DESIGN ASSIGNMENT ON

MICROWAVE OVEN

USING 8086

IN PARTIAL FULFILLMENT OF THE COURSE

MICROPROCESSOR PROGRAMMING AND INTERFACING

BITS PILANI K. K. BIRLA GOA CAMPUS

Submitted to:

K.R. Anupama

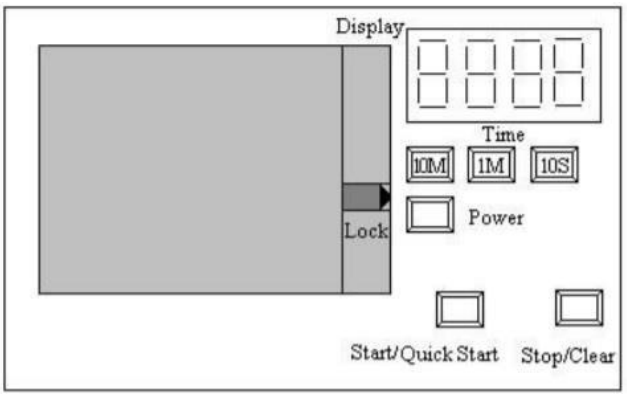
Group no:79

JASLEEN: 2017A7PS007G
NIDHI ZARE: 2017A7PS0139G
CHIRAG MIDHA: 2017A7PS0964G
SRUSHTI NIMBARTE: 2017A3PS0318G
ADITYA MOHAN: 2017A7PS0945G

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 59:59.
- Multiple key presses at the same time are not allowed.
- There is mechanism already in place whereby door will get locked if PC2 of 8255 is high and unlocked if PC2 is low.
- Time Display format - MM-SS
- Power Display format - PPPP
- The door will automatically get locked once the user presses start/quick start and will open when the process gets completed.

COMPONENTS USED

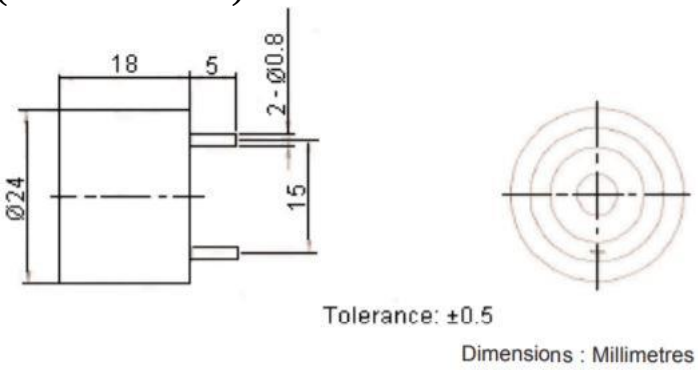
Chip Number	Name	Nos	Function
8086	Microprocessor	1	Central Processing Unit
8284	Clock Generator	1	Generates clock of frequency 5MHz and 2.5MHz (Peripheral clock)
74LS373	8-bit Latch	3	Latch the address bus
74LS275	8-bit buffer	2	Buffer data bus
74LS138	3:8 Decoder	2	Selecting I/O devices
2716	ROM-2K Chips (In Proteus minimum chip available is 4K ,i.e. 2732)	4	Read Only Memory
6116	RAM- 2K Chips	2	Random Access Memory
7432	2 Input OR Gate IC	1	Bitwise OR
7408	2 Input AND Gate IC	1	Bitwise AND
7404	NOT Gate IC	1	Logical Invertion
8253	Clock Timer	1	Generates required clock frequency
8259	Priority Interrupt Controller	1	For multiple interrupt sources
8255	Programmable Peripheral Device	1	Connected to various I/O device
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

ADDITIONAL HARDWARE

- Resistors: Controlling current in various parts of the design
- Buzzer: 12 Volt Piezo – Buzzer (ABI-007-RC)
- Heating Element: Magnetron

ADDITIONAL DETAILS

Buzzer: 12 Volt Piezo – Buzzer (ABI-007-RC)



Specifications:

Rated Voltage	12 V dc
Operating Voltage	3-16 V dc
Rated Current at Rated Voltage	8 mA
Sound output at 30 cm, Rated voltage	≥90dB
Resonant frequency at rated voltage	3700 ±500Hz
Operating Temperature	-20 to +60 °C
Storage Temperature	-30 to +80°C
Weight	5g

Heating Element: Magnetron (2M229 Series)

