

GSM Based Espec Oven Automatic Control Damper

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Abstract— This project presents an automatic control damper for "Espec Oven" which is widely used in the LED manufacturing plant. Espec Oven is used to cure LED autofocus. The purpose of this project is to design an automatic damper controller via SMS. This project consists of several main parts based on Espec Oven in the factory manufacturer of small electronic components. The parts include a timer circuit to set maximum 4 hours to operate up to 135°C, a SIEMENS TC35 GSM Module to send SMS or call the operator when the damper lift up automatically, and DC geared motor with encoder to lift up the damper after sufficient time 4 hours. This project able to facilitate the work of the operator in charge of the oven. By this project also, avoid finish product from the damage or over heat due to human error.

Keywords: GSM, SMS, DC motor, Espec Oven

I. INTRODUCTION

Espec's Clean Ovens are used extensively for heat treatment of specimens and drying components in stringent clean air requirements of Class 5 cleanliness. It also used to test auto-focus products on heat set temperature. The oven will reach temperatures of 135°C in an hour and will maintain until four hours. After four hours, the operator must lift up the damper manually to lower the temperature but in some cases they do not realize it since there is no alarm and notification after four hour. In Conclusive, this paper is aimed at developing a GSM based Espec oven automatic control damper with a GSM application to give an acknowledgment to the operator via SMS.



Figure 1: Espec Oven

GSM is stand for Global System for Mobile communications which is specialized type of modem that operates over subscription based a wireless network which is similar to a mobile phone. A GSM modem accepts a SIM card, and basically acts like a mobile phone for the computer. Traditional modem is attached to computers for dialing-up condition to connect with other computer systems. A GSM modem operates in the same way, except that it sends and

receives data through radio waves rather than a telephone line. For this GSM modem, SIEMENS TC35 GSM Module is used to allow an SMS features. The SIEMENS TC35 Module is AT Command where controlled GSM modem, via Serial Port (RS232/TTL communication). Common applications is sending or receiving SMS control or make phone calling.

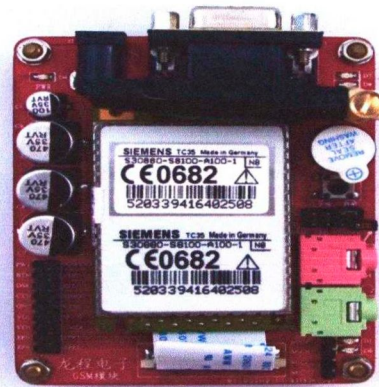


Figure 2: Top view SIEMENS TC35 GSM Module

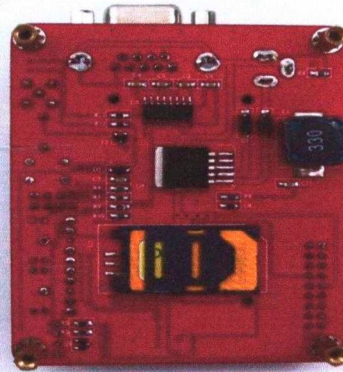


Figure 3: Bottom view SIEMENS TC35 GSM Module

In addition the GSM-based Espec oven can be easily developed and improved since its components are easily available in the local market and are available at very affordable prices.

