# Design manual

## Flow

Macintosh HD:Users:mrbladers:Dropbox:UNSW:COMP2121:Project:Flow.pdf

## Module specification

### Digits

Decimal digits output using LCD functions. Uses stack and temporary registers. Checks how large the input number is and turns it into up to 3 separate digits. Then displays those digits one by one using LCD functions.

### LCD

LCD commands and functions including sleep, displaying data from ASCII, display data from binary.

### Macros

All macros for using LCD commands and functions and to clear memory

### Timer0

Includes all timed functions for various modules including:

* debouncing for keypad
* debouncing for push buttons
* turntable spinning
* magnetron spinning
* microwave running

### Magnetron

Magnetron module for Microwave emulator. Includes only the Timer0 subroutines. To be used only inside of Timer0 (see timer0.asm). The main magnetron functionality resides in Timer0.

### Keypad

Keypad processing specific for Microwave emulator.

Functions:

* Read time
* Start
* Pause
* Add 30 sec
* Subtract 30 sec
* Add 1 minute
* Enter power mode
* Read power

Additional functionality resides in Timer0

### Turntable

Turntable module for Microwave emulator. Includes turntable functions that modify the rotation state as well as display functions.

### Open-Close

Open-close module for Microwave emulator. Includes push button subroutines and display functions.

## Data structures

All internal modules utilize registers r16-r31 as follows using .def:

|  |  |  |
| --- | --- | --- |
| Label | Register | Comment |
| row | r16 | current row number |
| col | r17 | current column number |
| rmask | r18 | mask for current row during scan |
| cmask | r19 | mask for current column during scan |
| temp1 | r20 | temporary register for various ops |
| temp2 | r21 | temporary register for various ops |
| temp | r22 | temporary register for various ops |
| lcd | r23 | lcd handle |
| debounceFlag0 | r24 | button 1 debounce flag |
| debounceFlag1 | r25 | button 2 debounce flag |
| timerTemp | r26 | temporary register for timer ops |
| digit | r27 | used to display decimal numbers digit by digit |
| debounceFlag | r30 | debounce flag for keypad |
| digitCount | r31 | how many digits we have to display |

The addresses were labelled as follows using .equ:

|  |  |  |
| --- | --- | --- |
| Label | Address | Comment |
| PORTLDIR | 0xF0 | PL7-4: output, PL3-0, input |
| INITCOLMASK | 0xEF | scan from the rightmost column |
| INITROWMASK | 0x01 | scan from the top row |
| ROWMASK | 0x0F | for obtaining input from Port L |
| LCD\_RS | 7 | RS pin for LCD |
| LCD\_E | 6 | E pin for LCD |
| LCD\_RW | 5 | RW pin for LCD |
| LCD\_BE | 4 | BE pin for LCD |

The memory was mapped as follows using .byte:

|  |  |  |
| --- | --- | --- |
| Label | Bytes | Comment |
| TempCounter | 2 | Temporary counter. Counts milliseconds |
| DisplayCounter | 1 | Used to call display\_data every 100ms |
| DebounceCounter | 2 | Debounce counter. Used to determine if 100ms have passed |
| MicrowaveCounter | 1 | used to count 1 second decrements of time |
| DisplayDigits | 4 | digits to display |
| EnteredDigits | 1 | digits that have been entered |
| DoorState | 1 | Door state 0: closed | 1: opened |
| Mode | 1 | Current mode 0: Entry | 1: Running | 2: Pause | 3: Finished | 4: Power Level |
| Minutes | 1 | Minutes in the microwave timer |
| Seconds | 1 | Seconds in the microwave timer |
| RefreshFlag | 1 | Flag to check whether to display data on keypress or not |
| More flag | 1 | Flag for addition of 30s |
| Less flag | 1 | Flag for subtraction of 30s |
| PowerLevel | 1 | Power level for magnetron 0: not set | 1: 100% | 2: 50% | 3: 25% |
| TurntableCounter | 2 | Counts 2.5 sec |
| TurntableState | 1 | stores the state of turntable 8bit - 8 states |
| TurntableDirection | 1 | stores the turntable direction flag 0 CW / 1 CCW |
| MagnetronTempCounter | 2 | Temporary counter. Used to determine if one time inc = 1/4 second has passed |
| MagnetronCounter | 1 | Counts how many time incs have passed |
| MagnetronOn | 1 | sets for how many time incs it should be on |
| MagnetronOff | 1 | sets for how many time incs it should be off |

