ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

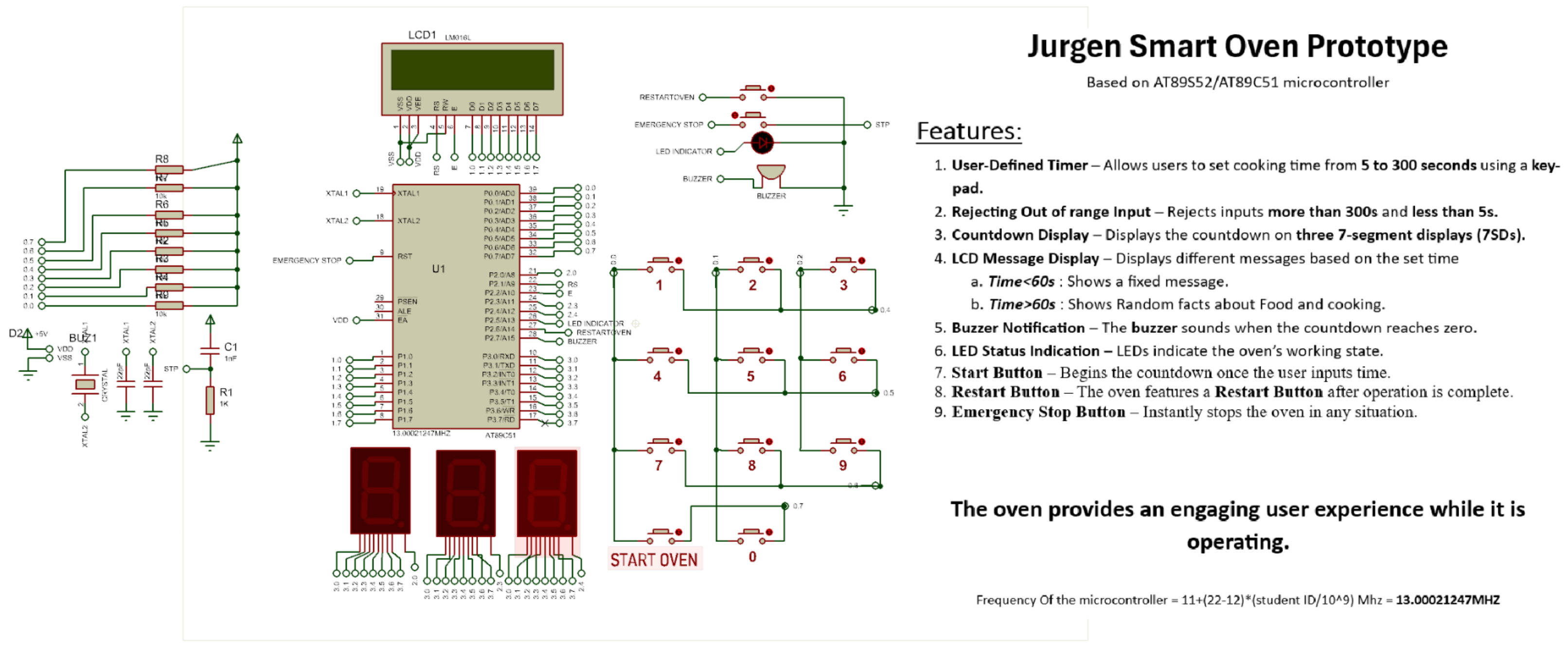
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

NAME	: K. M. Sirazul Monir	STUDENT ID	: 200021247
DEPARTMENT	: EEE	SECTION	: B

DATE OF SUBMISSION : 18/3/2025

COURSE NO.	: EEE 4705
COURSE TITLE	: Microcontroller Based System Design
ASSIGNMENT NO	: 01
ASSIGNMENT NAME	: Complex Engineering Problem

