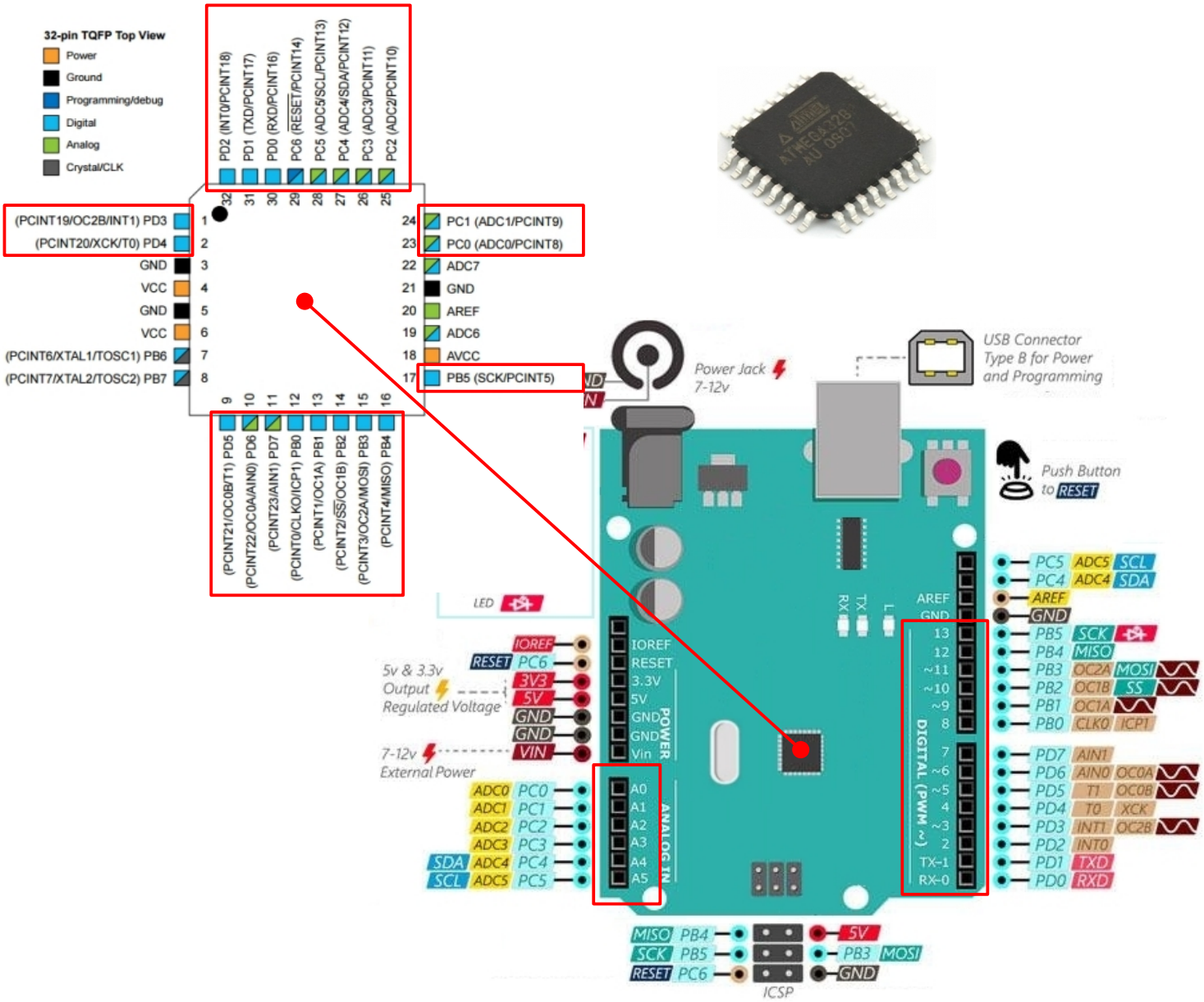
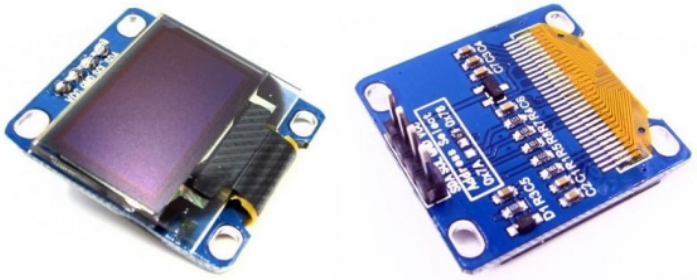
A small diversion from Beginners Tutorial (for those who wants some difficult stuff). Lets try something more creative with our OUTPUT I/O Pins and our simple digitalWrite() function which previously was just for turning LED ON and OFF