Specifications

Absolute Maximum Rating:

	Minimum	Maximum	
Filament voltage (Note 1)	3.0	4.0	V
Cathode preheating time	0	-	s
Peak anode voltage	-	4.2	kV
Average anode current	-	250	mAdc
Peak anode current	-	1.0	A
Anode input power	-	1.0	kW
Load VSWR (Note 2)	-	4	
Anode temperature (Note 3)	-	300	°C
Antenna seal temperature (Note 4)	-	320	°C
Capacitor temperature (Note 5)	-	120	°C
Storage temperature	-30	60	°C

Typical Operation:

Power supply : Single phase full wave rectified without filter		
Frequency	2460	MHz
Filament voltage	3.3	V
Peak anode voltage (Note 6)	4.0	kV
Average anode current	300	mAdc
Output power (matched load, Note 6)	850	W
Cooling air flow	800	ℓ/min
Pressure drop (Approx.)	80	Pa

MEMORY MAPPING

ROM: 00000H - 00FFFH

ROM	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1

RAM: 01000-01FFF

RAM	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1

ROM: FF000H - FFFFFH

ROM (even)	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
From 00000h	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
To 00FFEh	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

I/O MAPPING

8253: 10_H-16_H
8259: 18_H -$1A_H$
8255: 20_H-26_H

I/O MAPPING

8255	Address	I/O	Function
Port A	20h	Output	Display
Port B	22h	Output	Display
Port C	24h	Output	Output to buzzer, lock LED
Control Register	26h	-	Used for Programming 8255

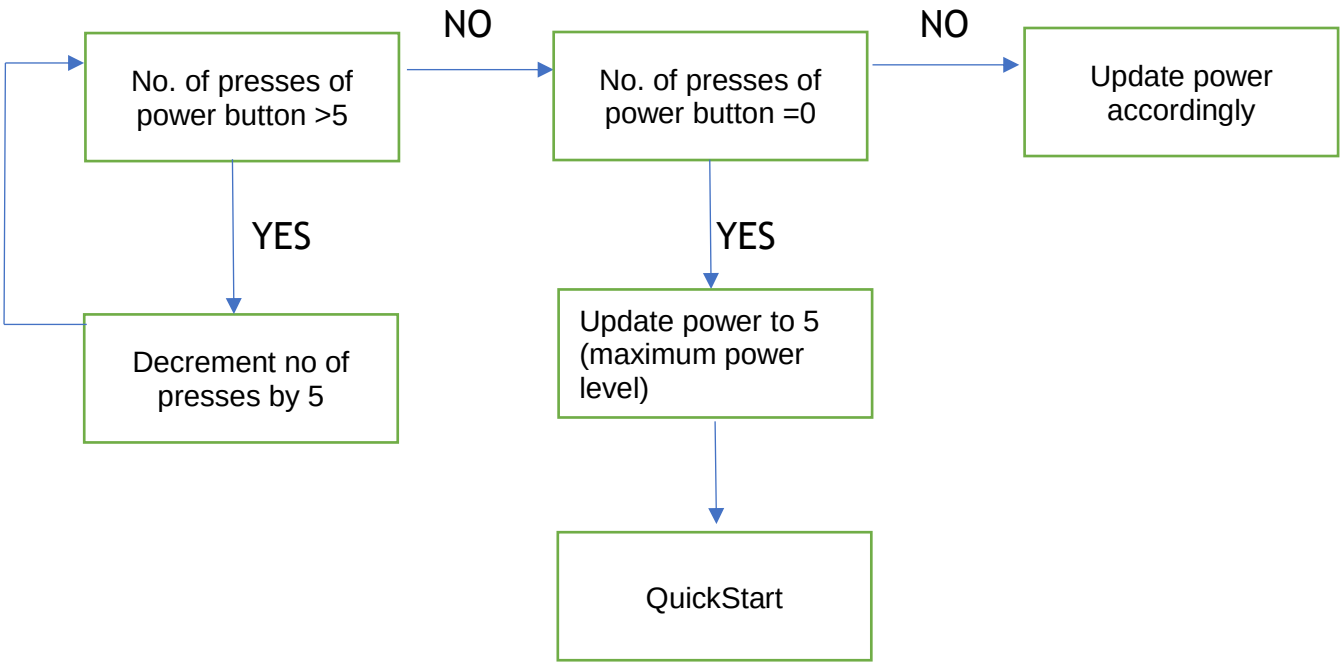
8253	Address	Mode	Count Loaded/Function
Counter A	10h	Mode 2	25,000 Decimal
Counter B	12h	Mode 2	100 Decimal
Counter C	14h	Mode 1	Count Loaded as per Power
Control Register	16h	-	Used for Programming Timer