II. METHODOLOGY

A. Flow Chart

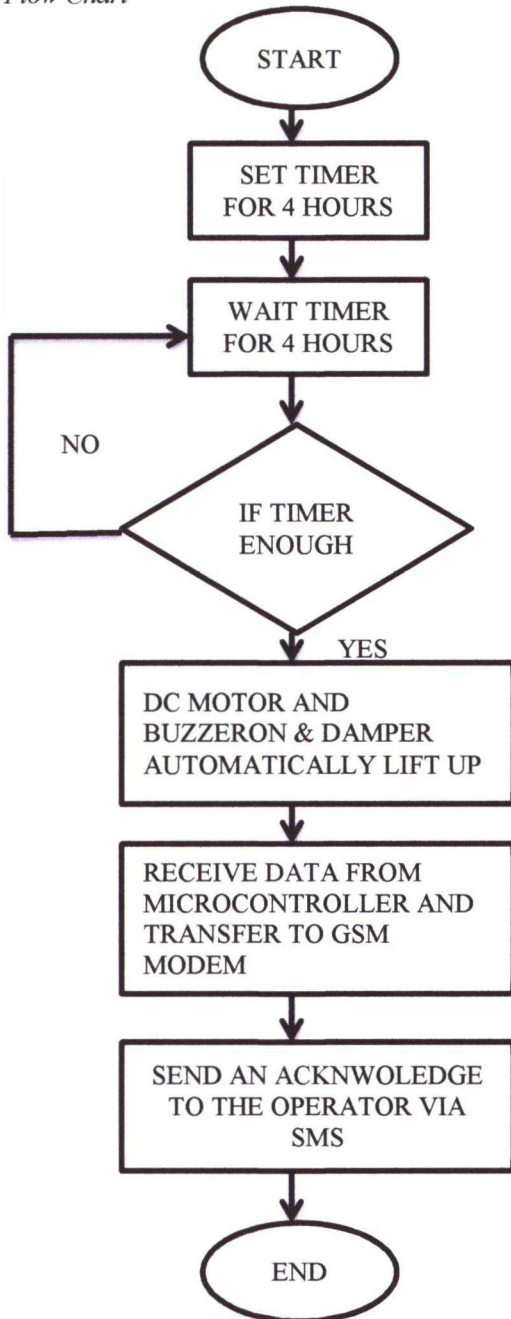


Figure 4: Flow chart design

Figure 4 shows the flow chart of the GSM based ESPEC oven automatic damper control in the factory manufacturer of LED electronic components. The operator sets the timer for 4 hours according to Standard Operation Procedure (SOP). Then the timer will count until 4 hours that is same to the time in the Espec oven. When the input timer is enough, it will read the DC motor speed and the buzzer simultaneously. After that, the damper will lift automatically. About a few seconds after the damper ON, the GSM modem will receive data from Arduino controller and send directly to the operator mobile phone. Then

the GSM modem will send an acknowledgement and a reminder to the operator via SMS to open the oven door in order to reduce the temperature.

B. Circuit Design

In the circuit design stage, a schematic diagram of an automatic control damper is designed to simplify the whole project. After that, the experimental process will be done. During do the experimental process, the circuit will be tested on the breadboard to check whether it has error or not. If there's error, testing and troubleshooting will be performed-

This project is connected with Arduino Uno and another part such as LCD, Keypad, buzzer, DC motor, GSM modem and other sub components such as resistor, diode, and transistor. For the power supply, battery 6V is used to start up the DC motor and adapter 4.5V to ON the GSM modem.

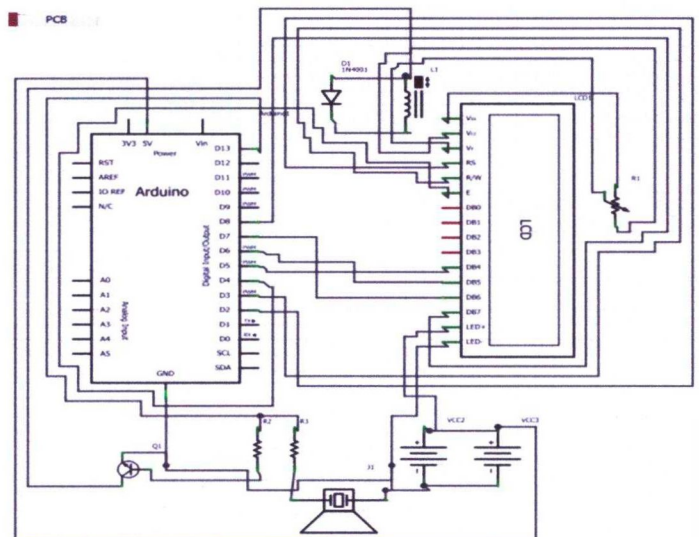


Figure 5: The schematic diagram of the ESPEC Oven Automatic Control Damper

Figure 5 shows the connection of the path automatic control damper. The main source of the microcontroller Arduino Uno R3, buzzer, and the DC motor is a 6V dc battery. This system uses a small DC motor using an Arduino and a transistor. The transistor is used as a switch to control the power to the motor to lift the damper up, Arduino pin 13 is used to turn ON and OFF the transistor and is given the name 'motorPin' in the sketch. If a small DC motor is used, it may consume more power than the Arduino digital outputs. Then, if the motor is connected directly to Arduino pin, most likely it will damage the Arduino. To avoid this problem occur, a small transistor of PN2222 is used as a switch that requires smaller amount of a current from the Arduino digital output to control the much bigger current of the DC motor.