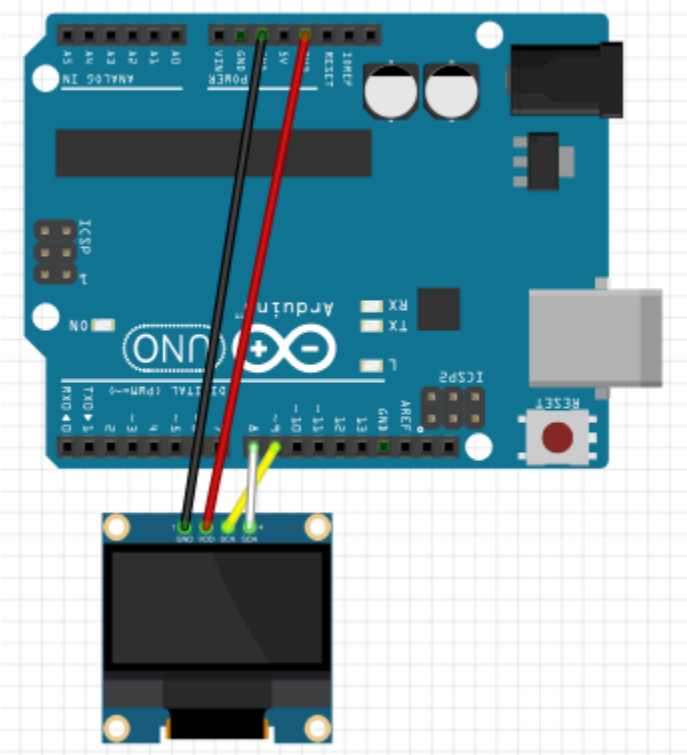
By supplying a series of 0V or 5V to OUTPUT I/O Pins at a specific sequence, we will be able to display things on the i2c SSD1306 OLED Screen attached to those OUTPUT I/O Pins



Below is the i2c SSD1306 OLED Screen 64x128 Pixel. IF you do not have this device, just look at the source codes.



ATMEGA328/Arduino Uno – I/O Pins – OUTPUT OLED
https://github.com/teaksoon/lmaewapm



1x Computer with Arduino IDE Software
1x USB 2.0 Type A/B Data Cable
1x Arduino Uno Board
1x i2c SSD1306 OLED Module 64x128pixel

OLED GND to Arduino Uno GND
OLED VCC to Arduino Uno 3.3V
OLED SDA to Arduino Uno Pin 8
OLED SCL to Arduino Uno Pin 9

Note: Sometimes SCL is also labelled as SCK

There are alot of codes in this Program. I wont post the full source codes here. You can download the full Source codes from my github page.

https://github.com/teaksoon/lmaewapm/blob/main/2021_11_22_io_pin_output_oled_source.zip

After download the Source Code, open the .zip file into a folder. Open the Source Code with your Arduino IDE Software and upload it into your ATMEGA328 micro-controller on your Arduino Uno.

You will see some activities on your i2c SSD1306 OLED Screen

This is just a regular OUTPUT I/O Pin VOLTAGE manipulation with 0V and 5V at a specific sequence, we can get things shown on the OLED Screen.

Earlier we only see the LED being turned ON and OFF with our digitalWrite(), now we are just being **a little bit more creative and with the 0V and 5V than previously, and we get something displayed on the OLED Screen.**

Actually it is not just the LED or OLED Screen only, there are alot more to it

Besides the “digitalWrite()” of the “C-Language with Arduino Library” included is also the codes for the “C-Language with AVR Library” which can run much faster, which will be very useful if we were to run alot of graphics on the OLED Screen.

ATMEGA328/Arduino Uno – I/O Pins – OUTPUT OLED
https://github.com/teaksoon/lmaewapm

This example is split into 3 files.
1. io_output_oled.ino is the test Program
2. io_oled_arduino.h is coding using the “C-Language with Arduino Library”
3. io_oled_avr.h is coding using the “C-Language with AVR Library”

This code in io_output_oled.ino uses codes from the io_oled_arduino.h
The top part must be commeented off

```
/*
#include "io_oled_avr.h"
// Default Pin for SDA=PB0,SCL=PB1, change below if other pins are used
#define PIN_SDA PB0  // ( which is Arduino Uno Pin 8 )
#define PIN_SCL PB1  // ( which is Arduino Uno Pin 9 )
*/

#include "io_oled_arduino.h"
// Default Pin for SDA=8,SCL=9, change below if other pins are used
#define PIN_SDA 8
#define PIN_SCL 9
```