Proteus schematic Screenshot



Jurgen Smart Oven Prototype

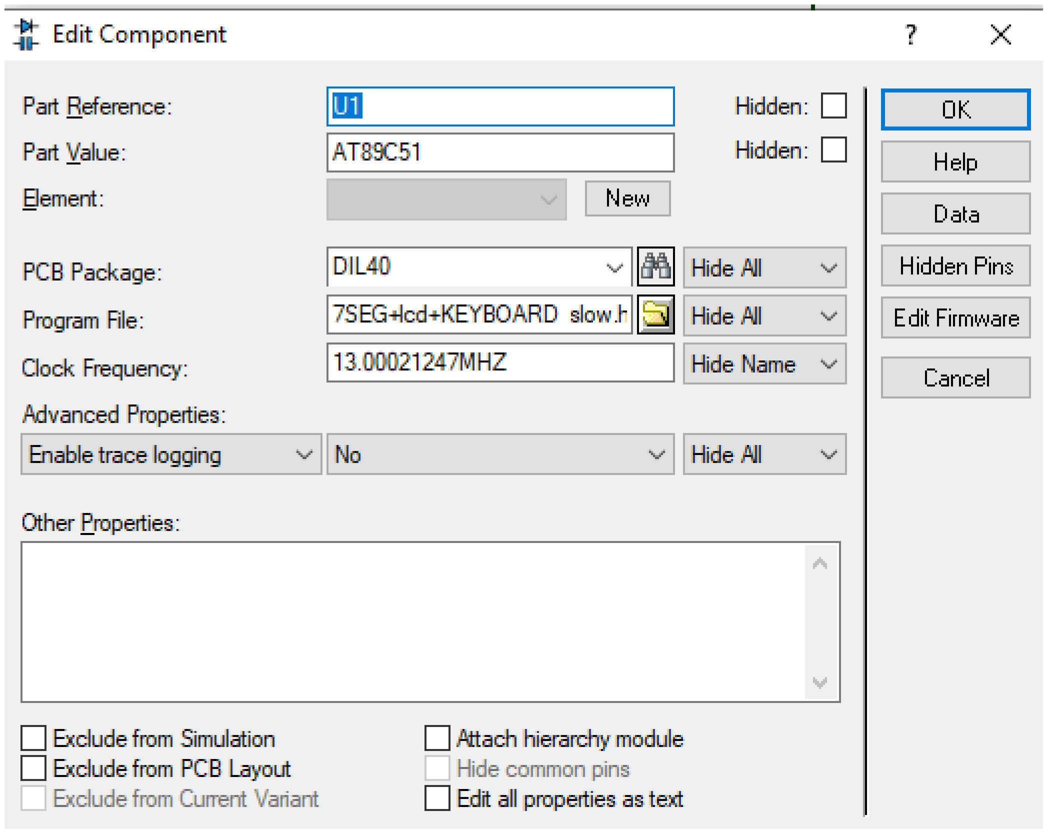
Based on AT89S52/AT89C51 microcontroller

Features:

1. **User-Defined Timer** – Allows users to set cooking time from **5 to 300 seconds** using a **key-pad.**
2. **Rejecting Out of range Input** – Rejects inputs **more than 300s** and **less than 5s.**
3. **Countdown Display** – Displays the countdown on **three 7-segment displays (7SDs).**
4. **LCD Message Display** – Displays different messages based on the set time
   a. ***Time<60s*** : Shows a fixed message.
   b. ***Time>60s*** : Shows Random facts about Food and cooking.
5. **Buzzer Notification** – The **buzzer** sounds when the countdown reaches zero.
6. **LED Status Indication –** LEDs indicate the oven's working state.
7. **Start Button** – Begins the countdown once the user inputs time.
8. **Restart Button** – The oven features a **Restart Button** after operation is complete.
9. **Emergency Stop Button** – Instantly stops the oven in any situation.

The oven provides an engaging user experience while it is operating.

Frequency Of the microcontroller = 11+(22-12)*(student ID/10^9) Mhz = **13.00021247MHZ**



Edit Component

Part Reference:	U1	Hidden: ☐	
Part Value:	AT89C51	Hidden: ☐	
Element:		New	
PCB Package:	DIL40	Hide All	
Program File:	7SEG+lcd+KEYBOARD slow.h	Hide All	
Clock Frequency:	13.00021247MHZ	Hide Name	
Advanced Properties:			
Enable trace logging	No	Hide All	

Other Properties:

☐ Exclude from Simulation
☐ Exclude from PCB Layout
☐ Exclude from Current Variant
☐ Attach hierarchy module
☐ Hide common pins
☐ Edit all properties as text

