MICROWAVE OVEN DESIGN ASSIGNMENT

Microprocessor Programming and Interfacing (ECE/EEE/INSTR F241)

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User Requirements and Technical Specifications

Description: Design a simple microwave oven without a grill.

Requirements:-

- 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-second slots, if power is 60% then for 6 secs the microwave is on and for the rest of the 4 seconds, 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 seconds - the 10 Minutes button has to be pressed once, the 1 Minute Button has to be pressed twice and the 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 it 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, the 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 the 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.
- Time Display Format – MM SS
- Power Display Format – PPPP

Assumptions

- A clock frequency of 2Mhz is available to be given to Timer (8253)
- There is a mechanism already in place where the door will get locked if the signal given to it from 8255 is high
- The magnetron (heating element) of the microwave oven is already available which amplifies the current sent to it by the 8253
- The time required for loading the latched values into counters of 8253 after giving the gate trigger has been taken as negligible in comparison to the total time
- Maximum time for cooking user can set is 59min and 59sec
- Multiple Keys cannot be pressed simultaneously

List of ICs Used

Chip Number	Chip	No. of Chips Used	Use
8086	Microprocessor	1	CPU
2732	ROM – 4K	2	Read-Only Memory
74LS245	8 BIT Latch	2	To Latch Data Bus
74LS373	8 BIT Latch	3	To Latch Address Bus
8255	Programmable Peripheral Interface	2	Connect to Various I/O Devices
8253	Clock Timer	2	To produce the stable frequency clock for 8086
74HC138	3 : 8 Decoder	1	For selecting between the various components like ROM, RAM, TIMER1
6116	RAM – 2K	2	Random Access Memory
74HC4511	BCD to 7 Segment Decoder	4	Display

Other Components Used

- Galanz M24FB-610A Generic Microwave Magnetron- Heating element
- Galanz SS-5-240-TD Synchronous Motor - Microwave Turntable Motor
- Buzzer (Electromechanical, 6V DC, Part Number - ABI-009-RC*)* - To Indicate the end of the cooking time
- NOR Gates - To allow or disallow Input from Pushbuttons
- Resistors
- 7 Segment Display (DL707) - To Display Time and Power (4)(active high)
- AND Gates (7408)
- LOGIC NOT (7404)
- LOGIC OR (7432)
- Push Buttons - To input
- VCC, Ground, LED's

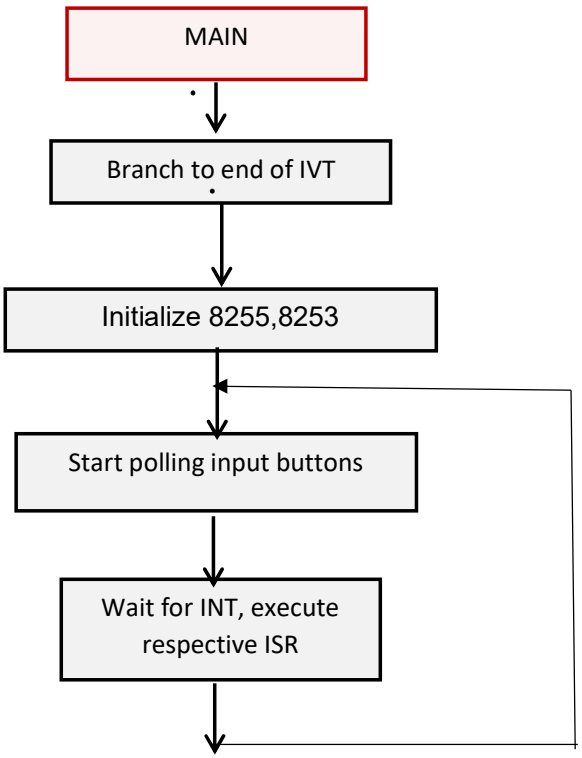
Address Map

- Memory Map
  - ROM : 00000H - 00FFFH
  - RAM : 01000H – 01FFFH

- I/O Map
  - 8253A : 02000H – 02FFFH
  - 8253B : 03000H – 03FFFH
  - 8255A : 04000H – 04FFFH
  - 8255B : 05000H – 05FFFH

