Liquid Crystal Display Separator Machine for Cell Phone and Tablet Screen

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Abstract*—The work is based on the development of an LCD separator machine for cell phone and tablet screens. There is a good chance that the phone screen has only the surface lens broken and not the LCD or LED screen inside. The cost of changing screens is greatly reduced with this screen separator. This machine includes a PTC heater and a quick-heating aluminum heating plate, a temperature sensor, a rotary switch encoder, a graphic display liquid crystal display (GLCD), a relay driver circuit, 30 A switch mode power, and an Arduino Uno R3 microcontroller. The LCD separator machine can be set to a maximum temperature of 150ºC. It works well and has a high level of control in that the temperature is banded between upper and lower 2ºC of the setting temperature. The power required is 150 W, and it heats up to 85 ºC in 3 minutes when the air flow is between 0.8 and 1.2 m/s, but it takes less than 2 minutes in an airtight environment.

***Indexed Terms*—temperature sensor, arduino microcontroller, rotary switch switching circuit.**

I. INTRODUCTION

With the increased use of Android phones and related screen torch devices, more technicians and tools are required to provide appropriate services at a lower cost and more effectively. The current technological trend is highly disadvantageous in developing countries, with a high rate of mismanagement of national funds, and the cost of tools for repair is excessively high. The vast majority of repair imports into the country were of poor quality and costly. The available torch screen heat removal device is as effective as it is, but it has drawbacks such as reliability, high cost, durability, and highly customized, which means that if there is a fault, it cannot be repaired.

Also, Babalola *et al*., 2015 and Builaminu *et al*., 2010 worked on temperature control to control oven and preservation of food materials, and the temperature range under control is up to 850ºC and 130ºC, respectively. The ICL7106 digital circuit and the Intel 8051 series microcontroller are used. Other studies make use of the Arduino and its free software, which is very effective, inexpensive, and simple to be used for control a device. Many temperature sensors, including thermocouple, DS18B20, LM35, and others, are compatible with the Arduino microcontroller.

Widhiada *et al*., (2017) proposed temperature distribution control development and design for baby incubator applications. It is critical in this system to maintain a specific temperature inside the incubator in order to maintain the proper health of the baby. The experiment included humidity as well as temperature measurement and control using a microcontroller-based system. This proved to be an extremely useful application for baby's care and health. Tan *et al*., (2010) provided a case study of hunidity and light control, including temperature control. The work was completed using a light sensor, temperature sensor, and Arduino hardware were interfaced with the computer. Essentially, the work was proposed for applications in environmental monitoring in a hospital setting. Eltrubaly *et al*., (2017) proposed a remote-controlled temperature monitoring system design and development. The work was based on Arduino and it aims to provide a viable solution to environmental monitoring and care.

Main goal of this project is to create a low-cost LCD separator machine for mobile phones and tablets with temperature control using Arduino that is reliable, long - lasting, easy to maintain when faulty, and rugged.

- Materials and Method

Figure 1 depicts the basic block diagram of a low-cost LCD separator machine for mobile phones and tablets with temperature control. The temperature sensor (DS18B20), dc heating element (automotive inner heater), relay control circuit, temperature setting rotary switch, Arduino Uno R3 microcontroller, graphical liquid crystal display (GLCD), and 20 A switch mode power supply comprise the LCD separator machine.

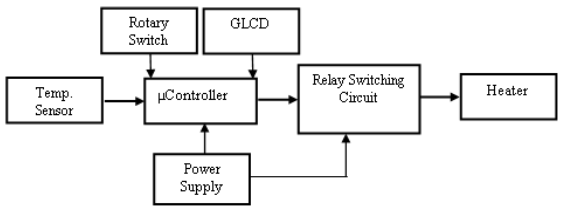

Figure 1: Basic Block Diagram of LCD Separator Machine for Mobile Phones and Tablet

II. TEMPERATURE SENSOR (DS18B20)

The direct-to-digital temperature sensor is the DS18B20. The sensor's resolution can be set to 9, 10, 11, or 12 bits, corresponding to increments of 0.5°C, 0.25°C, 0.125°C, and 0.0625°C, respectively. At startup, the resolution is set to 12-bit. The DS18B20 boots into a low power idle mode. The master issues the Convert T [44h] command to begin a temperature measurement and the A-to-D conversion. Following the conversion, the resulting thermal data is stored in the scratch-pad memory's 2-byte temperature register, after which the DS18B20 returns to its normal or idle state. If the DS18B20 is being powered by an external supply, the master can issue "read time slots" after the Convert T command, and the DS18B20 responds by transmitting 0 while the temperature conversion continues and 1 when it is completed. This notification technique cannot be used if the DS18B20 is being powered by parasitic power because the bus has to be pulled high by a strong pull-up during the entire temperature conversion. The internal block diagram of the DS18B20 is shown in Figure 2.

