

SOFT8037 Embedded Systems Programming – Lab Report

Completion Date: 26th March 2021

Value: 30 marks

On completion please zip up your files and upload to Canvas.

Q1

Given the following code for the versatilepb board:

```
int fbuf_init()
{
    fb = (int *)0x200000;
    *(volatile unsigned int *) (0x10120000) = 0x3F1F3F9C;
    *(volatile unsigned int *) (0x10120004) = 0x090B61DF;
    *(volatile unsigned int *) (0x10120010) = 0x200000;
    *(volatile unsigned int *) (0x10120018) = 0x82B;

    for (int i=0; i<480*640; i++)
        fb[i] = 0; // black screen
}
```

- a) What is the framebuffer?
- b) How does the *for* loop above make the screen black.

(3 marks)

Q2

What is the esp8266 WiFi module? Give a brief overview of the IoT and smart home devices based on the esp8266 WiFi module. Refer to firmware for such devices e.g. tasmota, esphome, mongoose OS in your answer.

See here for some examples <https://esphome.io/guides/diy.html>.

References

<https://www.itead.cc/smart-home.html>

<https://www.shelly.si/en/wifi-relays/1-shelly-1-wifi-relay-switch-3800235262009.html>

<https://esphome.io/>

<https://www.home-assistant.io/>

<https://tasmota.github.io/docs/About/>

<https://mongoose-os.com/>

<https://github.com/cesanta/mongoose-os-smart-light>

<https://lwn.net/Articles/822516/>

(9 marks)

Q3

Write a simple game which allows the user to move pacman around the versatilepb board screen – see sprites-scroll-lab.zip. The game should scroll in all directions and have code to avoid a “flickering display” using two framebuffers and interrupt driven driver for QEMU emulated versatilepb board .

Please note: you will require the latest version of qemu-system-arm to have video controller interrupts available.

See Canvas for instructions for installing the latest QEMU Ubuntu 18.04 has qemu-system-arm version 2.18 you need any version above 2.18.

The long way of installing the latest version:

Download QEMU source from qemu.org. Then extract and cd to qemu source directory

install dependencies

```
sudo apt-get install build-essential zlib1g-dev pkg-config libglib2.0-dev binutils-  
dev libboost-all-dev autoconf libtool libssl-dev libpixmap-1-dev libpython-  
dev python-pip python-capstone virtualenv
```

```
sudo apt-get install libsdl2-dev
```

----- libsdl1.2-dev --- might work.

```
./configure --target-list=arm-softmmu --disable-vnc --enable-sdl  
make  
sudo make install
```

(8 marks)

Q4

- What is a vector table and give an example?
- What is an interrupt handler and give an example?
- What is the PrimeCell Vectored Interrupt Controller (PL190) and how is it used to control interrupts from several different devices? Use the UART device as an example in your explanation.
- Explain how you would write a driver for an UART device which makes data available in a circular buffer - https://en.wikipedia.org/wiki/Circular_buffer.

Refer to the following manuals in your answer:

- Versatile Application Baseboard for ARM926EJ-S (HBI-0118) User Guide

- PrimeCell Vectored Interrupt Controller (PL190) Technical Reference Guide
- PrimeCell Color LCD Controller (PL110) Technical Reference Guide
- PrimeCell UART (PL011) Technical Reference Manual

(10 marks)