The transistor has three leads. Most of the current flows from the Collector to the Emitter, but this will only happen if a small amount is flowing into the Base connection. This small amount of current is supplied by the Arduino digital output.

The pin D13 of the Arduino is connected to the resistor. At the pin D13 also, the DC motor and buzzer are connected in series. A diode is used in this circuit is to connect across the connections of the motor. Diodes that is allows current to flow in one direction and shorting out any such reverse current from the motor to protect the Arduino from damage. This might happened when the power of the DC motor is turned OFF, a negative spike of voltage will be produced, that can damage the Arduino or the transistor.

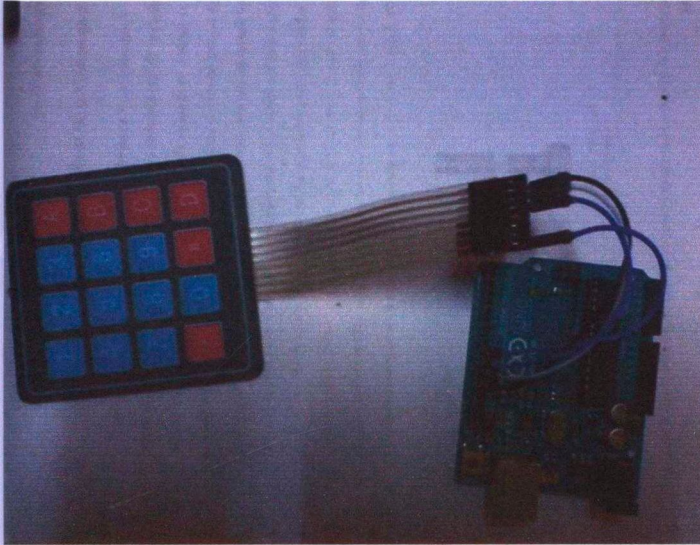


Figure 6: Connection keypad with Arduino

For timer path setting, Membrane Keypad 4x4 Arduino is used. The connection between membrane keypad and Arduino microcontroller are shown in Figure 6. The keypad is used for setting the timer up to 4 hours. Keypad numbers 1, 2 and 3 are chose for setting the time. Keypad number 3 is used for setting the hours, minutes and seconds. While the keypad numbers 1 and 2 is to raise and lower the time during the timer settings. Only one row of the keypad by connecting r0 to the pin D9 and c0 , c1 , c2 to the pin D10,D11, and D12 respectively. Table 1 shows the microcontroller parts that are connected to the input and output devices.

TABLE I. MICROCONTROLLER PIN CONNECTION

Arduino Pin	Input/output Device	Note
D0	UART Receiver	From GSM modem
D1	UART Transmitter	
D2	RS	From LCD
D3	RW	
D4	E	
D5	D4	
D6	D5	
D7	D6	
D8	D7	From Keypad
D9	R0	
D10	C0	
D11	C1	Output
D12	C2	
D13	Buzzer & DC Motot	

Figure 7 shows the circuit configuration of interfacing the GSM board with microcontroller; T1 and T0 are located at the header pin for external interface. This GSM board can be interfaced to any microcontroller that have UART.

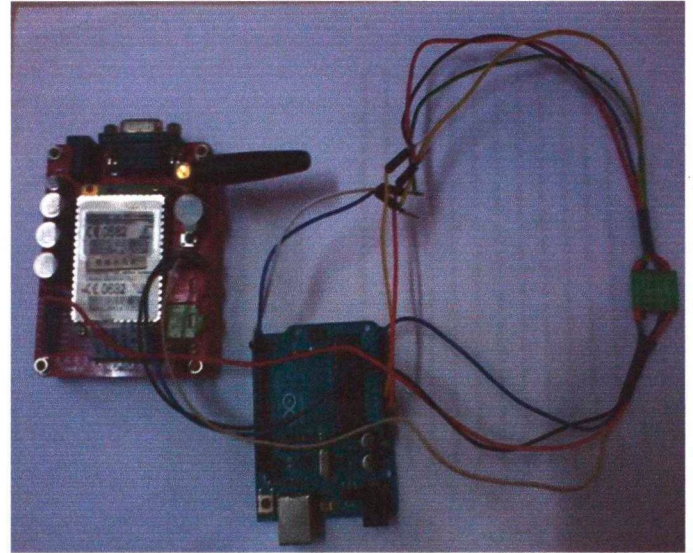


Figure 7: Interface from TC35 GSM development board

The figure 7 shows the diagram of the interface from TC35 GSM development board to Arduino Uno R3 microcontroller via a proper level shifter. However despite, that TC32 GSM development board still needs to be powered from external adapter. For this project, AC to DC adapter 5V 2A is used as the external adapter.