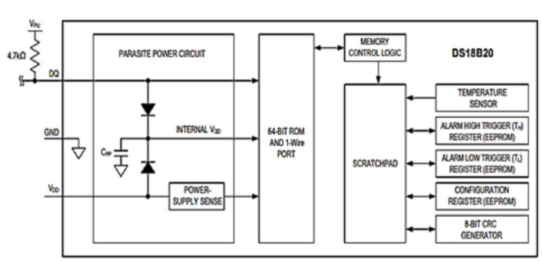

Figure 2: Internal Block diagram of DS18B20

III. RELAY SWITCHING CIRCUIT AND DC HEATER

To engage or disengage the positive temperature coefficient (PTC) heater, the transistor switching device was used to activate a relay. When 5 V is applied to the base of the transistor via an Arduino digital pin, the base emitter junction conducts and allows current to flow from the collector to the emitter via a load (relay) and is then energized (Buliaminu *et al.,* 2010). It will remain active until the Arduino's digital pin attains zero volts (LOW). As shown in Figure 3, the protective diode across the relay is used to remove the back emf of the relay coil. The heater used was obtained from a car, the PTC heater.

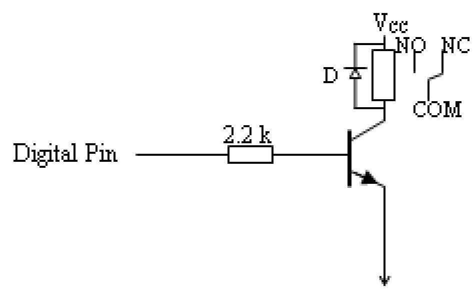

Figure 3: Relay Switching Circuit

IV. ROTARY SWITCH ENCODER FOR SETTING TEMPERATURE

The rotation of the disk causes pulses to be generated in both the DT and CLK pins. However, depending on the rotational direction, one pin's pulse always trails the other by 90 degrees (equal to the electrical contact spacing). The rotational direction of the encoder can be determined by reading and comparing the pulses from either pin. However, the exact position of the knob cannot be determined; only the direction of rotation relative to the original position or the position prior to applying power to the encoder can be known.

From the original position, the disk can rotate either clockwise or counter-clockwise. One of the pins changed states during the rotation. If the DT changed from high to low and CLK equals DT, the rotation is clockwise. DT, on the other hand, will not change state if rotated counter-clockwise. When it rotates counter-clockwise again, the DT goes from high to low, but CLK remains in the high state. This occurs regardless of DT and CLK's initial positions. This process assists in developing an algorithm for determining rotational direction.

Because the rotating encoder has a switch, it was used for press and releases switch selection of either increase or decrease temperature value when pressing the rotating spindle.

V. MICROCONTROLLER UNIT AND DISPLAY UNIT

A microcontroller is a small computer on a single integrated circuit that includes a processor core, memory, and programmable input/output peripherals. Microcontrollers, as opposed to microprocessors, are purposely designed for use in embedded applications, whereas microprocessors are used in personal computers and other general-purpose applications. The Atmega 2560 is a CMOS 8-bit microcontroller with low power and high performance based on the AVR enhanced RISC architecture. The Atmega 2560 has 256 Kbytes of RAM, 8 Kbytes of in-system self-programmable memory with write/read capability, and a 2 Kbyte EPROM. The microcontroller coordinates all of the instrument's activities, monitoring temperature from heat generated and displaying information.

The ST7920 display platform enables the ST7920 to be used with Arduino. The 3-wire SPI bus connects the information display components. A monochrome LCD graphic display is used. Any Arduino data port can be used to connect the E, R/W, and RS pins. It is critical to connect the PSB on the LCD to GND during SPI communication.

VI. TESTING AND EXAMINATION OF PERFORMANCE OF LCD SEPARATOR MACHINE

The temperature sensor was tested and response obtained is that display on the screen is equal to temperature read on Hg-in-glass thermometer. When the soldering iron is brought closer to the DS18B20 reading increases in value and when it withdraw the temperature falls in value. Also, when the temperature value is set to 40oC immediately the value approach and above the relay is trigger. The temperature sensor (DS18B20) has been calibrated standard from manufacture. When compared with the Hg-in-glass thermometer.

Procedure for the Operation of the Temperature

i. Temperature must be initially set to between 80oC to 100oC, using the rotary switch encoder
ii. Switch on the machine and wait for the metal plate to attain 80oC - 100oC.
iii. Phone’s screen must be placed directly on the silicon mat for about 5 minutes or more.
iv. Start to separate the LCD off from the glass with the cutting wire, moving it right and left with the wire between the LCD and the glass. This process must be done gently and slowly while the wire stays on the LCD surface, to avoid damaging the touch screen.
v. Finally separating the LCD from the main screen.

CONCLUSION

The LCD separator machine can be set to a maximum temperature of 150^{o}C. It works well and has a high level of control in that the temperature is banded between the upper and lower 2^{o}C of the setting temperature. The power required is 150 W, and it heats up to 85^{o}C in 3 minutes when the air flow is between 0.8 and 1.2 m/s, but it takes less than 2 minutes in an airtight environment. The machine is very effective, rugged, and simple to maintain. The total cost of building the machine was 38 dollars, compared to 75 dollars with VAT and other international and local logistic costs.

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