CODE

```
; Original Jurgen oven code
; All rights reserved by :
;;;;;;;;;;;;;;;;;;;;;;;;;;;; K. M. Sirazul Monir ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;




      org   0000h

     ;Initialize all ports to default state
INITIALIZE:     MOV       P3,#00000000B      ; Clear Port 3
     MOV P0, #0FEH               ; Set up keypad scanning
     MOV 30H,#0                  ; Clear memory variables
     MOV 32H,#0
     MOV R0,#0                   ; Reset register counters
     MOV R7, #15                 ; Set timer constant
     mov r5,#00H                 ; Clear fact counter
     MOV 69H,0H                  ; Clear memory location 69H
     CLR P2.7                    ; Turn off buzzer
     MOV P1, #00000000B          ; Initialize display port
     MOV TMOD, #11H              ; Set timer mode
     MOV TH1, #3CH               ; Initialize timer high byte
     MOV TL1, #98H               ; Initialize timer low byte
     SETB TR1                    ; Start timer
     CLR P2.5                    ; Turn off heating element

; Initialize registers for various operations
REGISTER_INIT:
MOV R3, #00H                      ; Clear display register
MOV R1, #00H                      ; Clear memory pointer
MOV R2, #00H                      ; Clear general purpose register


; Define LCD interface pins
IO_DEFINITION:
RS EQU P2.1                       ; Register Select pin for LCD
EN EQU P2.2                       ; Enable pin for LCD


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Initialize LCD with standard commands
LCD_INIT:
MOV R3, #38H                      ; Function set: 8-bit, 2 lines, 5x7 font
ACALL COMMAND                    ; Send command to LCD
MOV R3, #0EH                      ; Display on, cursor on
ACALL COMMAND
MOV R3, #80H                      ; Set cursor to beginning of first line
ACALL COMMAND
MOV R3, #01H                      ; Clear display
ACALL COMMAND

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Display "ENTER TIME IN s:" message
PROMPT_TIME_ENTRY: MOV DPTR,#TIME_PROMPT
DISPLAY_PROMPT:MOV A,#00H
     MOVC A,@A+DPTR
     JZ TIME_INPUT_LOOP           ; Jump if end of message (zero terminator)
     MOV R3,A
     ACALL DISPLAY              ; Display character
     INC DPTR
     LJMP DISPLAY_PROMPT


; Wait for first digit input from keypad
TIME_INPUT_LOOP:         LCALL SCAN
     MOV A,R0
     JZ TIME_INPUT_LOOP         ; If no key pressed, keep scanning

     MOV 40H,A                  ; Store first digit (hundreds place)
     ANL 40H,#00001111B         ; Mask upper bits to get digit value only
     MOV R1,#40H
     CJNE @R1,#0AH,CHECK_KEY_B  ; Check if valid digit (not A)
     SJMP TIME_INPUT_LOOP
CHECK_KEY_B:   CJNE @R1,#0BH,CHECK_KEY_C  ; Check if not B
     SJMP TIME_INPUT_LOOP
CHECK_KEY_C:   CJNE @R1,#0CH,CHECK_KEY_D  ; Check if not C
     SJMP TIME_INPUT_LOOP
CHECK_KEY_D:   CJNE @R1,#0DH,CHECK_KEY_E  ; Check if not D
     SJMP TIME_INPUT_LOOP
CHECK_KEY_E:   CJNE @R1,#0EH,CHECK_KEY_F  ; Check if not E
     SJMP TIME_INPUT_LOOP
CHECK_KEY_F:   CJNE @R1,#0FH,SHOW_DIGIT1  ; Check if not F
     SJMP TIME_INPUT_LOOP

; Display first digit on LCD
SHOW_DIGIT1:MOV R3, #0C0H             ; Set cursor to second line
     ACALL COMMAND
     MOV A,40H
     ADD A,#30H                 ; Convert digit to ASCII
     MOV R3,A
     ACALL DISPLAY
     lcall SHORT_DELAY          ; Small delay between keypresses


; Wait for second digit input from keypad
TENS_DIGIT_INPUT:        LCALL SCAN
```

```
     MOV A,R0
     JZ TENS_DIGIT_INPUT        ; If no key pressed, keep scanning
     MOV 44H,A                  ; Store second digit (tens place)
     ANL 44H,#00001111B         ; Mask upper bits


     MOV R1,#44H
     CJNE @R1,#0AH,CHECK_TENS_B ; Check if valid digit (not A)
     SJMP TENS_DIGIT_INPUT
CHECK_TENS_B:  CJNE @R1,#0BH,CHECK_TENS_C  ; Check if not B
     SJMP TENS_DIGIT_INPUT
CHECK_TENS_C:  CJNE @R1,#0CH,CHECK_TENS_D  ; Check if not C
     SJMP TENS_DIGIT_INPUT
CHECK_TENS_D:  CJNE @R1,#0DH,CHECK_TENS_E  ; Check if not D
     SJMP TENS_DIGIT_INPUT
CHECK_TENS_E:  CJNE @R1,#0EH,CHECK_TENS_F  ; Check if not E
     SJMP TENS_DIGIT_INPUT
CHECK_TENS_F:  CJNE @R1,#0FH,SHOW_DIGIT2   ; Check if not F
     SJMP TENS_DIGIT_INPUT


; Display second digit on LCD
SHOW_DIGIT2:   MOV A,44H
     ADD A,#30H                 ; Convert digit to ASCII
     MOV R3,A
     ACALL DISPLAY
     lcall SHORT_DELAY          ; Small delay between keypresses


; Wait for third digit input from keypad
ONES_DIGIT_INPUT:        LCALL SCAN
     MOV A,R0
     JZ ONES_DIGIT_INPUT        ; If no key pressed, keep scanning
     MOV 53H,A                  ; Store third digit (ones place)