TABLE II. INTERFACE FROM TC35 GSM DEVELOPMENT BOARD TO LC04A TO ARDUINO UNO R3

TC35	LC04A LV	LC04A HV	Arduino Uno R3
VDD (3.3V)	+	+	VDD (6V)
GND	-	-	GND
R0	LT1	HT1	RX
T0	LT2	HT2	TX

C. Building Block

The development of GSM based ESPEC oven automatic control damper is divided into two parts; hardware and software development. In the hardware development, a GSM based ESPEC oven automatic control damper is built and tested. In the software development, a program that controls the components and handles the communication between the microcontroller and mobile phone is developed and its function will be tested.

III. RESULTS AND DISCUSSION

The design of the GSM based Espec oven automatic control damper that expected to lift up the damper automatically and to give reminder or notification to the operator via SMS when time given is enough. This project of GSM based Espec oven automatic control damper as a prototype to facilitate production operators to avoid part damage due to lacking of awareness. Figure 9 shows the original project complete hardware circuit.

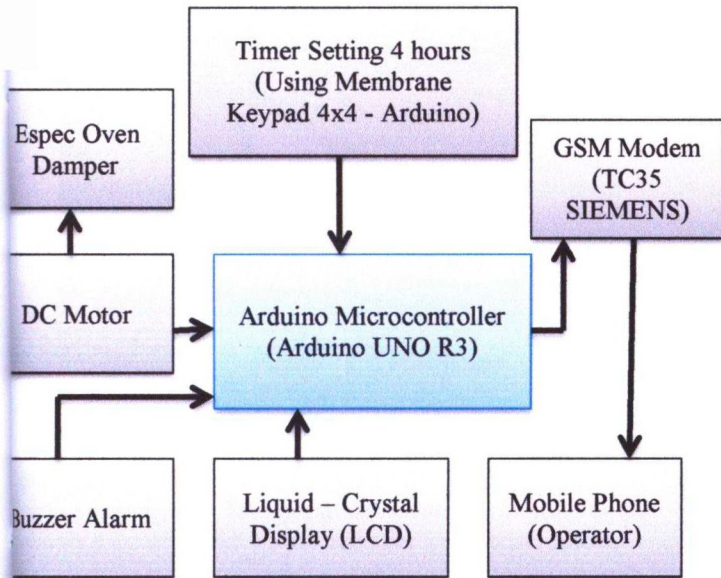


Figure 8: Block diagram GSM based ESPEC oven

The block diagram of a GSM based ESPEC oven automatic control damper is shown in Figure 8. The system consists of several modules; controller, detection, display, deactivation and communication modules. In this system, SAMSUNG GT-S5300 is used as the communication module and Arduino UNO R3 microcontroller as the controller module. The microcontroller functions to detect the membrane keypad button or activation key, control the communication module and deactivate the DC motor using a transistor.

For the detection part, which consisted of a membrane 4x4 keypad, Arduino and LCD display. The keypad is installed for setting the timer. And the LCD display is functioned to display the operation times.

In the communication part, it will handle message transmission to the operator. The purpose is to give an acknowledgement to the operator when the timer reached 4 hours. The GSM modem is controlled by the microcontroller. When the DC motor lift the damper up automatically, the microcontroller will send the data to GSM modem and allowed sufficient time for the mobile phone to send a message. From the message, the operator will aware that the Espec Oven's operation time is completed, and she/he must immediately proceed to next standard of procedure to further reduce the temperature inside the oven.

In the deactivation module or DC motor path, a transistor PN2222 as a switch to control the DC motor is connected to the damper. The function of the DC motor is to lift the damper automatically which will turn the power motor off. The buzzer is also added in this project to enhance awareness to the operator when operation time is completed.