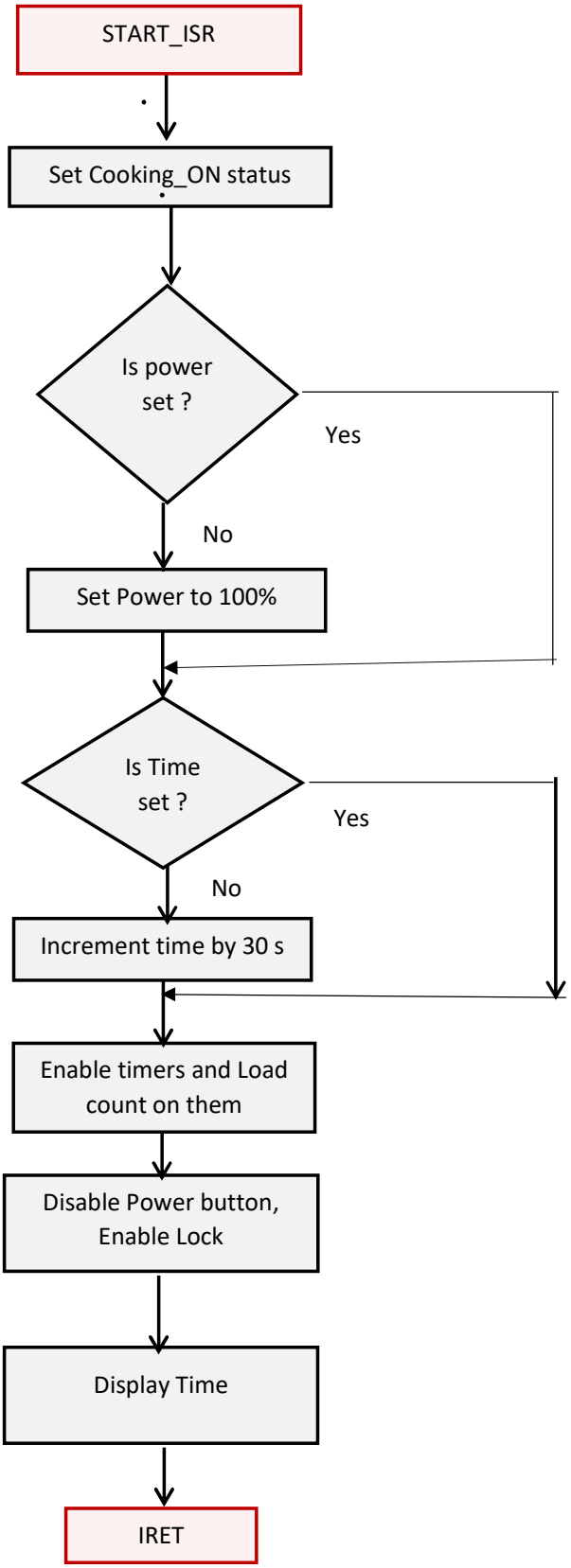
Flow Chart

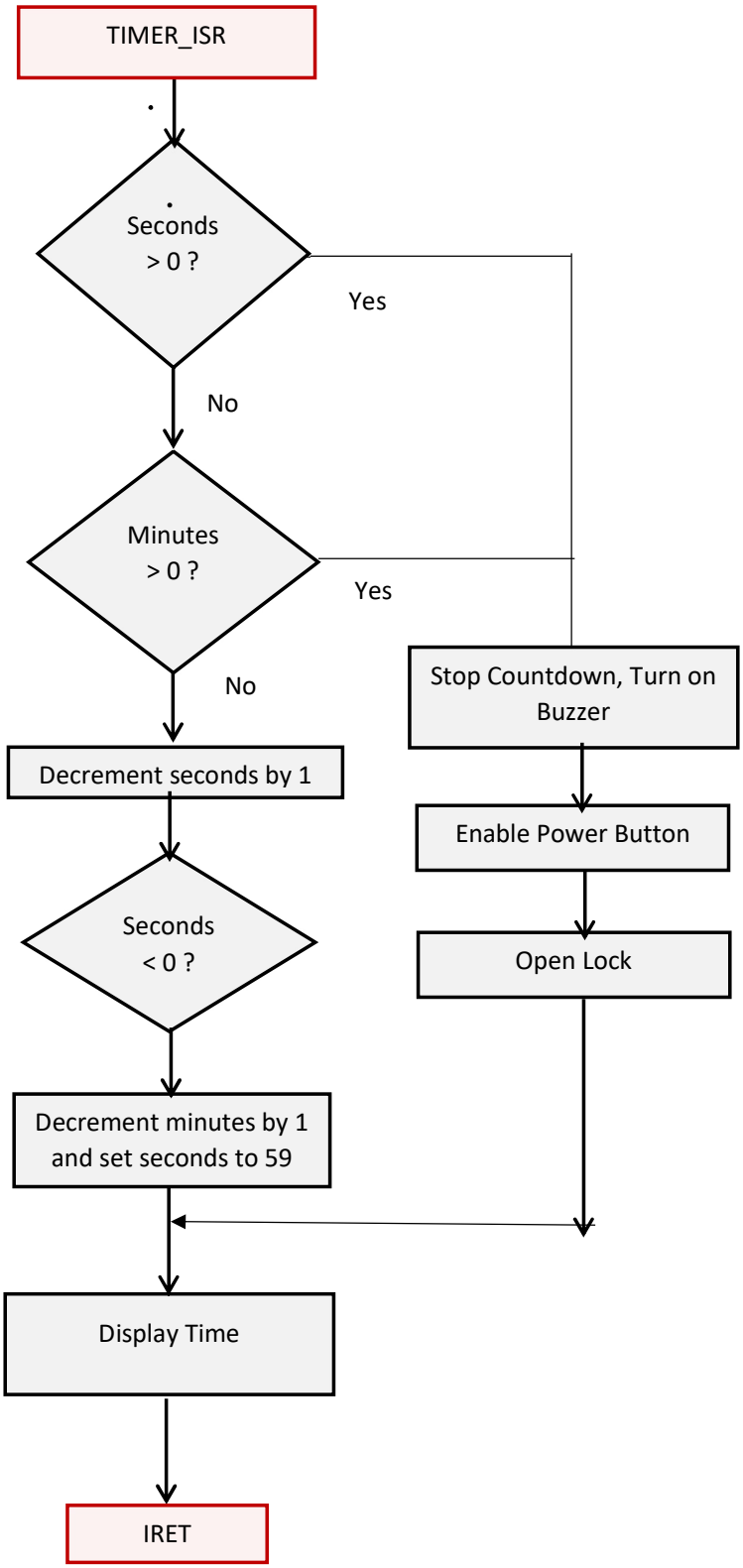
Main Program

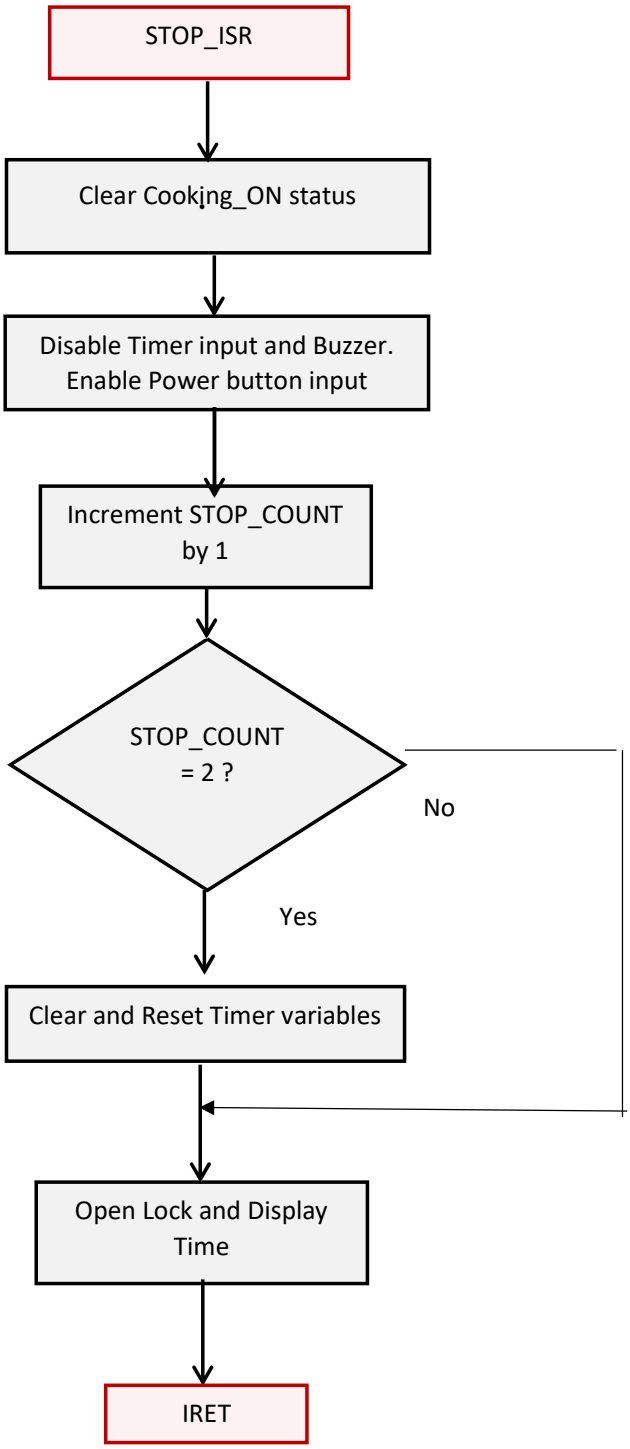


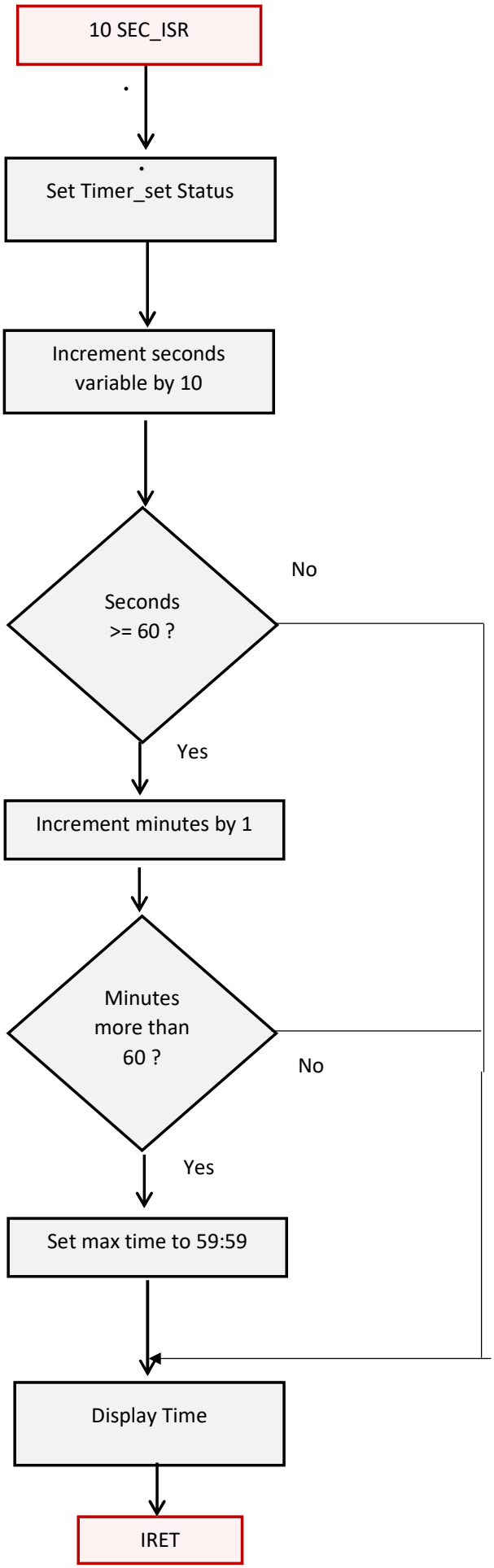
Flow Chart

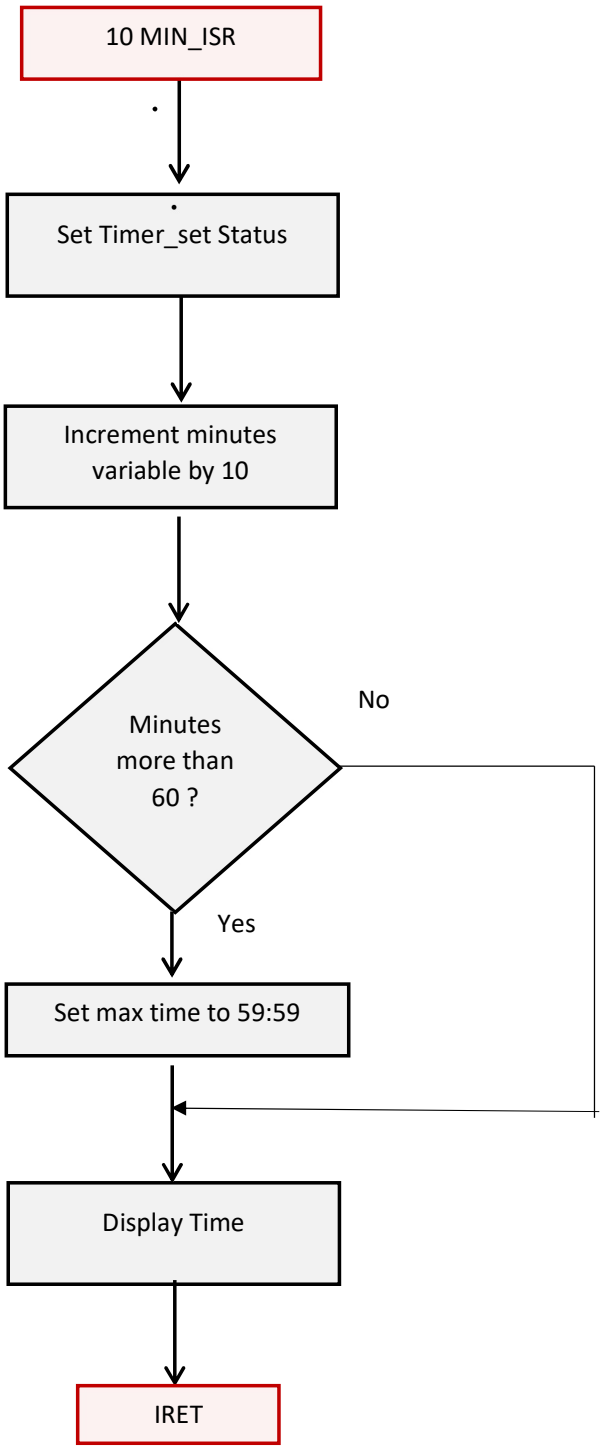
Interrupt Service Routines