     ANL 53H,#00001111B         ; Mask upper bits


     MOV R1,#53H
     CJNE @R1,#0AH,CHECK_ONES_B ; Check if valid digit (not A)
     SJMP ONES_DIGIT_INPUT
CHECK_ONES_B:  CJNE @R1,#0BH,CHECK_ONES_C  ; Check if not B
     SJMP ONES_DIGIT_INPUT
CHECK_ONES_C:  CJNE @R1,#0CH,CHECK_ONES_D  ; Check if not C
     SJMP ONES_DIGIT_INPUT
CHECK_ONES_D:  CJNE @R1,#0DH,CHECK_ONES_E  ; Check if not D
     SJMP ONES_DIGIT_INPUT
CHECK_ONES_E:  CJNE @R1,#0EH,CHECK_ONES_F  ; Check if not E
     SJMP ONES_DIGIT_INPUT
CHECK_ONES_F:  CJNE @R1,#0FH,SHOW_DIGIT3   ; Check if not F
     SJMP ONES_DIGIT_INPUT


; Display third digit on LCD
SHOW_DIGIT3:   MOV A,53H
     ADD A,#30H                 ; Convert digit to ASCII
     MOV R3,A
     ACALL DISPLAY
     lcall SHORT_DELAY          ; Small delay between keypresses


; Wait for START key (F key)
WAIT_FOR_START:           LCALL SCAN
     MOV A,R0
     ANL A,#00001111B
     CJNE A,#0FH,WAIT_FOR_START  ; Keep waiting until F key is pressed


; Calculate total time in seconds from the three digits entered
     MOV A,44H                  ; Get tens digit
     MOV B,A
     MOV A,#10
     MUL AB                     ; Multiply tens digit by 10
     ADD A,53H                  ; Add ones digit
     MOV 60H,A                  ; Store tens + ones value


     MOV A,40H                  ; Get hundreds digit
     MOV B,A
     MOV A,#100
     MUL AB                     ; Multiply hundreds digit by 100
     MOV 62H,A                  ; Store low byte of result
     MOV A,B
     MOV 61H,A                  ; Store high byte of result
     MOV A,62H
     ADD A,60H                  ; Add (tens + ones) to (hundreds * 100)
     MOV 62H,A
     JNC CHECK_MAX_TIME         ; Check if carry occurred during addition
     INC 61H                    ; If carry, increment high byte


; Check if time exceeds 300 seconds (maximum allowed)
CHECK_MAX_TIME:  MOV A,61H      ; Load high byte into accumulator
        CJNE A,#01H,CHECK_UPPER_BYTE  ; Compare with 01H (300 > 256)
        MOV A,62H                     ; If high byte is 01H, check low byte
        CJNE A,#2dH,CHECK_LOWER_BYTE  ; Compare with 2DH (45 decimal, 256+45=301)
        JMP TIME_OVER_300             ; If equal to 300 exactly, time is too large

CHECK_UPPER_BYTE: JC CHECK_MIN_TIME   ; If high byte < 01H, time is < 256
        JMP TIME_OVER_300             ; If high byte > 01H, time is > 300

CHECK_LOWER_BYTE: JC CHECK_MIN_TIME   ; If low byte < 2DH, time might be valid
        JMP TIME_OVER_300             ; If low byte > 2DH, time is > 300

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Check if time is less than 5 seconds (minimum allowed)
CHECK_MIN_TIME:  MOV A,61H            ; Load high byte into accumulator
        JNZ CHECK_MID_TIME            ; If high byte > 0, time is > 255
        MOV A,62H                     ; Load low byte into accumulator
        CJNE A,#05H,CHECK_MIN_TIME_TEMP ; Compare with 5 seconds
        JMP CHECK_MID_TIME            ; If exactly 5, proceed to mid check

CHECK_MIN_TIME_TEMP: JC TIME_UNDER_5  ; If Carry is set, time is < 5
        JMP CHECK_MID_TIME            ; If Carry is not set, time is > 5

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

; Display error for time less than 5 seconds
TIME_UNDER_5:  MOV DPTR,#TIME_TOO_SHORT_MSG
     MOV R3, #01H              ; Clear display and set cursor to first position
     ACALL COMMAND
DISPLAY_SHORT_TIME_ERROR:MOV A,#00H
     MOVC A,@A+DPTR
     JZ SHOW_RETRY_MESSAGE
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_SHORT_TIME_ERROR


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Show retry message on second line
SHOW_RETRY_MESSAGE: MOV R3, #0C0H      ; Set cursor to second line
     ACALL COMMAND
     MOV DPTR,#RETRY_MESSAGE
DISPLAY_RETRY:MOV A,#00H
     MOVC A,@A+DPTR
     JZ RETRY_DELAY
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_RETRY

RETRY_DELAY:   LCALL LONG_DELAY      ; Wait before restarting
     Ljmp INITIALIZE             ; Restart the program

; Check if time is more than 60 seconds (cooking method selection)
CHECK_MID_TIME:  MOV A,61H            ; Load high byte into accumulator
        JNZ TIME_OVER_60              ; If high byte > 0, time is > 255 > 60
        MOV A,62H                     ; Load low byte into accumulator
        CJNE A,#3CH,CHECK_60_TEMP     ; Compare with 60 (3CH) seconds
        JMP TIME_OVER_60              ; If exactly 60, consider it > 60

CHECK_60_TEMP: JC TIME_UNDER_60       ; If Carry is set, time is < 60
        JMP TIME_OVER_60              ; If Carry is not set, time is > 60


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Handle time > 60 seconds cooking mode
