

# **Microprocessor Programming and Interfacing**

## **Design assignment - MICROWAVE OVEN**



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## **ACKNOWLEDGEMENT:**

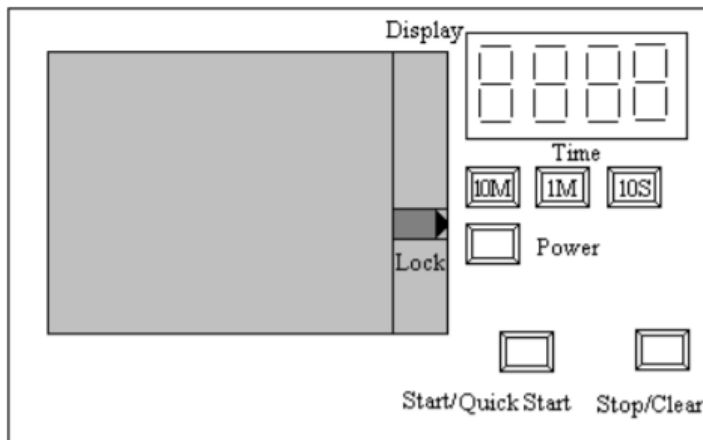
We would like to express our sincere gratitude to Professor Anupama K. R., Instructor In Charge of Microprocessor Programming and Interfacing, for guiding us in the duration of this design assignment. We are very grateful to her for giving us this golden opportunity to work on this report and it's because of her valuable advice that we were able to successfully complete this report.

## **TABLE OF CONTENT**

<b>ACKNOWLEDGEMENT:</b>	<b>2</b>
<b>REQUIREMENTS AND TECHNICAL SPECIFICATIONS:</b>	<b>4</b>
<b>ASSUMPTIONS:</b>	<b>5</b>
<b>JUSTIFICATIONS:</b>	<b>5</b>
<b>COMPONENT SPECIFICATIONS:</b>	<b>6</b>
<b>ADDRESS MAPPING:</b>	<b>7</b>
Memory Map:	7
I/O Map:	7
8255 Configuration:	8
8253 Configuration:	9
8259 Configuration:	9
<b>DESIGN:</b>	<b>10</b>
<b>FLOW DIAGRAM:</b>	<b>11</b>
Main Loop:	11
Interrupt Service Routines:	12
Subroutine:	13
<b>VARIATIONS IN PROTEUS DESIGN:</b>	<b>14</b>
<b>FIRMWARE:</b>	<b>14</b>
<b>LIST OF ATTACHMENTS:</b>	<b>15</b>

## **REQUIREMENTS AND TECHNICAL SPECIFICATIONS:**

User Interface is shown below:



### **Description:**

A Simple Microwave Oven without a grill.

- User can cook at 5 different Power levels: 100%, 80%, 60%, 40 % 20%
- Ever 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 the user is setting power level or Time, the value being pressed should be displayed, and when the 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 the cooking process is terminated.
- User can terminate cooking anytime by pressing the STOP button.
- When the Stop button is pressed once cooking is aborted, timer is stopped, not cleared; cooking can be resumed by pressing Start.
- When the stop is pressed twice, cooking is aborted, and the 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:**

- Only one button is being pressed at a time
- The door will only open once the cooking ends and stop is pressed or if stop is pressed twice.
- Initial power level in % is displayed in the format 0PPP (e.g. 0080 for 80%)
- At all other times, the timer is displayed in place of the power level.
- Time is displayed in the format MM:SS where the minimum time is 00:00 and maximum is 99:59 (realistically 99:50)
- The timer, if increased beyond 99:50 using the 10s button, will return to 00:00
- There exists a mechanism that can utilize the digital signal (in the specified power level form) from our system to activate the Magnetron
- Even in quick start mode the user may set the power, though not necessarily

## **JUSTIFICATIONS:**

- To ensure that the microwave cannot be powered while the door is open, the power to the system is delivered only if the door is closed.
- The outputs for the lock and the buzzer are put through a tri-state buffer to meet their current requirements without affecting the ports of 8255.
- Hardware Debounce Circuit has been added to filter out switch chatter.
- We have used a byte of flags in memory(Active, Paused, Power, Buzzer, TimeSet) along with a main loop and a set of 7 branching isr's. This was done to make our design work as a state system.