This code in io_output_oled.ino uses codes from the io_oled_avr.h
The bottom group must be commented off

```
#include "io_oled_avr.h"
// Default Pin for SDA=PB0,SCL=PB1, change below if other pins are used
#define PIN_SDA PB0  // ( which is Arduino Uno Pin 8 )
#define PIN_SCL PB1  // ( which is Arduino Uno Pin 9 )

/*
#include "io_oled_arduino.h"
// Default Pin for SDA=8,SCL=9, change below if other pins are used
#define PIN_SDA 8
#define PIN_SCL 9
*/
```

If you wish to use other I/O Pins, just change the #define PIN_SDA and #define PIN_SCL to other valid Pin Numbers

ATMEGA328/Arduino Uno – I/O Pins – OUTPUT OLED
https://github.com/teaksoon/lmaewapm

Source Codes responsible for the 0V/5V manipulation on the OUTPUT I/O Pin to make the OLED Screen show things, using digitalWrite();
from the io_oled_arduino.h file

```
void _io_oled_i2c_start() {
  digitalWrite(_io_pinSDA, HIGH); __asm__("NOP");
  digitalWrite(_io_pinSCL, HIGH); __asm__("NOP");
  digitalWrite(_io_pinSDA,  LOW); __asm__("NOP");
  digitalWrite(_io_pinSCL,  LOW); __asm__("NOP");
}

void _io_oled_i2c_stop() {
  digitalWrite(_io_pinSDA,  LOW); __asm__("NOP");
  digitalWrite(_io_pinSCL, HIGH); __asm__("NOP");
  digitalWrite(_io_pinSDA,  LOW); __asm__("NOP");
}

uint8_t io_oled_i2c_write_byte(uint8_t dat) {
uint8_t ack=0;  // 0=successful, 1=failed
  for(uint8_t i=0; i < 8; i++) {
    if (dat&0x80) {
      digitalWrite(_io_pinSDA, HIGH);
    } else {
      digitalWrite(_io_pinSDA, LOW);;
    }
    dat<<=1;
     __asm__("NOP");
    digitalWrite(_io_pinSCL, HIGH);  __asm__("NOP");
    digitalWrite(_io_pinSCL,  LOW);  __asm__("NOP");
  }
  digitalWrite(_io_pinSDA, HIGH);
  digitalWrite(_io_pinSCL, HIGH); __asm__("NOP");
  digitalWrite(_io_pinSCL,  LOW);
  return ack;
}
```

I am sure everyone here already know what digitalWrite() does to the OUTPUT I/O Pin.

_io_pinSDA and **_io_PinSCL** are basically our regular Pin Number

Maybe **__asm__** is an alien to some of you. That is an **inline Assembly Code, calling a single INSTRUCTION from our AVR INSTRUCTION SET.**

“NOP” simply means **“NO OPERATIONS”**, it is spending 1-clock cycle doing nothing.

ATMEGA328/Arduino Uno – I/O Pins – OUTPUT OLED
https://github.com/teaksoon/lmaewapm

Source Codes responsible for the 0V/5V manipulation on the OUTPUT I/O Pin to make the OLED Screen show things, using direct CPU Memory PORT manipulation from the io_oled_avr.h file

```
void _io_oled_i2c_start() {
  (PORTB |= (1<< _io_pinSDA)); __asm__("NOP");
  (PORTB |= (1<< _io_pinSCL)); __asm__("NOP");
  (PORTB &= ~(1<<_io_pinSDA)); __asm__("NOP");
  (PORTB &= ~(1<<_io_pinSCL)); __asm__("NOP");
}

void _io_oled_i2c_stop() {
  (PORTB &= ~(1<<_io_pinSDA)); __asm__("NOP");
  (PORTB |= (1<< _io_pinSCL)); __asm__("NOP");
  (PORTB |= (1<< _io_pinSDA)); __asm__("NOP");
}

uint8_t io_oled_i2c_write_byte(uint8_t dat) {
uint8_t ack = 0;  // 0=successful, 1=failed
  for(uint8_t i=0; i < 8; i++) {
    (dat & 0x80) ? (PORTB |= (1<< _io_pinSDA)) : (PORTB &= ~(1<<
_io_pinSDA));
    dat<<=1;
     __asm__("NOP");

    (PORTB |= (1<< _io_pinSCL));  __asm__("NOP");
    (PORTB &= ~(1<<_io_pinSCL));  __asm__("NOP");
  }
  (PORTB |= (1<<_io_pinSDA));
  (PORTB |= (1<<_io_pinSCL)); __asm__("NOP");
  (PORTB &= ~(1<<_io_pinSCL));
  return ack;
}
```

IF you are confused with the codes, means we need to build a stronger foundation before can achieve something big, othwerwise after building that that “Robotic SmartCar”, thats the end of our journey.

We can do far more than that