TIME_OVER_60: MOV DPTR,#TIME_OVER_60_MSG
     MOV R3, #01H                       ; Clear display
     ACALL COMMAND
DISPLAY_OVER_60:MOV A,#00H
     MOVC A,@A+DPTR
     JZ START_OVEN_MESSAGE_2
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_OVER_60

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Handle time < 60 seconds cooking mode
TIME_UNDER_60: MOV DPTR,#TIME_UNDER_60_MSG
     MOV R3, #01H                       ; Clear display
     ACALL COMMAND
DISPLAY_UNDER_60:MOV A,#00H
     MOVC A,@A+DPTR
     JZ START_OVEN_MESSAGE_1
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_UNDER_60

; Display error for time > 300 seconds
TIME_OVER_300: MOV DPTR,#TIME_OVER_300_MSG
     MOV R3, #01H                       ; Clear display
     ACALL COMMAND
DISPLAY_OVER_300:MOV A,#00H
     MOVC A,@A+DPTR
     JZ SHOW_RETRY_MESSAGE
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_OVER_300


; Show "OVEN STARTED" message for mode 2
START_OVEN_MESSAGE_2:MOV DPTR,#OVEN_STARTED_MSG
     MOV R3, #0C0H                      ; Set cursor to second line
     ACALL COMMAND
DISPLAY_START_2:MOV A,#00H
     MOVC A,@A+DPTR
     JZ COOKING_LOOP_2
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_START_2

; Show "OVEN STARTED" message for mode 1
START_OVEN_MESSAGE_1:MOV DPTR,#OVEN_STARTED_MSG
     MOV R3, #0C0H                      ; Set cursor to second line
     ACALL COMMAND
DISPLAY_START_1:MOV A,#00H
     MOVC A,@A+DPTR
     JZ COOKING_LOOP_1
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_START_1

; Main cooking loop for mode 2 (higher power)
COOKING_LOOP_2:MOV       R6,#20             ; Initialize loop counter
     SETB P2.5                         ; Turn on heating element
COOKING_COUNTDOWN_2:
     LCALL DELAY_1S                    ; Wait for 1 second
     LCALL DECREMENT_TIMER             ; Update the countdown
     DJNZ R6,COOKING_COUNTDOWN_2       ; Loop until counter expires
     LCALL UPDATE_DISPLAY_1            ; Update 7-segment display 1
     LCALL UPDATE_DISPLAY_2            ; Update 7-segment display 2
        LCALL UPDATE_DISPLAY_3            ; Update 7-segment display 3
     LCALL DISPLAY_RANDOM_FACT         ; Show a random cooking fact
     MOV       R6,#20                       ; Reset loop counter
        SJMP COOKING_COUNTDOWN_2          ; Continue cooking loop

; Main cooking loop for mode 1 (lower power)
COOKING_LOOP_1: LCALL LONG_DELAY         ; Small initial delay
SETB P2.5                               ; Turn on heating element
DISPLAY_COOKING_TIP:LCALL DELAY_1S      ; Wait for 1 second
     LCALL DECREMENT_TIMER             ; Update the countdown

      ;LCALL UPDATE_DISPLAY_1          ; Uncomment if using 7-segment displays
     ;LCALL UPDATE_DISPLAY_2           ; in mode 1
        ;LCALL UPDATE_DISPLAY_3
        SJMP DISPLAY_COOKING_TIP          ; Continue cooking loop


; Display cooking tip for mode 1
DISPLAY_COOKING_TIP_TEXT:
MOV DPTR,#QUICK_COOK_TIP
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_TIP_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_TIP_END
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_TIP_LOOP
DISPLAY_TIP_END:
RET


; Display rotating facts for mode 2
DISPLAY_COOKING_FACT:
MOV DPTR,#DEFAULT_FACT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_FACT_END
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_LOOP
DISPLAY_FACT_END:
RET

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;---------------------------------------------------------------
; Display a random cooking fact from the fact library
DISPLAY_RANDOM_FACT:INC R5
     mov A,TL1                         ; Get a semi-random value from timer

     add a,r5                          ; Combine with counter for better randomness
     ;ANL A,#00001111B
     mov r5,A
     CJNE R5,#01H,CHECK_FACT_2         ; Check which fact to display
     MOV DPTR,#FACT_2_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_2_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END_TEMP
     MOV R3,A
     ACALL DISPLAY

     INC DPTR
     LJMP DISPLAY_FACT_2_LOOP

CHECK_FACT_2:
     CJNE R5,#02H,CHECK_FACT_3         ; Check for fact 3
     MOV DPTR,#FACT_3_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_3_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END_TEMP
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_3_LOOP


CHECK_FACT_3:
     CJNE R5,#03H,CHECK_FACT_4         ; Check for fact 4
     MOV DPTR,#FACT_4_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_4_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END_TEMP
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_4_LOOP