## **COMPONENT SPECIFICATIONS:**

(RESISTANCES AND GATES AS WELL)

<b><u>S.NO</u></b>	<b><u>CHIP NUMBER</u></b>	<b><u>CHIP</u></b>	<b><u>USE</u></b>
1	8284	TIMING SIGNAL GENERATOR	5MHz FOR 8086 AND 2.5MHz FOR 8253
2	8086	MICROPROCESSOR	CENTRAL PROCESSING UNIT
3	74LS373	ADDRESS LINE DEMUX	USED FOR DEMULTIPLEXING THE ADDRESS LINES
4	74LS245	DATA LINE DEMUX	USED FOR DEMULTIPLEXING THE DATA LINES
5	74LS138	MEMORY/INPUT/OUTPUT DECODER	USED IN THE DECODING LOGIC
6	LS244	CONTROL/BANK SIGNAL	CONTROL SIGNALS
7	2716	2KB ROM	CODE SEGMENT MEMORY
8	6116	2KB RAM	WORKING MEMORY
9	8259	INTERRUPT CONTROLLER	HANDLES BUTTON/TIMER INPUTS
10	8253	COUNTER	GENERATES 1Hz SIGNAL FOR TIMER
11	8255	OUTPUT PORTS	CONNECTIONS TO DISPLAYS AND OUTPUTS
12	74HC4511	BCD TO 7-SEGMENT LATCH	FOR CONVERTING PORT OUTPUT FOR THE 7 SEGMENT DISPLAYS
13	DM74LS5279	S'R' LATCH	COMMAND BUTTONS DEBOUNCE FIX
14	SN74AUC1G126	TRI STATE BUFFER	OUTPUT SIGNALS
15	2M214 – 21GKH	MAGNETRON	USES POWER SIGNAL TO GENERATE EM WAVES
16	SQ1039	ACTUATOR LOCK	TO LOCK MICROWAVE DOOR
17	TDSG5160	7 SEGMENT DISPLAYS	TO DISPLAY POWER/TIMER
18	ABI-009-RC	BUZZER	END OF COOKING SIGNAL

### **ADDRESS MAPPING:**

#### **Memory Map:**

Component	Memory Address
Rom1, Starting Address	00000h
Rom1, Ending Address	00FFFh
Ram, Starting Address	01000h
Ram, Ending Address	01FFFh
Rom2, Starting Address	FF000h
Rom2, Ending Address	FFFFFh

#### **I/O Map:**

Component	I/O Address
8255, Starting Address	00000h
8255, Ending Address	00007h
8253, Starting Address	00008h
8253, Ending Address	0000Fh
8259, Starting Address	00010h
8259, Ending Address	00012h

## 8255 Configuration:

PORT	PORT ADDRESS	MODE	INPUT/OUTPUT	CONNECT TO
A	00H	0	OUTPUT	2 HIGHER 7 SEG DISPLAYS
B	02H	0	OUTPUT	2 LOWER 7 SEG DISPLAYS
C0	04H (CTRL REGISTER BEING USED 06H)	BSR	OUTPUT	LOCK
C1	04H (CTRL REGISTER BEING USED 06H)	BSR	OUTPUT	POWER SIGNAL
C2	04H (CTRL REGISTER BEING USED 06H)	BSR	OUTPUT	BUZZER
C3 to C7	_____	BSR	_____	NOT IN USE



### 8253 Configuration:

PORT	ADDRESS	MODE	CONNECTED TO
COUNTER0	08H	2	<b>CLK:</b> PCLK FROM 8284 <b>OUT:</b> CLK OF COUNTER1
COUNTER1	0AH	2	<b>CLK:</b> OUT OF COUNTER0 <b>OUT:</b> IR6 OF 8259 USING A NOT GATE
COUNTER2	0CH	_____	NOT IN USE
CONTROL REGISTER	0EH	_____	_____