Interrupt Vector Table

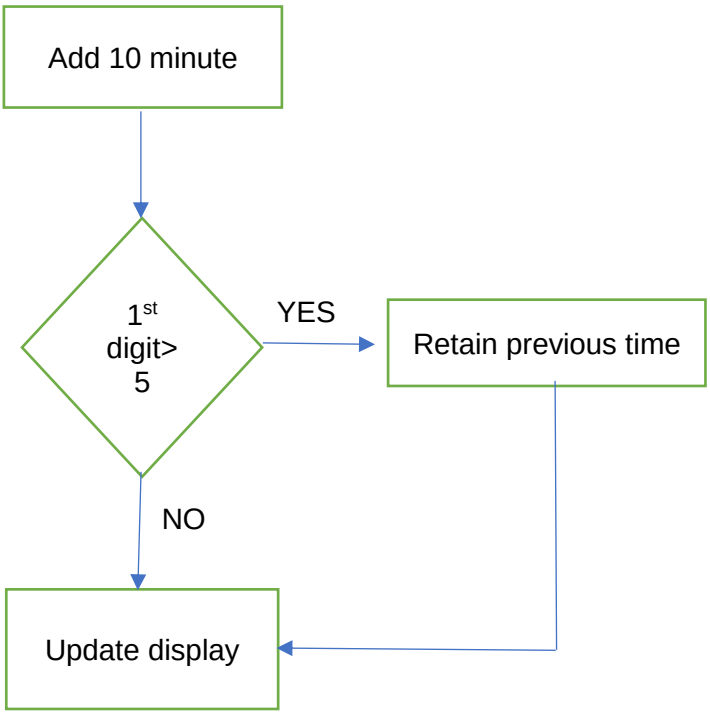
Vector No	Associated with
40h	10 min button
41h	1 min button
42h	10 sec button
43h	Start
44h	Power
45h	Stop
46h	Timer 1 sec

FLOWCHARTS

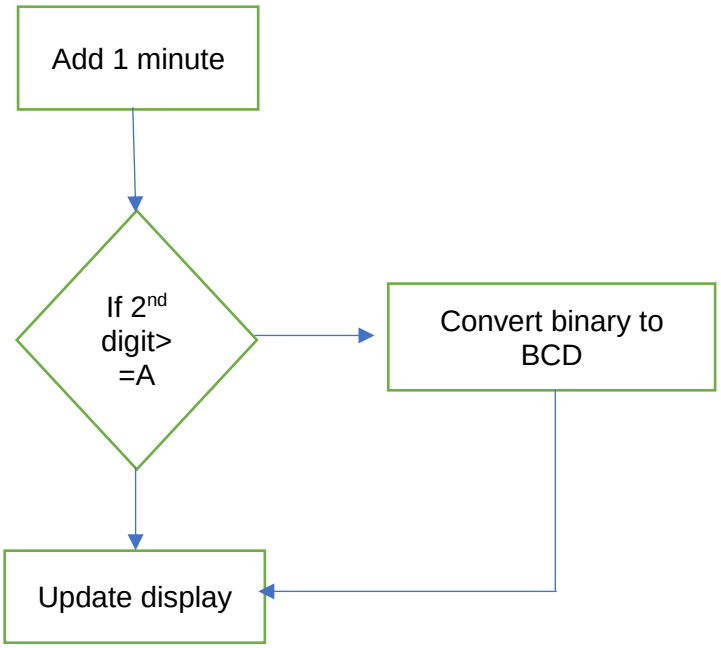
power



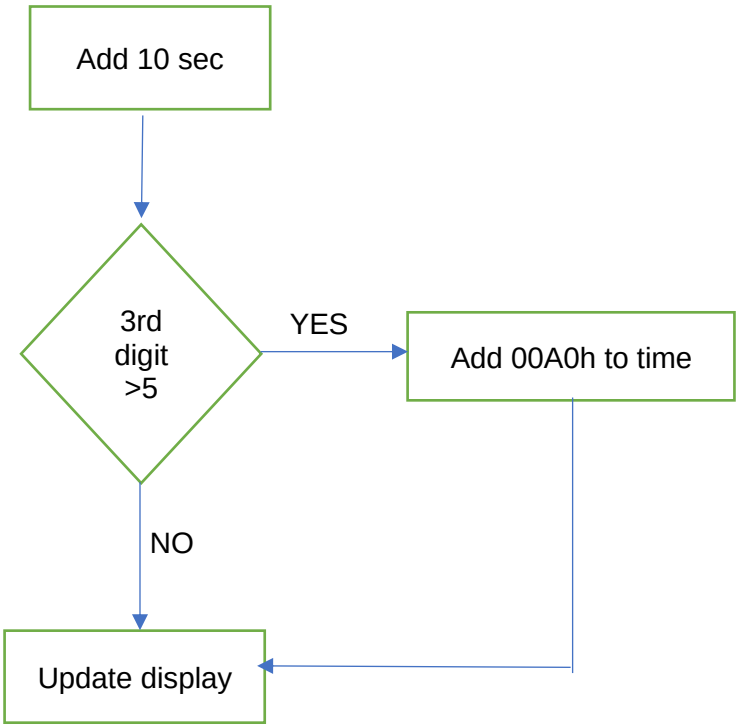
t_10min



t_1min

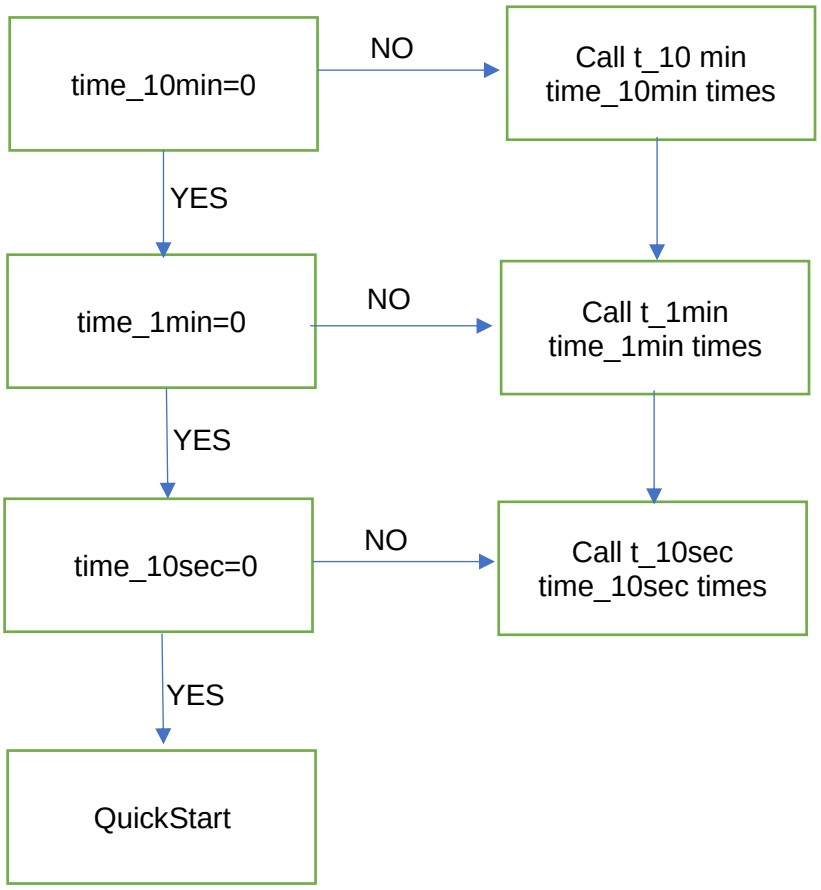


t_10sec

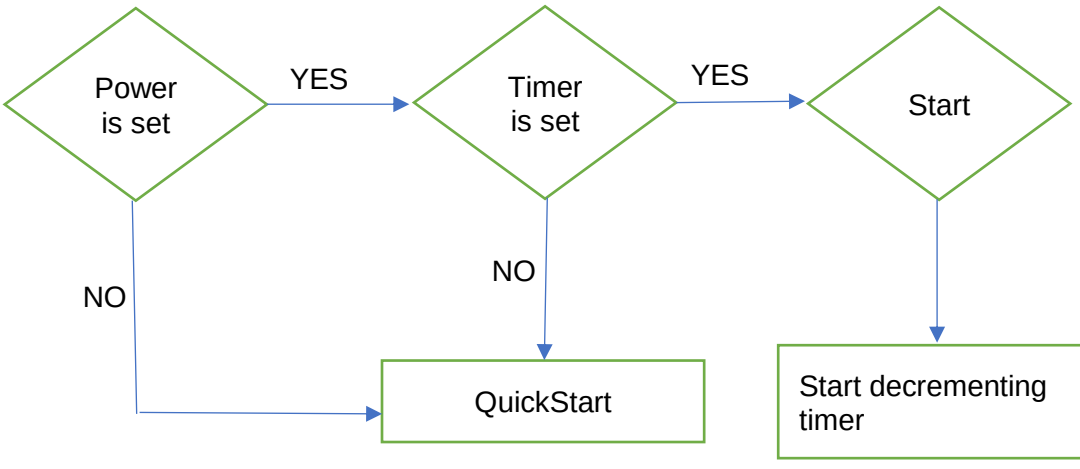


