EE2016 Project: Microcontroller Design for Microwave Oven

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1   Aim

Implement the microcontroller for a microwave oven incorporating its usual functionalities (listed here) and demonstrate through emulation in lab.

2   Equipments You Might Require

AVR processor, PC loaded with AVR Studio software, breadboard, buzzer, LEDs, input switches and other components

3   Problem Definition

3.1   Overview of Microcontroller Design for Microwave Oven

3.1.1   Requirments

1. Determine the mode selected. Start operating in that mode.

2. In Microwave mode,

   (a) check whether the door is closed,
   (b) ensure ONLY microwave utensils are used inside the chamber,
   (c) start timer after setting the 'time' or getting the user input
   (d) switch ON the magnetron, by activating the microwave relay.
   (e) Power level to be chosen (depending on the food items to be cooked)
       i. Low-600 Watts
       ii. Medium-800W
       iii. High-1000W

3. In grill mode, the magnetron is switched OFF, while the heating filament is switched ON. In this mode also similar checks are done:

   (a) check whether the door is closed,
   (b) start timer after setting the '*time*' or getting the user input
   (c) through the grill relay, switch ON the heating element
   (d) Power level to be chosen (depending on the food items to be grilled)
       i. Low-600 Watts
       ii. Medium-800W
       iii. High-1000W

4. Only one interrupt is to be used, which corresponding to 'accidental' door opening.

5. Following (buttons) are the inputs

	Button	Function
	Microwave	Selects Microwave mode
	Grill	Selects Grill mode
	10 min	Increment timer by 10 mins
	1 min	Increment timer by 1 min
	10 sec	Increment timer by 10 sec
	Stop / Clear	1. If the microwave is in ON condition, this button turns OFF & pauses the timer count down. 2. If you are setting the timer, this button clears the time to 00:00. Useful if you have made some mistake during setting.
	Start	1. If you have paused the timer to open the oven and check the status of food, this button will resume the timer. 2. After time is setup you need to press this to turn the microwave (or grill).

3.2 Implementation

1. Identify the list of interrupt(s): Only the accidental door opening has to invoke 'interrupt' signal, which immediately switches OFF the magnetron and runs a high sounding buzzer. One could use INT0 in AVR

2. The above inputs (Table 1) could be implemented in the keypad as provisioned in the ARM7TDi development board in the lab.

3. Outputs are LEDs to denote the cooking / grilling process is over and a sounding buzzer. Emergency alarm sounding (output) when accidental opening of the door.

   (a) Buzzer and Alarms:
      i. If door is opened during conguration time -> Low frequency beep to indicate door opened.
      ii. If door is opened while cooking/grilling-> High frequency beep (to emulate alarm signal) to Indicate Danger.
   (b) LEDs:
      i. If button is pressed during configuration/ setting time -> Turn on Green LED for 1 sec only ONCE.
      ii. If Timer is complete -> Turn on Green LED and stay there for 12 secs to indicate that the job is done.

4. LCD interface??

3.2.1 Hardware Connections

Sensors used are: door lock sensor

Controlling Relays   Their are two controlling relay
   The microwave relay: this controls power to the microwave function.
   The grill relay: this controls the power to the grill function.

Using the Microwave Timer   The first screen of timer asks you to choose one of the operating modes. You can choose from Microwave or Grill functions. Press the respective button on the keypad to choose the mode.
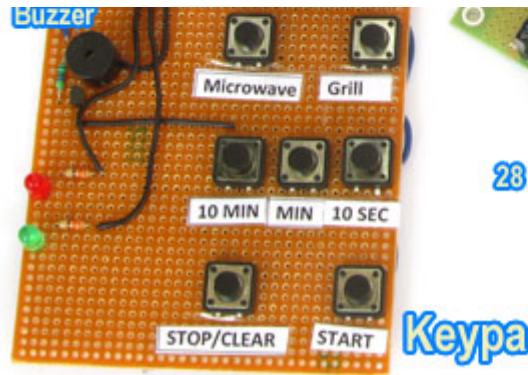
The user interface has the following parts.

Output Device: A 16×2 alphanumeric LCD Module is used as the main output device. It can display numbers, alphabets and few symbols. It can show two line and each line can have 16 characters. The backlight enables the text to be visible even in dark.

A buzzer beeps when the system receive input from the user and the input is successfully processed. For example if the user presses 10 MIN button to increment timer by 10 min and this is successfully carried out the buzzer beeps. But if the timer is already at the maximum setting (90 minutes) the operation could be carried out, so the buzzer does not beeps.

4 Tips for Solution & Demonstration

4.1 Tips for Solution

4.1.1 Hardware

You need to come up with a hardware configuration for AVR Atmega8 esp. INT0 for interrupt signal from the door open latch. Add accessaries (pull-up resistors, etc). Take help of lab staff. You need to implement (a) timers, (b) interrupts

4.1.2 Software

You could choose to implement either in AVR assembly or C-interfacing in AVR. First draw the flow chart and then write the C-code, check it in Atmel's AVR studio software. Show it to the TAs. Then start experimenting (meaning perfecting the output, by giving inputs) as given below.

4.2 Demonstration

Following is the way, in which students have to demonstrate their results (or the code is working). Hence, we suggest the following analogous input /output is done to emulate the realworld function of the microwave oven.

Input: Keys (mode select, timer, power levels, start) plus door latch sensor

Output: buzzer (0.5 Hz for alarm, 1 sec for button select, 3 secs for job completion) LEDs (Red & Green), LCD??

5 References

1. Mohammad Ali Mazidi

2. William Stallings