## Algorhytm descriptions

As taken from git README.md:

### # Start button

If door flag is 1 - don't do anything (door opened)

If time is not set - increase the minutes by 1 i.e. if 00:00 -> 01:00

Sets the mode to running (updates the mode flag)

Inverts the turntable direction flag

\*If time is set and mode is running just increase the minutes by 1

### # Stop button

If power entry flag is 0

if entry mode

clear minutes and seconds

If running mode

set mode to pause

Else

Set to entry mode

Set power entry flag to 0

powerOn = 1 (switch the magnetron on)

displayPower

### # Open door button

If door flag is not 1:

Set door flag to 1

Set mode to pause

Call displayData

### # Close door button

If door flag is not 0:

Set door flag to 0

Set mode to pause

Call displayData

### # C button

If door flag is 1 - don't do anything (door opened)

If running mode - add 30 seconds

### # D button

If door flag is 1 - don't do anything (door opened)

If running mode - subtract 30 seconds

### # A button

If door flag is 1 - don't do anything (door opened)

If entry mode - set to Power entry flag to 1

### # Digit 0-9

If door flag is 1:

don't do anything (door opened)

If power entry mode flag is 0:

Updates the time

If minutes are not set - update the minutes:

00:00

4 pressed sets 40:00

5 pressed sets 45:00

another 4 pressed sets 45:40

So on the press if decimal is set, update the ones, if both set - update the seconds

If seconds are set - don’t do anything on digits

Else

if digits are 1-3

set power = digit

\*Use key debounce - prevent from digit doubling on holding the key

### # Turntable

If door flag is 1 - don't do anything (door opened)

8 states assigned to binary

00000001 |

00000010 /

00000100 -

00001000 \

00010000 |

00100000 /

01000000 -

10000000 \

00000000 |

Three revs per minute means state changes 20 (sec) / 8 = once in 2.5 seconds

Direction flag flips every time the mode is set to running

If flag is 1, shift 1 bit to right

If flag is 0, shift 1 bit to left

Display turntable symbol - separate function

### # Magnetron

If door flag is 1 - don't do anything (door opened)

If mode is running

If power 3 - spin for 1/4 of a second and stop

If power 2 - spin for 1/2 of a second and stop

If power 1 - spin for 1 second and stop (never stop)

\*Spin motor at 75 rev/sec

### # Timer

If door flag is 1 - don't do anything (door opened)

Decrement seconds if > 0

If seconds == 0, decrement minutes if > 0, set seconds to 60

If minutes == 0, set mode to Finished

Each 2.5 seconds call Turntable

Each 0.25 seconds call Magnetron

### # displayData

Move the cursor to time place (top-left)

Display current time (displayDigits)

Move the cursor to turntable place (top-right)

Display turntable state (displayTurntable)

Move the cursor to the door place (bottom-left)

Display the text (displayText)

Move the cursor to the door place (bottom-right)

Display the door state (displayDoor)

### # displayDoor

open/closed door show "O" or "C"

light the top-most LED if opened

### # displayDigits

Poll for digits to be entered

Multiply the 4 byte number by 10, 100, 1000 to shift the digits to the left

Keep minutes and seconds separately

### # displayPower

light the 8 LEDs according to power

if power = 3 light up 11000000

if power = 2 light up 11110000

if power = 1 light up 11111111