time

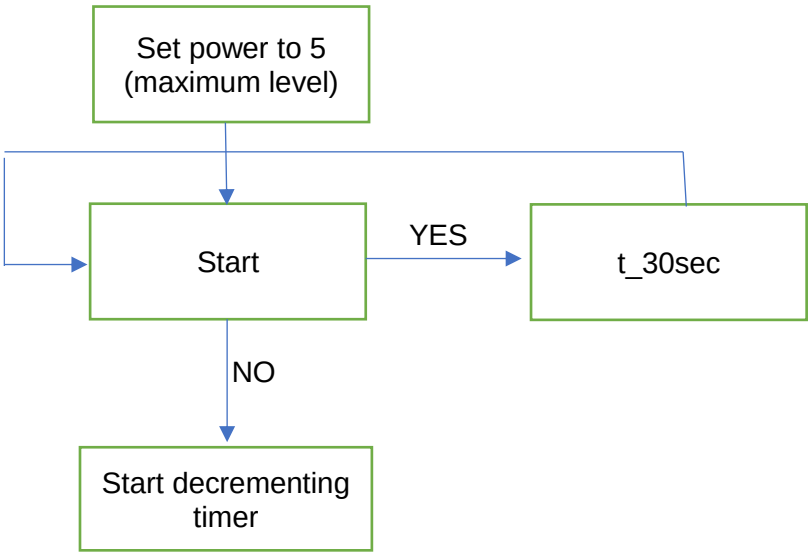
time_10min: No. of presses of 10 min button
time_1min: No. of presses of 1 min button
time_10sec: No. of presses of 10 sec button