```

```

CHECK_FACT_4:
     CJNE R5,#04H,CHECK_FACT_5         ; Check for fact 5
     MOV DPTR,#FACT_5_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_5_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END_TEMP
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_5_LOOP


CHECK_FACT_5:
     CJNE R5,#05H,CHECK_FACT_6         ; Check for fact 6
     MOV DPTR,#FACT_6_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_6_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END_TEMP
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_6_LOOP

DISPLAY_RANDOM_FACT_END_TEMP: LJMP DISPLAY_RANDOM_FACT_END

CHECK_FACT_6:
     CJNE R5,#06H,CHECK_FACT_7         ; Check for fact 7
     MOV DPTR,#FACT_7_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_7_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_7_LOOP

CHECK_FACT_7:
     CJNE R5,#07H,CHECK_FACT_8         ; Check for fact 8
     MOV DPTR,#FACT_8_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_8_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_8_LOOP


CHECK_FACT_8:
     CJNE R5,#08H,CHECK_FACT_9         ; Check for fact 9
     MOV DPTR,#FACT_9_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_9_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_9_LOOP


CHECK_FACT_9:
     CJNE R5,#09H,CHECK_FACT_10        ; Check for fact 10
     MOV DPTR,#FACT_10_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_10_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_10_LOOP


CHECK_FACT_10:
     CJNE R5,#10,RESET_FACT_COUNTER    ; Check for fact 11 or reset
     MOV DPTR,#FACT_11_TEXT
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
DISPLAY_FACT_11_LOOP:MOV A,#00H
     MOVC A,@A+DPTR
     JZ DISPLAY_RANDOM_FACT_END
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FACT_11_LOOP


RESET_FACT_COUNTER: MOV R5,#0H        ; Reset fact counter and start again
     LJMP DISPLAY_RANDOM_FACT


DISPLAY_RANDOM_FACT_END:
RET
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;----------------------------------------
; Decrement the cooking timer by 1 second
DECREMENT_TIMER:
       DEC 53H                       ; Decrement ones digit
        MOV A, 53H

        CJNE A, #11111111B, CONTINUE_TIMER  ; Check for underflow (FF)

        ; Reset ones digit and decrement tens digit
        MOV 53H, #9
        DEC 44H
        MOV A, 44H

        CJNE A, #11111111B, CONTINUE_TIMER

        ; Reset tens digit and decrement hundreds digit
        MOV 44H, #9
        DEC 40H
        MOV A, 40H

        CJNE A, #11111111B, CONTINUE_TIMER

        LJMP COOKING_FINISHED          ; Timer has expired

CONTINUE_TIMER:
RET

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Handle cooking completion
COOKING_FINISHED:        CLR P2.5            ; Turn off heating element
     MOV R3, #01H                      ; Clear display
     ACALL COMMAND
     MOV DPTR,#COOKING_FINISHED_MSG
DISPLAY_FINISHED:MOV A,#00H
     MOVC A,@A+DPTR
     JZ SOUND_BUZZER
     MOV R3,A
     ACALL DISPLAY
     INC DPTR
     LJMP DISPLAY_FINISHED

; Sound buzzer to indicate cooking completion
SOUND_BUZZER: SETB P2.7                ; Turn on buzzer
LCALL LONG_DELAY                       ; Keep buzzer on for delay period
CLR P2.7                               ; Turn off buzzer

; Wait for reset button press
WAIT_FOR_RESET:JB P2.6, WAIT_FOR_RESET ; Wait until reset button pressed
     LJMP INITIALIZE                   ; Reset the system

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

; LCD character display subroutine
DISPLAY:
MOV P1, R3                            ; Send character data to port
SETB RS                               ; Set Register Select for data
SETB EN                               ; Enable pulse high
CLR EN                                ; Enable pulse low
ACALL DELAY                           ; Small delay
RET

; LCD command subroutine
COMMAND:
MOV P1, R3                            ; Send command data to port
CLR RS                                ; Clear Register Select for command
SETB EN                               ; Enable pulse high
CLR EN                                ; Enable pulse low
ACALL DELAY                           ; Small delay
RET

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