### 8259 Configuration:

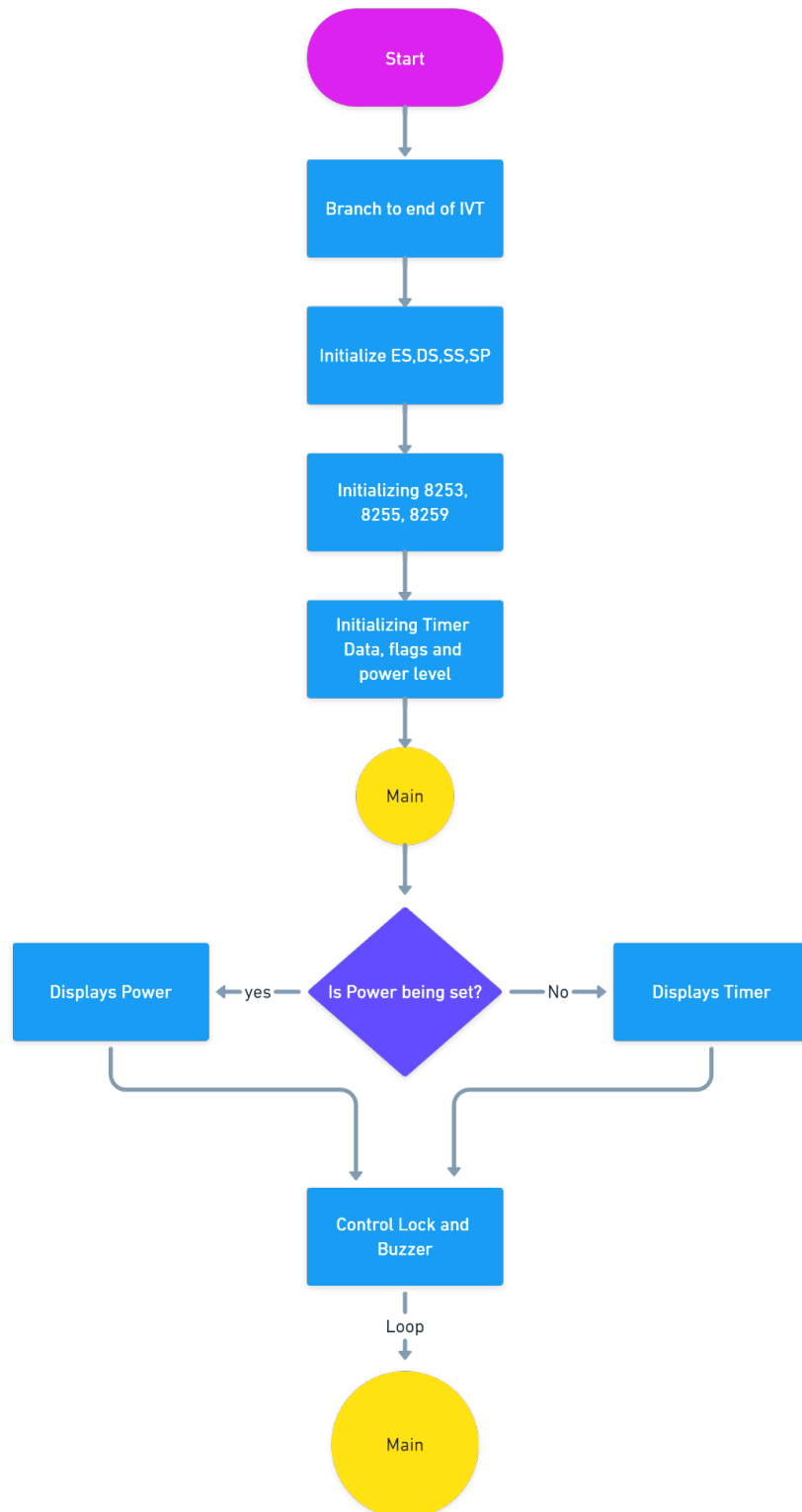
IR number	Source	Function
IR0	START BUTTON	QUICK START/ START
IR1	STOP/CLR BUTTON	PAUSE / CLEAR
IR2	10 MIN BUTTON	ADDS 10 MIN TO TIMER
IR3	1 MIN BUTTON	ADDS 1 MIN TO TIMER
IR4	10 SEC BUTTON	ADDS 10 SEC TO TIMER
IR5	PWR BUTTON	CHANGES POWER LEVEL
IR6	8253 1 Hz SIGNAL	TIMER UPDATE
IR7	GROUND	NOT IN USE