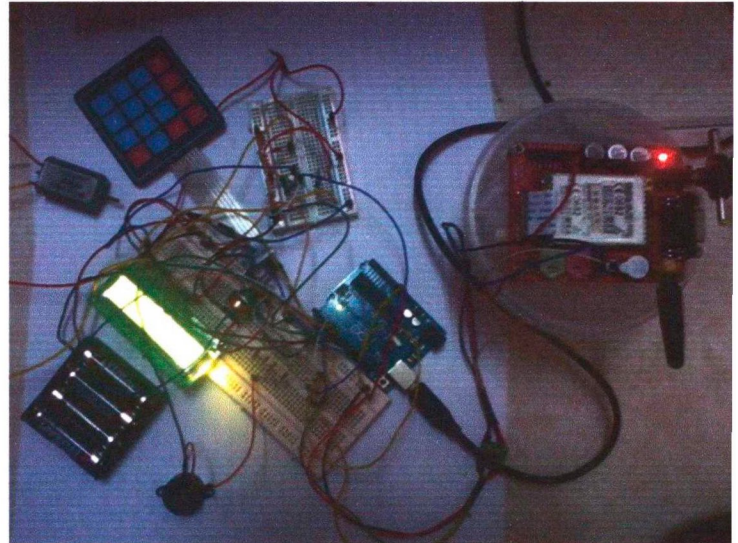


Figure 9: Complete hardware circuit

The operator must set up the time for four hours according to the Standard Operation Procedure. For this system, the keypad is used as a button to the timer. Keypad numbers 1, 2 and 3 are programmed in the microcontroller for setting the time. For setting the hours, minutes and seconds, keypad number 3 is used. While the keypad numbers 1 and 2 is to raise and decrease the time for the timer settings purpose. At the same time this timer is appeared on the LCD screen as in Figure 10 and 11.



Figure 10: Set the time



Figure 11: Timer count

After that, the time will count up until the time reached 4 hours. When the LCD print "Alarm" that mean the time is enough and alarm will be activated. At the same time, DC motor is active to lift up the oven damper. Figure 12 and 13 shows a square wave before and after DC motors active.

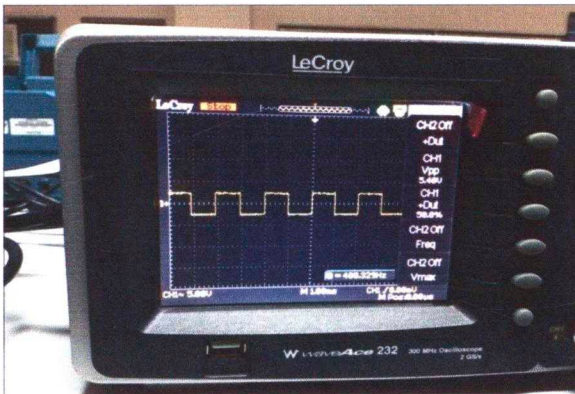


Figure 12: DC motor activate

In Figure 12, the square wave shows the dc motor is in active condition with 5.40V (Vpp). The oven damper is in OFF condition at this time, which means the oven is in operation mode.



Figure 13: DC motor deactivate

In Figure 13, the straight-line shows where dc motor is in deactivate condition with 560mV (Vpp). At this condition, that the oven damper is automatically ON. After a while, the Arduino Uno R3 microcontroller will receive the data from GSM modem. Major role of this project is to give acknowledgement to the operator when the damper is lift up by the dc motor. Finally, the operator receives an SMS from the GSM modem (TC35 SIEMENS) immediately after the damper is lifted up. The AT commands are given by the microcontroller to the GSM modem to give acknowledgment to the operator via SMS. Figure 14 shows the SMS to notify operator that the oven dampers are lifted up and she/he are required to proceed to the next working procedure to reduce the temperature inside the oven.



Figure 14: SMS to the operator

IV. CONCLUSION

In conclusion, the automatic controller design helps to reduce the possibility of part damage due to overheat by automatically stop the oven's operation after 4 hours. In addition, the GSM design helps to give a reminder to the operator in-charge whenever the process is completed. The function is beneficial for lean process as it helps to reduce human error due to overlook of the oven's operation time. It is important because time and temperature are most crucial factor in heat treatment process for small electronics component as LED.

For future works, it is recommended to add other features to the design such as send acknowledgment to other operators as operators in charge on the day of an emergency case, dampers can control ON and OFF via the call, this project can be reset via SMS, added as an indicator like LED when ON and OFF dampers to the design.

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