2014 – 2015 Electronics Design Project 2

Knowledge checklist

Here are list of questions covering the materials for each lecture. These are knowledge testers and are not tutorial questions as such. They give an indication of the level of knowledge and subjects which were presented in each lecture.

Dr D Muir

15/1/15 Lecture 1

What is this year’s project?
Can you draw a basic block diagram of the hardware of the project?
Describe the function of each of the system blocks: sensor, process, display, PSU.
What is signal conditioning?
How does the signal conditioning link between the sensor and the micro?
What does the signal conditioning do?
How does the sensor work?
What is an IR proximity detector?
What is the level of signal coming from the sensor?
What input signal level does the micro need?
Why is amplification necessary?
What extra features does the amplifier have to have?
What is the noise which will affect the sensor output?
What is the high frequency noise?
What frequency is the noise – and what might be causing it?
What is a basic OP Amp circuit?
How is the gain calculated?
What is a DC blocking capacitor and what is it for?
Give an example of the use of a DC blocking capacitor in the circuit.
Give the expression which allows you to calculate the corner frequency of the high pass filter.
Show how the DC blocking capacitor creates a high pass filter at the input.
Draw a circuit and show how to calculate a simple low pass filter.
What frequencies of high pass and low pass filters are needed in this project design?
What does ‘single rail operation’ mean when applied to an OP Amp circuit?
Draw a circuit of a simple Op Amp which is powered from a single rail.
Draw a suitable circuit for creating a Vref at mid voltage for use in an inverting Op Amp circuit to allow it to operate from a single rail. What values of resistor and capacitor are suitable for such a circuit?
Project planning – what is it?
Why is project planning needed?
What is a project plan?
What items are detailed on a project plan?

What microprocessor is to be used on the project?
What display is to be used in the project?
Draw the circuit of an 8x8 LED matrix.
What does common cathode mean?
Is the LED matrix used in the project common cathode or common anode?
Describe how multiplexing is used to drive all the 64 LEDs in an 8x8 array using only 16 wires.
What is multiplexing? Describe in what circumstances it is useful.
Describe a display driver chip you have used.
What is SPI and where is it used?
What signal lines does SPI use and what do they do?
Sketch a picture of the SPI signals as it transfers a byte of data.
What is the MISO connection?
What is the CS, Load or SS connection?
What is the SCK connection?
Describe how the display driver chip is organized so that it makes showing graphics on the LED matrix simple.
How much data is transferred between the micro and the display chip?
What is the structure of the data which is used to update the display registers?
What data rate is appropriate for the SPI to run?
If the display has to be fully updated 25 times a second, what is the minimum data rate needed on the SPI connection?
What challenges become apparent when a circuit is of mixed voltage?
What is the difference between 5V and 3.3V logic circuits?
How are signals on 3.3V logic transformed into those appropriate to 5V logic?
Why is a buffer chip necessary in the display breakout board?
Describe the function of the 74HCT04 in the display breakout board.
The SPI signals from the micro to the display chip are buffered using a 74HCT04 chip which is in fact an inverter. How is this possible?
Decoupling capacitors, what are they for?
Where are decoupling capacitors placed in the circuit?
Where are decoupling capacitors placed in the PCB layout?
What values are normally used for decoupling capacitors?
What types of capacitor are used for decoupling, and why?
Name a few types of capacitor.
What does polarized mean when talking about capacitors?
How do polarized capacitors differ from ‘normal’ ones?
Why are polarized capacitors useful?
What is ESR and how does it affect the use of a capacitor?
What capacitor types have good ESR?
In what situations are electrolytic capacitors used?
Why are electrolytic capacitors used?
What are the benefits of tantalum capacitors?
Describe some circumstances where Tantalum capacitors are important.
What are the deviations from perfect which cause real capacitors to be so different in practice?