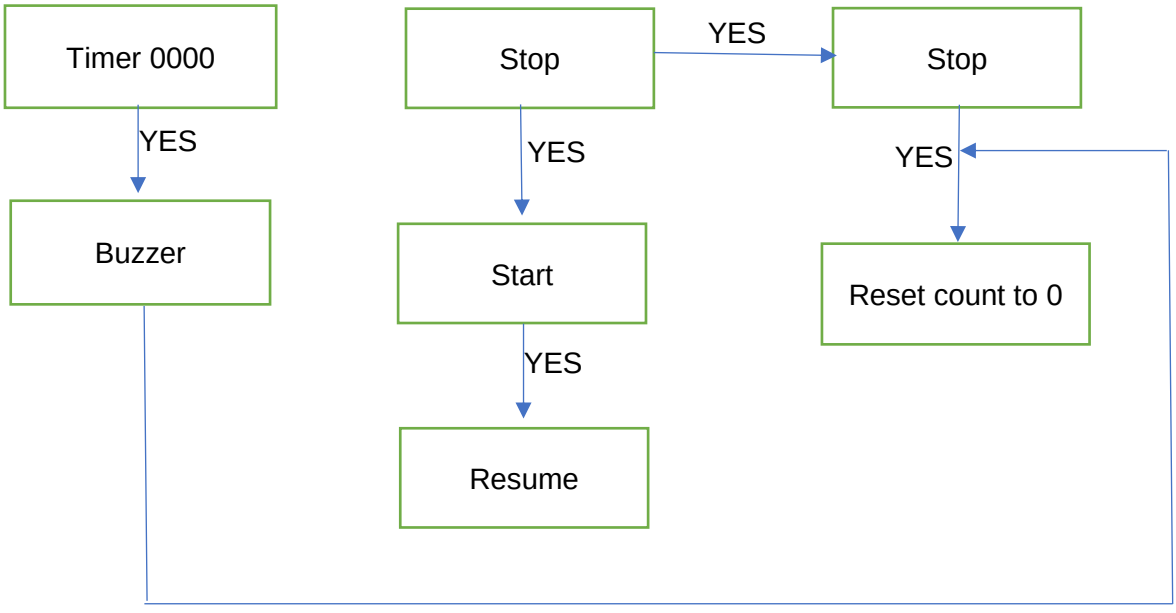
start



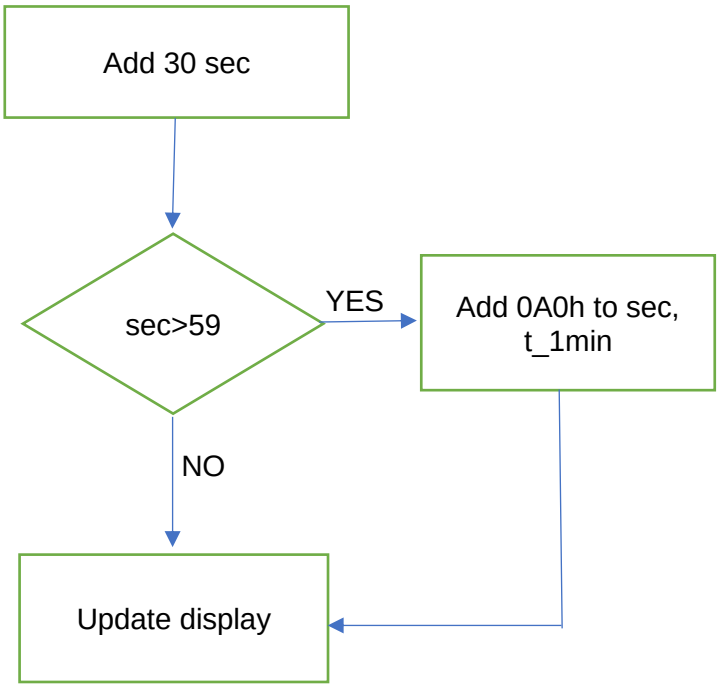
QuickStart



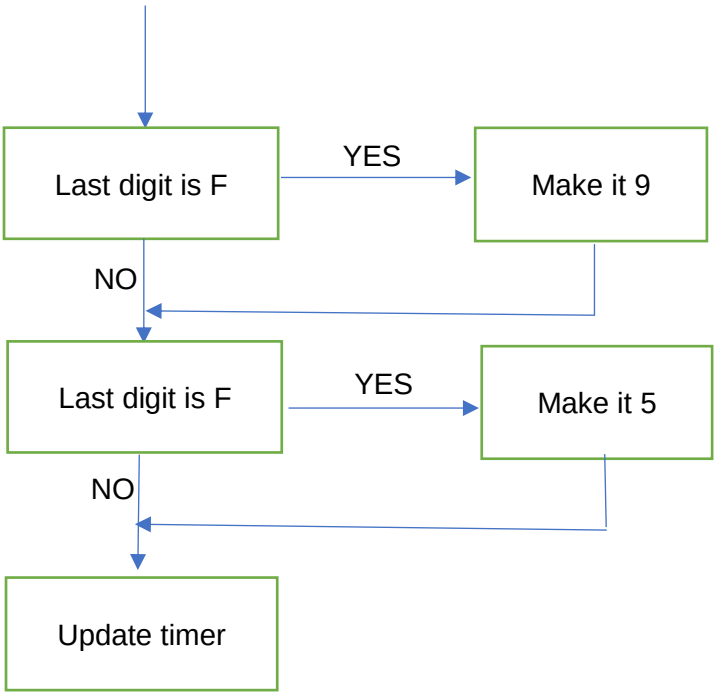
Stop



t_30sec



Decrement timer



USER'S MANUAL

- The Microwave can be used in two modes:
  Quick Start and **Normal Start**.
- In Normal mode of operation:
  - Set the Power at which the microwave is to be operated.
  - Set the time of cooking.
  - Press Start and wait until the cooking is done
- For the Quick Start mode of operation:
  - Press Start, for each press of this button the time of cooking is incremented by 30 seconds
  - The power in quick start mode is 100%

- While the cooking is being done, in case you wish to stop/pause the cooking push the stop button once. This will pause the cooking and it can be resumed by pressing the start button again.
- After the cooking is done, the microwave is automatically reset. If you wish to reset it midway press the stop button twice.