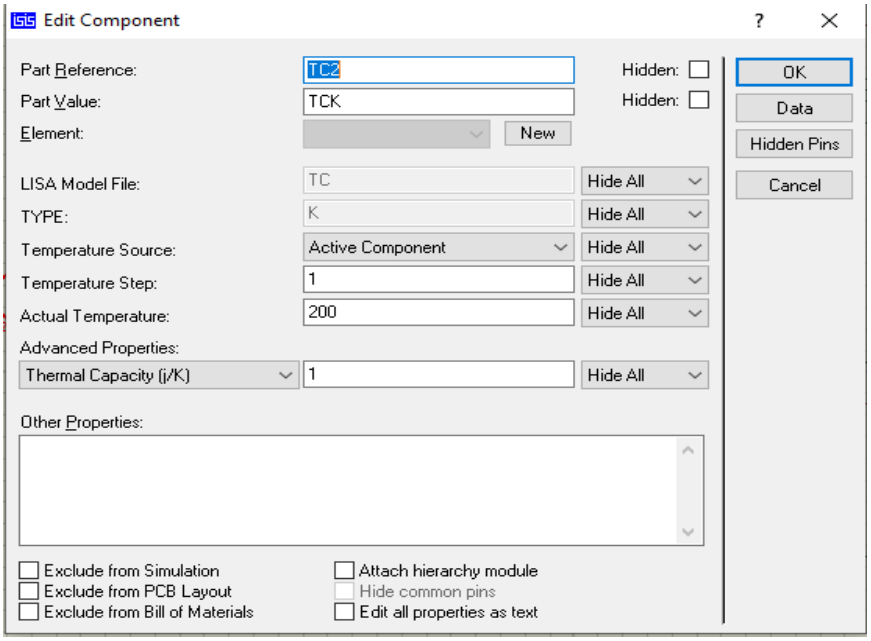

Fig. 5: TCK thermocouple voltage adjustment

RESULTS AND DISCUSSION

Overview: The proteus simulation model of the system is shown below. The system is designed to open the dispel door for a temperature of 300 and above degree centigrade and to close the heat dispel door for a temperature <300° centigrade[3]. This temperature range can be adjusted via. the potentiometer attached to the comparator (Fig. 4).

Simulation of the automatic heat dispel system for a 200° centigrade baking oven temperature: The TCK thermocouple voltage adjustment and the simulation result are shown in Fig. 5 and 6, respectively.

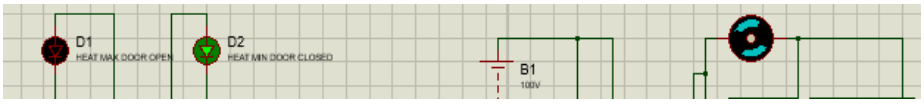

Fig. 6: Simulation result

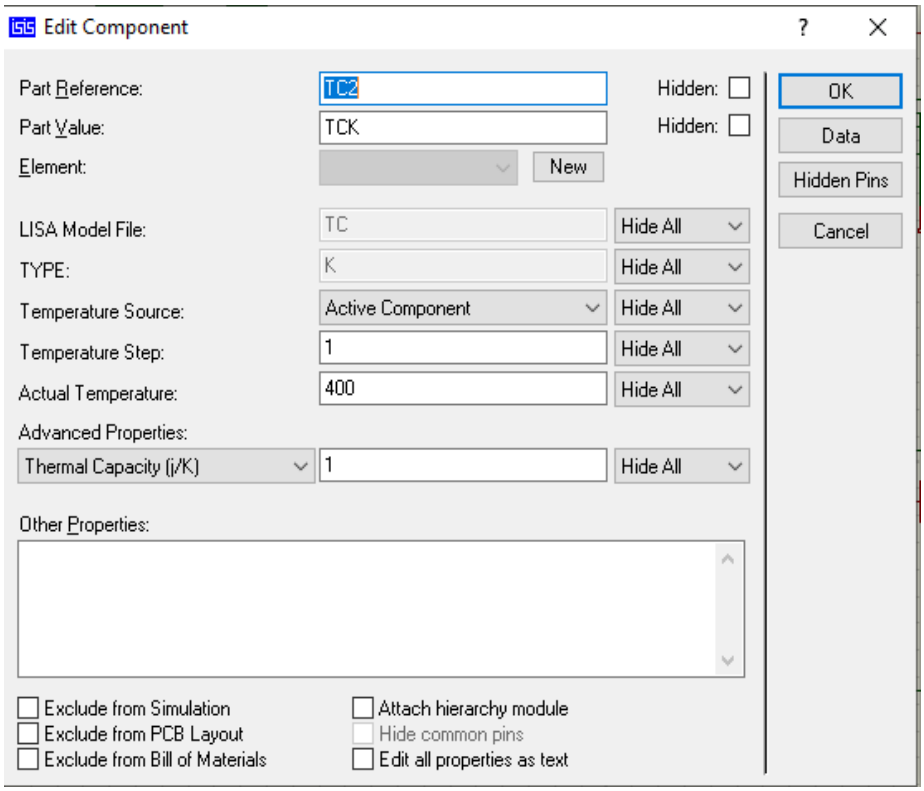

Fig. 7: TCK thermocouple adjustment

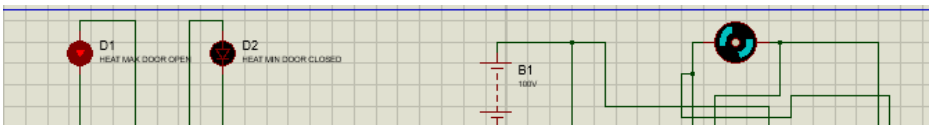

Fig. 8: Simulation result (Door open)

The simulation result shows that the motor is rotating in door close direction and the indicator for heat dispel door closed Green led is on.

Simulation of the automatic heat dispel system for a 400° centigrade baking oven temperature: The TCK thermocouple voltage adjustment and the simulation result are shown in Fig. 7 and 8, respectively[4].

The simulation result shows that the motor is rotating in door open direction and the indicator for heat dispel door open red led is on[5].

CONCLUSION

In this study, designing and controlling of a DINGSON biscuit oven have been done with the help of Proteus software successfully. Thermocouple sensor has been used to sense the temperature of the oven in order to release extra heat from the oven depending on the temperature adjusted by the operator. The temperature range can be adjusted at the desired level for the effect of surrounding temperature. The simulation result shows that the system is effective for the given set point temperature.

REFERENCES

01. Jibril, M., H. Tesfaye, T. Beyene and T. Moges, 2020. Automatic heat dispel system for DINGSON biscuit oven using thermocouple temperature sensor. Preprints, Vol. 1, 10.20944/preprints202010.0073.v1
02. Ramseden, 2020. Temperature measurement sensors. Questex LLC., New York, USA.
03. Anonymous, 2020. LM111/LM211/LM311 datasheet. Texas Instruments, Dallas, Texas, USA.
04. John, S. and B. Hemalatha, 2015. PLC based induction motor starting and protection. Int. J. Eng. Res. Gen. Sci., 3: 893-897.
05. Anonymous, 2009. Thermocouple theory 2009. Pyromation, Inc., Fort Wayne, Indiana.