; Keypad scanning subroutine
SCAN:
SCAN_START:
     JNB       P0.0, COLUMN_1            ; Check column 1
     JNB       P0.1, COLUMN_2            ; Check column 2
     JNB       P0.2, COLUMN_3            ; Check column 3
     JNB       P0.3, COLUMN_4            ; Check column 4
     SJMP      EXIT_SCAN
COLUMN_1:
     JNB       P0.4, KEY_1               ; Check for key 1
     JNB       P0.5, KEY_4               ; Check for key 4
     JNB       P0.6, KEY_7               ; Check for key 7
     JNB       P0.7, JUMP_TO_KEY_F        ; Check for key F
     SETB      P0.0
     CLR       P0.1
     SJMP      EXIT_SCAN
COLUMN_2:
     JNB       P0.4, KEY_2               ; Check for key 2
     JNB       P0.5, KEY_5               ; Check for key 5
     JNB       P0.6, KEY_8               ; Check for key 8
     JNB       P0.7, KEY_0               ; Check for key 0
     SETB      P0.1
     CLR       P0.2
     SJMP      EXIT_SCAN
COLUMN_3:
     JNB       P0.4, KEY_3               ; Check for key 3
     JNB       P0.5, KEY_6               ; Check for key 6
     JNB       P0.6, KEY_9               ; Check for key 9
     JNB       P0.7, JUMP_TO_KEY_E        ; Check for key E
     SETB      P0.2
     CLR       P0.3
     SJMP      EXIT_SCAN
COLUMN_4:
     JNB       P0.4, JUMP_TO_KEY_A        ; Check for key A
     JNB       P0.5, JUMP_TO_KEY_B        ; Check for key B
     JNB       P0.6, JUMP_TO_KEY_C        ; Check for key C
     JNB       P0.7, JUMP_TO_KEY_D        ; Check for key D
     SETB      P0.3
     CLR       P0.0
     LJMP      EXIT_SCAN
```

```
EXIT_SCAN:
     RET

; Jump tables for key handling (to handle branch distance limitations)
JUMP_TO_KEY_A: LJMP KEY_A
JUMP_TO_KEY_B: LJMP KEY_B
JUMP_TO_KEY_C: LJMP KEY_C
JUMP_TO_KEY_D: LJMP KEY_D
JUMP_TO_KEY_E: LJMP KEY_E
JUMP_TO_KEY_F: LJMP KEY_F

; Key handler routines
KEY_0:
     MOV       R0, #16D                  ; Store keycode for key 0
     LJMP      SCAN_START
KEY_1:
     MOV       R0, #1D                   ; Store keycode for key 1
     LJMP      SCAN_START
KEY_2:
     MOV       R0, #2D                   ; Store keycode for key 2
     LJMP      SCAN_START
KEY_3:
     MOV       R0, #3D                   ; Store keycode for key 3
     LJMP      SCAN_START
KEY_4:
     MOV       R0, #4D                   ; Store keycode for key 4
     LJMP      SCAN_START
KEY_5:
     MOV       R0, #5D                   ; Store keycode for key 5
     LJMP      SCAN_START
KEY_6:
     MOV       R0, #6D                   ; Store keycode for key 6
     LJMP      SCAN_START
KEY_7:
     MOV       R0, #7D                   ; Store keycode for key 7
     LJMP      SCAN_START
KEY_8:
     MOV       R0, #8D                   ; Store keycode for key 8
     LJMP      SCAN_START
KEY_9:
     MOV       R0, #9D                   ; Store keycode for key 9
     LJMP      SCAN_START
KEY_A:
     MOV R0, #10                      ; Store keycode for key A
     LJMP SCAN_START
KEY_B:
     MOV R0, #11                      ; Store keycode for key B
     LJMP SCAN_START
KEY_C:
     MOV R0, #12                      ; Store keycode for key C
     LJMP SCAN_START
KEY_D:
     MOV R0, #13                      ; Store keycode for key D
     LJMP SCAN_START
KEY_E:
     MOV R0, #14                      ; Store keycode for key E
     LJMP SCAN_START
KEY_F:
     MOV R0, #15                      ; Store keycode for key F (START key)
     LJMP SCAN_START

; Update the first 7-segment display (hundreds place)
UPDATE_DISPLAY_1: CLR P2.0           ; Select first display
     ;MOV A,30H
     ;JNZ DISP1DONE

     MOV       A,40h                       ; Get hundreds digit
     mov       dptr,#SEGMENT_PATTERNS    ; Look up display pattern
     movc      A,@a+dptr
     mov       P3,A                     ; Output to port
     LCALL     DISPLAY_DELAY            ; Short delay
     MOV P3,#00H                     ; Clear the display
     SETB P2.0                       ; Deselect first display
     RET

; Update the second 7-segment display (tens place)
UPDATE_DISPLAY_2: CLR P2.3           ; Select second display
     ;MOV A,30H
     ;JNZ DISP1DONE

     MOV       A,44h                       ; Get tens digit
     mov       dptr,#SEGMENT_PATTERNS    ; Look up display pattern
     movc      A,@a+dptr
     mov       P3,A                     ; Output to port
     LCALL     DISPLAY_DELAY            ; Short delay
     MOV P3,#00H                     ; Clear the display

     SETB P2.3                       ; Deselect second display
     RET

; Update the third 7-segment display (ones place)
UPDATE_DISPLAY_3: CLR P2.4           ; Select third display
     ;MOV A,30H
     ;JNZ DISP1DONE

     MOV       A,53h                       ; Get ones digit
     mov       dptr,#SEGMENT_PATTERNS    ; Look up display pattern
     movc      A,@a+dptr
     mov       P3,A                     ; Output to port
     LCALL     DISPLAY_DELAY            ; Short delay
     MOV P3,#00H                     ; Clear the display

     SETB P2.4                       ; Deselect third display
     RET

; Timing and delay subroutines
DISPLAY_DELAY: MOV       R1, #10           ; Short delay for display refresh
HERE2:         MOV       R2, #255              ; Inner loop counter
```

```
HERE:          DJNZ      R2, HERE                    ; Decrement inner counter
     DJNZ      R1, HERE2                ; Decrement outer counter
     RET


DELAY:         MOV       R1, #50                   ; Medium delay for LCD operations
HER2:          MOV       R2, #255                    ; Inner loop counter
HER: DJNZ      R2, HER                        ; Decrement inner counter
     DJNZ      R1, HER2                 ; Decrement outer counter
     RET

; Long delay (approximately 5 seconds)
LONG_DELAY:  MOV R0, #10              ; Outer loop counter
HE3:     MOV R1, #255                 ; Middle loop counter
HE2:     MOV R2, #255                 ; Inner loop counter
HE:      DJNZ R2, HE                  ; Decrement inner counter
         DJNZ R1, HE2                 ; Decrement middle counter
         DJNZ R0, HE3                 ; Decrement outer counter
         RET

; Short delay for keypad debounce
SHORT_DELAY:  MOV R0, #2              ; Outer loop counter
sHE3:     MOV R1, #255                ; Middle loop counter
sHE2:     MOV R2, #255                ; Inner loop counter
sHE:      DJNZ R2, sHE                ; Decrement inner counter
         DJNZ R1, sHE2                ; Decrement middle counter
         DJNZ R0, sHE3                ; Decrement outer counter
         RET

; One second delay using timer 0
DELAY_1S:
    CLR TR0                          ; Stop Timer 0
    CLR TF0                          ; Clear Timer 0 overflow flag
                                     ; Timer 0 in 16-bit mode

    MOV TH0, #3CH                    ; High byte of initial value
    MOV TL0, #98H                    ; Low byte of initial value
    SETB TR0                         ; Start Timer 0

WAIT_FOR_TIMER:
    LCALL UPDATE_DISPLAY_1           ; Update display while waiting
     LCALL UPDATE_DISPLAY_2
    LCALL UPDATE_DISPLAY_3
    JNB TF0, WAIT_FOR_TIMER          ; Wait until Timer 0 overflows
    CLR TR0                          ; Stop Timer 0
    CLR TF0                          ; Clear overflow flag
    DJNZ R7, DELAY_1S                ; Decrement counter and repeat if not zero
    MOV R7, #20                      ; Reset counter
    ;SJMP DELAY_LOOP                 ; Removed loop
RET
     org  900h
; 7-segment display patterns (common cathode)
SEGMENT_PATTERNS:        DB 3FH,06H,05BH,04FH,066H,06DH, 07DH,07H,07FH,06FH, 077H,07CH,039H,05EH,079H,071H,3FH

; Text strings for LCD display
TIME_PROMPT: DB "ENTER TIME IN s:",0
OVEN_STARTED_MSG: DB "OVEN STARTED",0

TIME_OVER_300_MSG: DB "TIME>300s",0

TIME_TOO_SHORT_MSG: DB "TIME<5s",0

TIME_OVER_60_MSG: DB "TIME>60s",0

TIME_UNDER_60_MSG: DB "TIME<60s",0
COOKING_FINISHED_MSG: DB "OVEN STOPPED",0
RETRY_MESSAGE: DB "TRY AGAIN",0
DEFAULT_FACT: DB "COOKING",0
FACT_2_TEXT: DB "HEATWAVE COMING!",0
FACT_3_TEXT: DB "ZAPPING DINNER!",0
FACT_4_TEXT: DB "TEMPS RISING...",0
FACT_5_TEXT: DB "KILLING GERMS!",0
FACT_6_TEXT: DB "FLAVOR LOADING...",0
FACT_7_TEXT: DB "GETTING TOASTY!",0
FACT_8_TEXT: DB "BAKING MAGIC...",0
FACT_9_TEXT: DB "ALMOST READY",0
FACT_10_TEXT: DB "BAKE@350C=SAFE!",0
FACT_11_TEXT: DB "LOADING FOOD...",0

QUICK_COOK_TIP: DB "READY IN 1MIN!",0

;====================================================================
      END
```