DESIGN ASSIGNMENT ON

MICROWAVE OVEN

USING 8086

IN PARTIAL FULFILLMENT OF THE COURSE

MICROPROCESSOR PROGRAMMING AND INTERFACING

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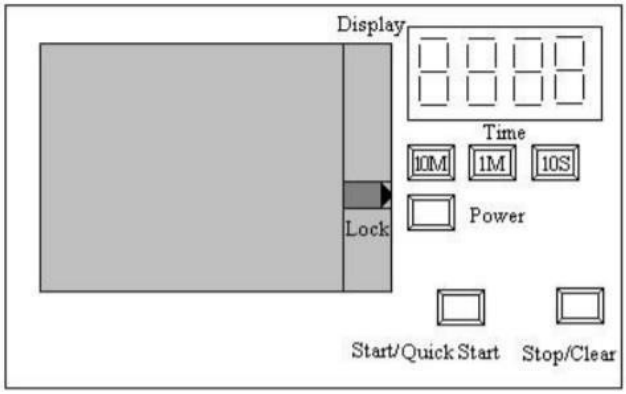
PROBLEM STATEMENT

System to be Designed: Microwave Oven (Q10)

Description: A Simple Microwave Oven without grill.
User Interface: Is shown in the following Figure



User can cook at 5 different Power levels: 100%, 80%, 60%, 40 % 20%

- Every press of the Power Button decrements the power level by 20 %
- 1 Press - 100%; 2 Presses – 80%; 3 Presses – 60%; 4 Presses – 40 %; 5 Presses – 20%
- 6 Presses – Brings the power level back to 100 %
- The Default power level is 100%
- Power Level is varied by controlling the amount of time for which the microwave is turned on.
- Time of cooking is broken up into 10 sec slots, if power is 60% then for 6 secs the microwave is on and rest of the 4 secs the microwave is off.
- Time is set as multiples of 10 Mins, 1Min, 10 Secs. For e.g. if the cooking time is 12 Minutes and 40 secs- the 10 Minutes button has to be pressed once, 1 Minute Button has to be pressed Twice and 10 seconds button has to be pressed four times.
- Once Time has been set Power cannot be modified.
- When user is setting power level or Time, the value being pressed should be displayed, and when user presses the Start button, the cooking process begins and the time left for cooking to complete is displayed.
- Once the cooking begins the door gets locked and should open only when cooking process is terminated.
- User can terminate cooking anytime by pressing the STOP button.
- When Stop button is pressed once cooking is aborted, timer is stopped, not cleared; cooking can be resumed by pressing Start.
- When stop is pressed twice, cooking is aborted and timer is also cleared.
- When cooking time elapses, a buzzer is sounded; pressing the Stop Button stops the buzzer.
- A Quick Start mode is available where timer or power need not be set, just Start button needs to be pressed, the default power value is taken and time is set as 30 secs, for every press of the start button time is incremented by 30 seconds.

ASSUMPTIONS

- Maximum cooking time at once is 99 minutes 50 seconds.
- Multiple keys are not pressed at the same time .
- Time Display format - MM-SS
- Power Display format – PPPP

COMPONENTS USED

Chip Number	Name	Nos	Function
8086	Microprocessor	1	Central Processing Unit
8284	Clock Generator	1	Generates clock of frequency 5MHz and 2.5MHz (Peripheral clock)
74LS373	Octal Latch	3	Demultiplex address, data bus.
74LS244	8-bit buffer	1	Buffer and enhance the strength of input signals.
74LS138	3:8 Decoder	3	Selecting between 8255,8259,8254 and ROM,RAM chips (even and odd bank).
2716	ROM-2K Chips	4	Read Only Memory
6116	RAM- 2K Chips	2	Random Access Memory
7432	2 Input OR Gate IC	1	Bitwise OR
7404	NOT Gate IC	1	Logical Inversion
8254	Clock Timer	1	Generates clock frequency 1Hz to be used as real-time clock.
8259	Priority Interrupt Controller	1	For multiple interrupt sources
8255	Programmable Peripheral Device	1	Generating output signals for output devices.
7447	BCD to 7 Segment Decoder	4	Generates signals for 7 segment display for given BCD value
7 Segment Display	LED Display	4	Display time and power
LS245	Octal Buffers	2	Latch the data bus

ADDITIONAL HARDWARE

- Resistors: Controlling current in various parts of the design
- Buzzer: 12 Volt Piezo – Buzzer (ABI-007-RC)
- Heating Element: Magnetron- Toshiba 2M240 series
- Electromagnetic Door Lock: ML600DS
- Microwave Turntable Motor: SP ElEMECH SSM-16HR 6549W1S011N
- 6 Push Buttons: To input the power, time, start and stop signals from the user.
- 2 OPTOCOUPLERS – Texas Instruments – MOC3020

MEMORY MAPPING

ROM1: 00000_H-$00FFF_H$
RAM1: 01000_H -$01FFF_H$
ROM2: $FF000_H$-$FFFFF_H$

I/0 MAPPING

8255: 18_H-$1E_H$
8259: 20_H -22_H
8254: 28_H-$2E_H$

8255	Address	I/O	Funct ion
Port A	18h	Output	Output BCD value to 7447.
Port B	1Ah	Output	Output BCD value to 7447.
Port C	1Ch	Output	Output to buzzer, lock, LED, Magnetron Relay.
Control Register	1Eh	-	Used for Programming 8255

8254	Address	Mode	Count Loaded/Function
Counter A	28h	Mode 3	5000 Decimal
Counter B	2Ah	Mode 3	1000 Decimal
Counter C	2Ch	-	-
Control Register	2Eh	-	Used for Programming Timer

INTERRUPT VECTOR TABLE

Vector No	Associated with
50h	10 min button
51h	1 min button
52h	10 sec button
53h	Start button
54h	Power button
55h	Stop button
56h	Timer 1 sec