Assignment 4

Oled display

* Connect OLED display from the USB Multifunction card to the MCUs parallel bus interface
* This enables display of text information to the user. E.g. print the score while playing and to display menu
* So we will only write to the OLED??

The display to be used – LY190 -128064

* The display is a monochrome 128\*64 dot matrix display module.
* It can be connected to the MCU’s parallel bus interface and be used in the same way as the SRAM and ADC.
  + The 8bit parallel bus interface
  + The display can also be controlled with SPI
* The display is hardware configured to use **8080-parallel** interface with only write operations possible (!RD always high)
  + In this mode we need to use the
    - !WR – we have this from the MCU
    - !CS – From the gal. **The GAL signal to the OLED is active low.**
    - D/!C (data command) – **maybe we have to select our own pin**
* The oled has to registers
  + One for command
  + One for data
  + The D/!C pin decides which is to be accessed
    - Has only one pin for this
    - Command; D/!C = 0
    - Data: D/!C = 1
* There is a controller in the OLED
  + The controller has 128 \* 64 bits = 1kB RAM
  + This is divided into 8 pages. **What is a page?**
  + When one byte is written into the RAM, all the rows of the current columns are filled
  + Each it represents one pixel!!!
    - With 8-bit architecture you can minimum write 8- pixels at a time

USB multifunction card

* OLED
  + The oled is connected to the microcontrollers by default, by shorting the headers, it can be accessed from the external headers called OLED BUS.
    - **This is how we will connect the external memory parallel bus from the MCU to the OLED**
* Resett button
  + The reset buton sends a signal to the board including the OLED
    - **This can be used to write a reset function for the OLED later**

Controller

* D/!C - data/command pin is the same for the OLED and MCU
  + When pulled high ->data is treated as data
  + When pulled low ->data will be transferred to the command register
* E (!RD) – read data pin
  + When connected in mode 8080 - > **the pin receives the READ signal (!RD)**
  + We will only write to the OLED
  + **Keep this pin high**
* R/!W – read/write pin
  + When in 8080 mode -> the pin will be **Write (!WR) input.**
  + Data write is initiated when this pin is pulled **LOW and the chip is selected**
  + This is suppose to be connected to the !WR pin from the MCU
* 8080 – parallel interface (8bit)
  + BS0 = 0
  + BS1 = 1
  + BS2 = 1
    - These pins must be possible to set since we can program in I2C
* Match operating frequency of display
  + Pipeline processing must be performed internally
* Command decoder
  + The module determines whether the data input is interpreted as data or command
    - If D!/C = 1
      * The data is written to GDDRAM
    - If D/!C = 0
      * Data input will be decoded and written to the corresponding command register
* FR synchronization
  + Depending whether the MCU can finish writing a frame image within one frame period, it is classified as either **fast write MCU or slow write MCU**
* Graphic display data ram (GDDRAM)
  + Is a bit mapped RAM holding the bit pattern to be displayed. The size of the RAM is 128 x 64 bits
  + The RAM is divided into 8 pages

Thoughts

* The display is hardware configured to use 8080 interface
  + **The BS0:2 is already set**
  + **The E(!RD) is already set**
* **We have to figure out the protocol and the timing**
  + How do I make my data/command signal to perfectly time with all the other signals from the external memori??
    - Maybe the external memory has extra pin for oled?
    - Maybe I can set the read/command pin first and the write data or command?
* Chapter 7 describes the functional block description
* Chapter 8 describes the command table
* Chapter 9 describes the command description
* **What I have to do** 
  + **Harwarde configuration** 
    - **Make one pin on the atmega into data/command pin**
    - **Connect the data pins**
    - **Connect the write pin**
    - **Connect the CS pin**
  + **Software** 
    - **Make a write command function**
    - **Make a write data function**

Exercise

1. Extend the logic in the GAL IC so that it will generate correct control signals for the display based on the address
   1. **Not really necessary right now**
2. Connect the display to the data bus and the required signals form the GAL and the MC.
   1. Is it possible to connect the !WR from the MCU directly to the !WR in the OLED?
      1. **Apparently not**
   2. Check table 7-2 in the **OLED advanced datasheet up against the external memory timing diagram in the atmega datasheet.**