48623 - Mechatronics 2

Assignment 2 - Sensing

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# 1 Background Information:

The system used for this assignment is the DSX Kit supplied by UTS. The microcontroller specific to this kit is the Microchip PIC16F877A microcontroller. Embedded C was used to program this chip to complete the functions listed below. The infrared sensor used is the Sharp GP2Y0A02YK0F sensor.

# 2 Aims:

The aim of this system is to use an infrared sensor to measure distance. The ADC result from the sensor is converted to a distance measurement in centimetres using binary coded decimal, which is then displayed and updated continuously on the LCD screen.

# 3 Structure of the Program:

(N.B. Not in order of operation)

## 3.1 Pre-Processor Directives:

* The initialise.h file is included in the code
* The oscillator frequency is set at 20 MHz along with the timer0 start count

## 3.2 Global Variables:

* The bits and integers for use in the clock flags are defined
* The interrupt LED is defined as RB0

## 3.3 Interrupt Routine:

* The flags are used to toggle the heartbeat LED at a frequency 1Hz (every 500ms)

## 3.4 Infrared Sensor:

* The voltage from the sensor is converted to a distance in centimetres. Several ‘if’ statements are used in order to approximate the formula used to convert the voltage to a distance, according to the segmented line graph shown on UTS Online.

## 3.5 LCD Screen:

* Several sub-routines are located in this part of the code:
  + Init\_lcd: initialise
  + lcd\_write\_data: writes data to the LCD
  + lcd\_set\_cursor: moves the LCD cursor to the desired location
  + lcd\_write\_2\_digit\_bcd: converts 2 digit number and displays it on the LCD
  + lcd\_write\_4\_digit\_bcd: converts 4 digit number and displays it on the LCD

## 3.6 ADC Routine:

* several sub-routines are located in this part of the code:
  + init\_acd: initialise
  + channel\_switch: switch between available channels
  + acd\_read: obtain an adc result from the selected channel

## 3.7 Main Program:

* The system is initialised
* The interrupt routine is run
* The infrared routine runs and obtains an ADC value which is converted to a distance. It is then displayed on the LCD.

# 4 Distance Estimation Method:

The distance estimation method used was a series of ‘IF’ statements. The code is as follows:

if (value >= 2.5 && value < 3)

{ value = 20 - 20\*(value - 2.5);}

else if (value >= 2 && value < 2.5)

{ value = 30 - 20\*(value - 2);}

else if (value >= 1.5 && value < 2)

{ value = 40 - 20\*(value - 1.5);}

else if (value >= 1.25 && value < 1.5)

{ value = 50 - 40\*(value - 1.25);}

else if (value >= 0.9 && value < 1.25)

{ value = 70 - 40\*(value - 0.9);}

else if (value >= 0.65 && value < 0.9)

{ value = 100 - (30/0.25)\*(value - 0.65);}

else if (value >= 0.5 && value < 0.65)

{ value = 140 - (40/0.15)\*(value - 0.5);}

It compares the ADC value with each case of the if statements in order to apply the appropriate formula to it. The table of results can be seen below.

|  |  |  |  |
| --- | --- | --- | --- |
| ADC Value | Distance | ADC Value | Distance |
| 3.0 | 10.0 | 1.7 | 36.0 |
| 3.0 | 11.0 | 1.7 | 37.0 |
| 2.9 | 12.0 | 1.6 | 38.0 |
| 2.9 | 13.0 | 1.6 | 39.0 |
| 2.8 | 14.0 | 1.5 | 40.0 |
| 2.8 | 15.0 | 1.5 | 42.0 |
| 2.7 | 16.0 | 1.4 | 44.0 |
| 2.7 | 17.0 | 1.4 | 46.0 |
| 2.6 | 18.0 | 1.3 | 48.0 |
| 2.6 | 19.0 | 1.3 | 56.0 |
| 2.5 | 20.0 | 1.2 | 58.0 |
| 2.5 | 21.0 | 1.2 | 60.0 |
| 2.4 | 22.0 | 1.1 | 62.0 |
| 2.4 | 23.0 | 1.1 | 64.0 |
| 2.3 | 24.0 | 1.0 | 66.0 |
| 2.3 | 25.0 | 1.0 | 68.0 |
| 2.2 | 26.0 | 0.9 | 70.0 |
| 2.2 | 27.0 | 0.9 | 76.0 |
| 2.1 | 28.0 | 0.8 | 82.0 |
| 2.1 | 29.0 | 0.8 | 88.0 |
| 2.0 | 30.0 | 0.7 | 94.0 |
| 2.0 | 31.0 | 0.7 | 100.0 |
| 1.9 | 32.0 | 0.6 | 113.3 |
| 1.9 | 33.0 | 0.6 | 126.7 |
| 1.8 | 34.0 | 0.5 | 140.0 |
| 1.8 | 35.0 |  |  |

# 5 Characteristic Graphs: