



COMP140 Individual Creative Computing Project



FALMOUTH
UNIVERSITY

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COMP210: Interfaces & Interaction

1: Hardware Interfaces

Register Attendance



Figure 1: Attendance monitoring is in place. It is your responsibility to ensure that you have signed yourself in.

Learning Outcomes

After this session you will be able to:

- ▶ **Select** the appropriate method for communication
- ▶ **Outline** the difference between I2C and SPI
- ▶ **Implement** a hardware interface between the Arduino and a sensor

What is Serial Communication?

- ▶ Arduino to Multimedia Computer (retro term alert)
- ▶ Arduino to Arduino
- ▶ Arduino to sensors

Types of Serial Communications

- ▶ **I2C**
- ▶ RS232
- ▶ **USB**
- ▶ R2422
- ▶ CAN
- ▶ Microwire
- ▶ RS485
- ▶ **SPI**
- ▶ **TTL**

Protocols

A protocol is the language that governs communication between systems or devices.

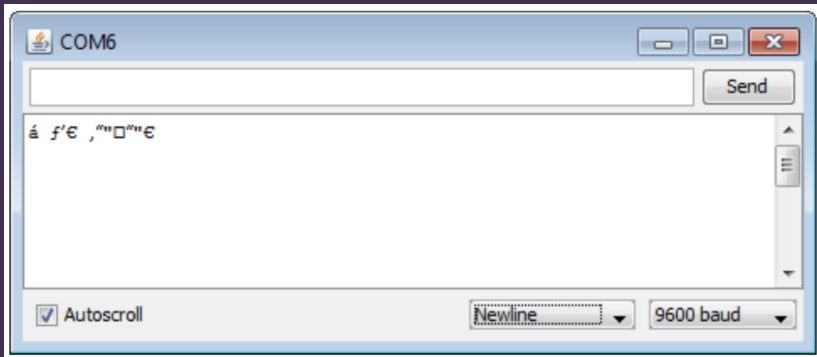
- ▶ Midi
- ▶ DMX-512
- ▶ X10
- ▶ USB
- ▶ RS485
- ▶ UDP/IP
- ▶ TCP/IP

Serial/UART

As mentioned previously...

- ▶ This is how an Arduino talks to a computer
- ▶ Arduino has an onboard UART to Seral Converter
- ▶ Requires an agreed baud rate: `Serial.begin(9600)`
- ▶ Two communication lines - RX to receive and TX to transmit
- ▶ TX connects RX, RX to TX
- ▶ Used by some peripherals such as Bluetooth modules

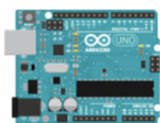
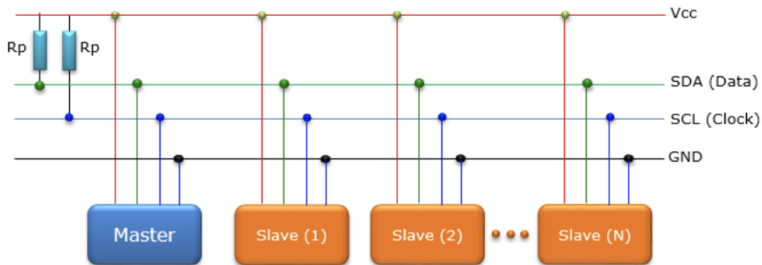
When Time Goes Wrong



Inter-Integrated Circuit (I²C)

- ▶ Pronounced I Square C
- ▶ Uses a clock Signal
- ▶ Two communication lines - SDA (data) and SCL (clock)
- ▶ Multiple I²C devices can communication on the same data lines (bussed)
- ▶ Slave devices have an address

I²C Bus Example

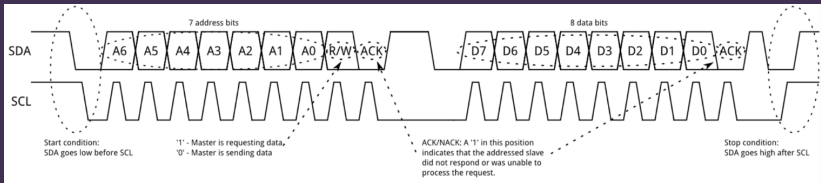


Examples

Wire Library

- ▶ I²C Library for Arduino
- ▶ Arduino can be either host or slave
- ▶ Particularly useful for wired Arduino-to-Arduino communication