**DESIGN:**

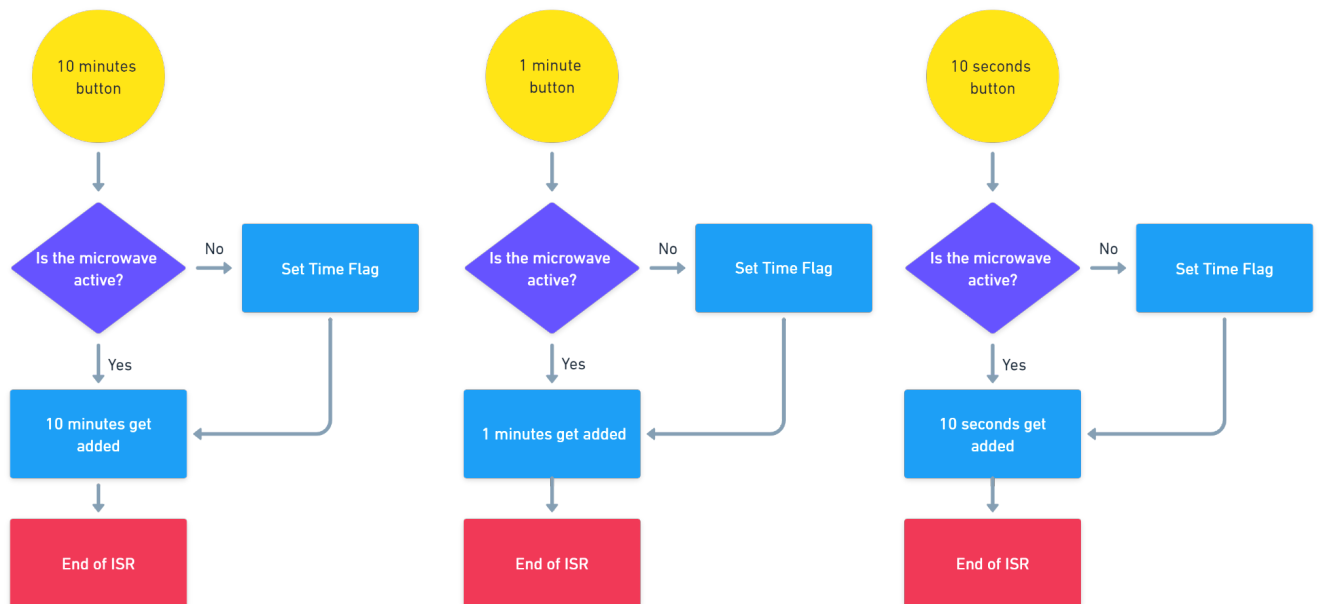
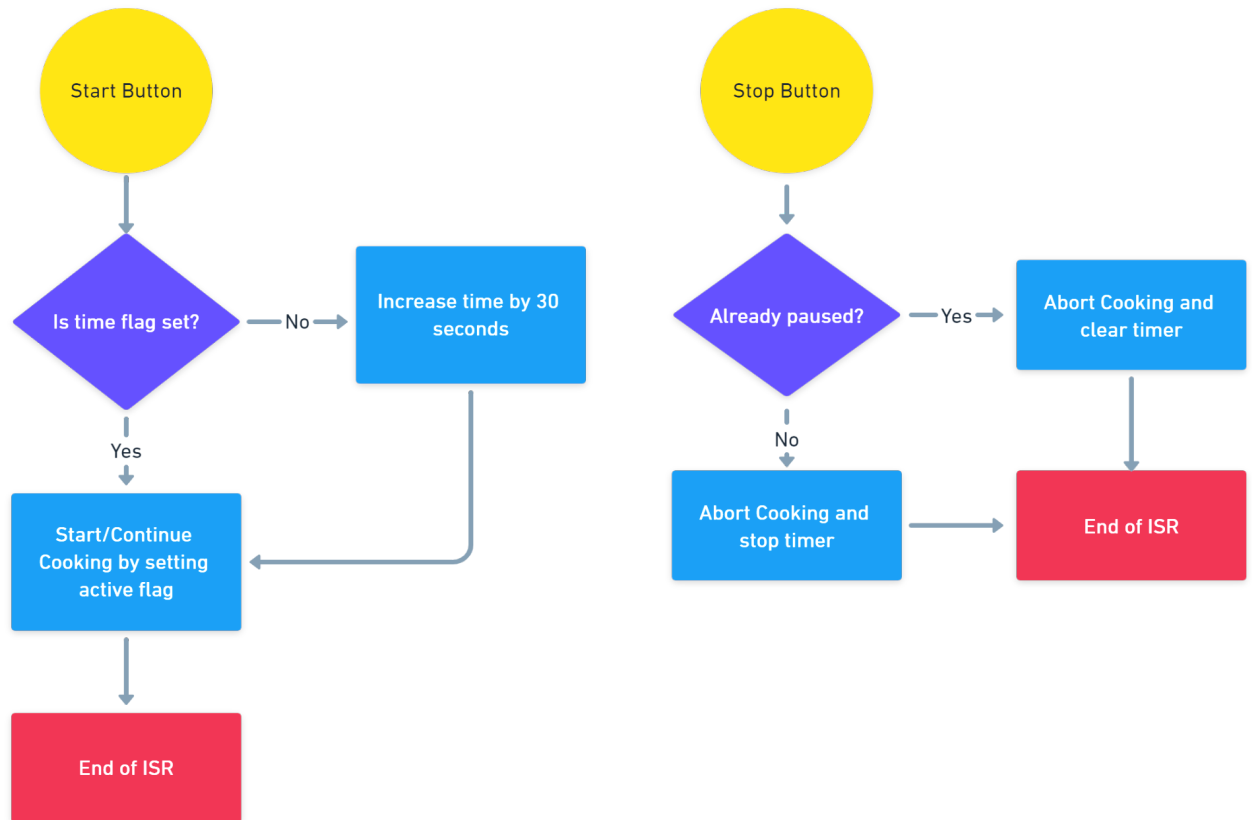
Proteus DSN file attached to this submission. (Page is left blank on purpose)