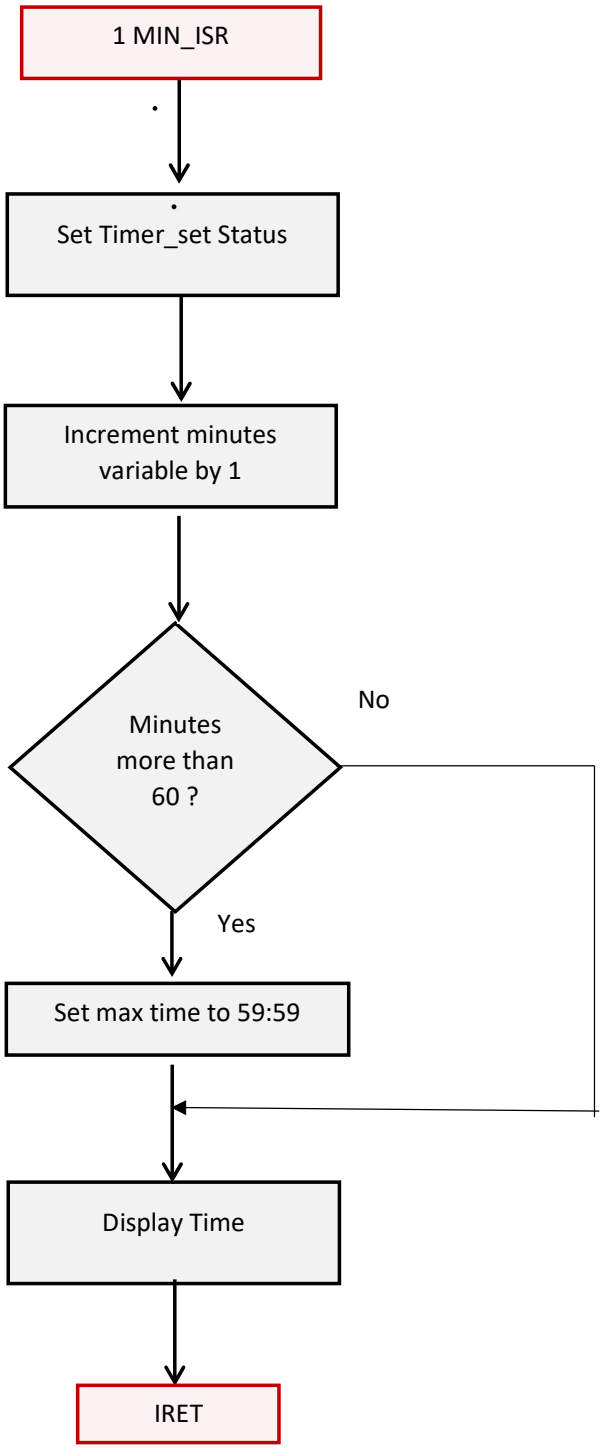


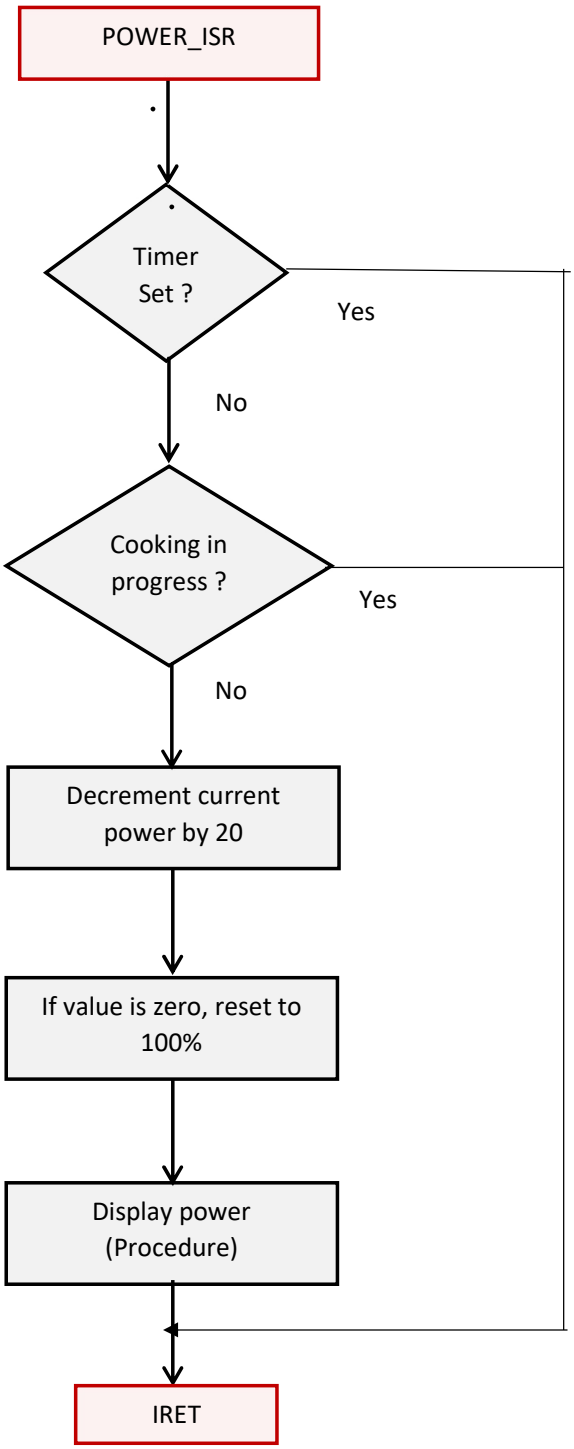

TIMER_ISR
Seconds
> 0 ?
Yes
No
Minutes
> 0 ?
Yes
No
Stop Countdown, Turn on Buzzer
Decrement seconds by 1
Enable Power Button
Seconds
< 0 ?
Open Lock
Decrement minutes by 1 and set seconds to 59
Display Time
IRET


STOP_ISR
Clear Cooking_ON status
Disable Timer input and Buzzer.
Enable Power button input
Increment STOP_COUNT
by 1
STOP_COUNT
= 2 ?
No
Yes
Clear and Reset Timer variables
Open Lock and Display
Time
IRET


10 SEC_ISR
Set Timer_set Status
Increment seconds variable by 10
Seconds >= 60 ?
No
Yes
Increment minutes by 1
Minutes more than 60 ?
No
Yes
Set max time to 59:59
Display Time
IRET


10 MIN_ISR
Set Timer_set Status
Increment minutes variable by 10
Minutes more than 60 ?
No
Yes
Set max time to 59:59
Display Time
IRET


1 MIN_ISR
Set Timer_set Status
Increment minutes variable by 1
Minutes more than 60 ?
No
Yes
Set max time to 59:59
Display Time
IRET


POWER_ISR
Timer Set ?
Yes
No
Cooking in progress ?
Yes
No
Decrement current power by 20
If value is zero, reset to 100%
Display power (Procedure)
IRET