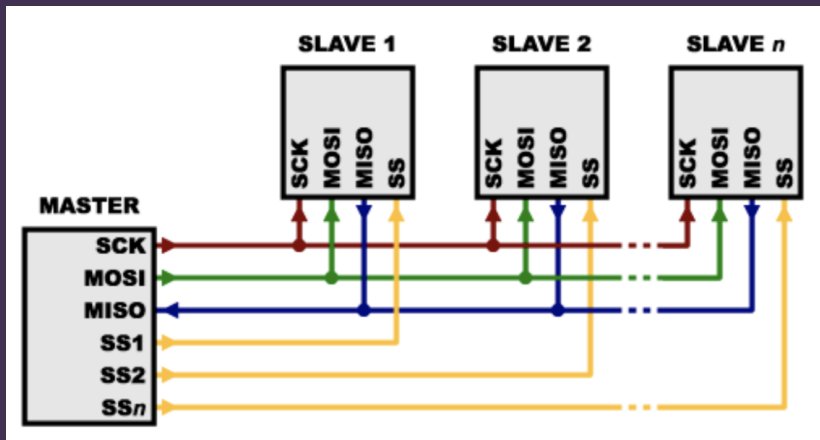
I²C Communication Example



Serial Peripheral Interface (SPI)

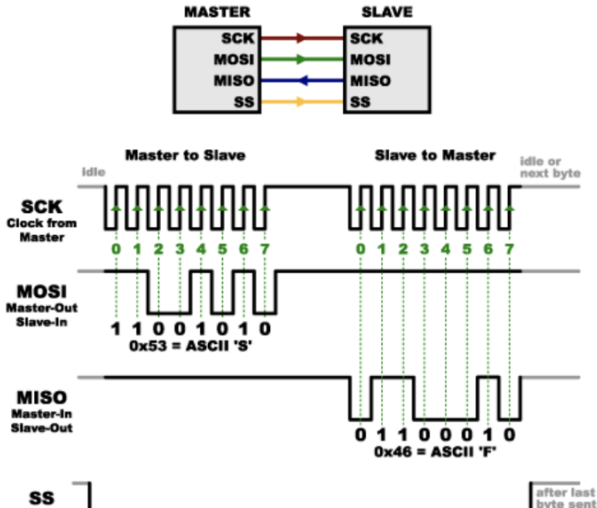
- ▶ Uses a clock signal
- ▶ Requires 4 lines
- ▶ MISO - master in slave out
- ▶ MOSI - master out slave in
- ▶ SCK - serial clock
- ▶ CS - chip select
- ▶ Not addressed - each slave device requires a discrete chip select line.

SPI Bus Example



SPI Communication Example

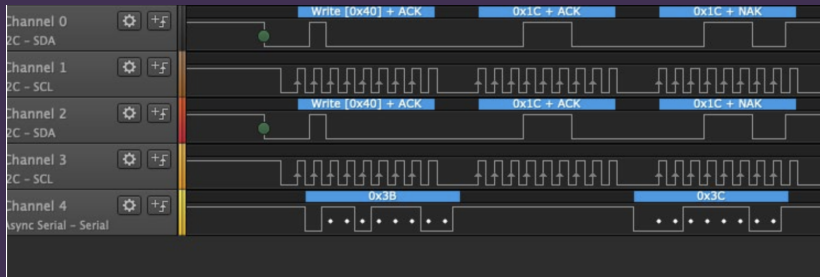
SPI COMMUNICATION EXAMPLE



Logic Analysers

- ▶ Not doing what you expect? Spy on them!
- ▶ Logic analysers are the digital equivalent of an oscilloscope
- ▶ Can have up to 8 signal capture lines
- ▶ Capture digital logic (HIGH or LOW)
- ▶ Easy to connect to existing circuits
- ▶ USB connection for data capture
- ▶ We have a couple in the Games Academy

Logic Analyser Software



Differential Signal

- ▶ Low voltage signals are susceptible to noise over long distance
- ▶ Noise can turn a digital 1 into a 0
- ▶ Differential Signal is one solution
- ▶ Used by USB and in professional audio
- ▶ The hardwork is done for you: PCA9615 chip converts I²C to diff



How does Differential Signal Work?

- ▶ Two lines carry the same signal, but one is inverted
- ▶ The two lines cancel each other out
- ▶ All that is left is the noise
- ▶ The noise is then cancelled out