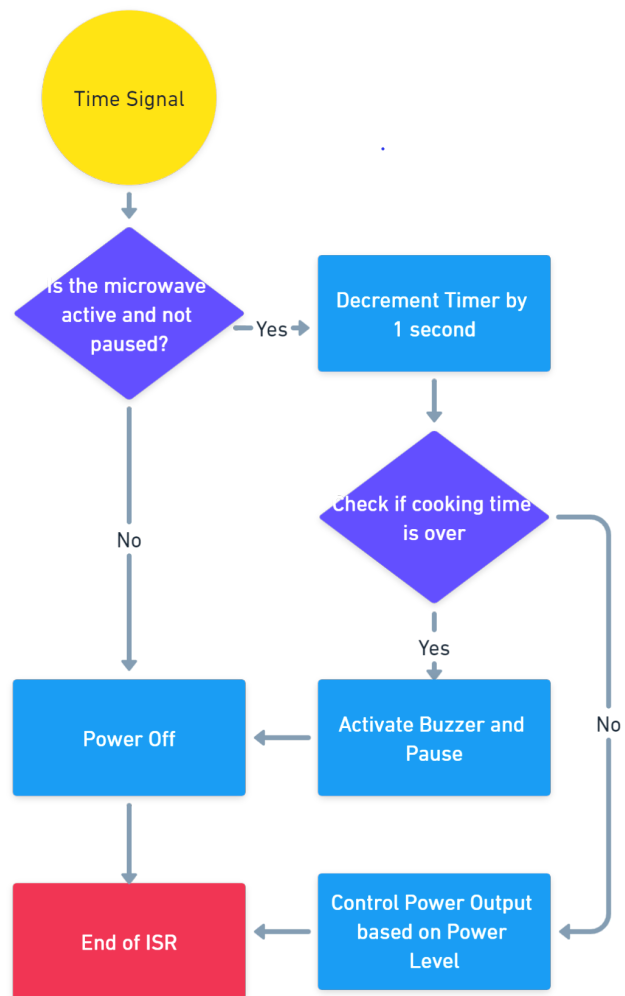
## FLOW DIAGRAM:

### Main Loop:

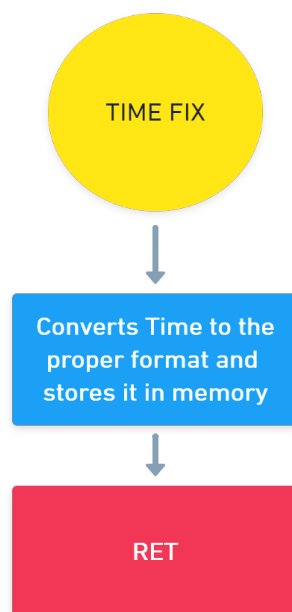


## Interrupt Service Routines:





## Subroutine:



### **VARIATIONS IN PROTEUS DESIGN:**

- The debounce circuit has been omitted as digital simulation and will not suffer from the fluctuation of signals
- 2732 has been used (keeping pin A11 grounded) as 2716 is not modeled in proteus
- Buffer and resistances have been omitted for the same reason as point 1
- The magnetron, buzzer and Lock are represented only as signals
- The door button is omitted in proteus

### **FIRMWARE:**

ASM file attached to this submission. (Rest of the page is blank on purpose)

## **LIST OF ATTACHMENTS:**

- Complete Hardware Real World Design
- Manuals
  - 74HC4511-BCD TO 7-SEGMENT LATCH
  - DM74LS5279-S'R' Latch
  - SN74AUC1G126-TriState Buffer
  - 2M214 – 21GKH-Magnetron
  - TDSG5160-7 Segment Display
  - ABI-009-RC-Buzzer
  - SQ1039-Actuator Lock
- Proteus Design file: **G2\_Microwave.DSN**
- The Firmware code: **G2\_Microwave.ASM**
- The assembled source file: **G2\_Microwave.BIN**