Brief:

- ## Summary:

I will attempt to use a standalone ATMega328P MCU to control a EGBT-045MS Bluetooth module mounted on a HC-05 breakout board.

- ## Advantages:
  - Ease of programming through Arduino IDE, which in my opinion is the most resourceful, well documented, development-friendly interface.
  - If successful and advanced to later stages, product cost can be cut dramatically compared to current main option (B1010SP module) and secondary option (BLEnano)
  - ?

- ## Disadvantages:
  - Untested bluetooth module range?
    - Solution: Consider other boards (HC-06?)
    - Solution: Mount different Bluetooth modules on the HC-05 board (see definitions section for details)
  - ?

Resources and references:

http://www.martyncurrey.com/hc-05-and-hc-06-zs-040-bluetooth-modules-first-look/
http://elasticsheep.com/2011/04/serial-port-bluetooth-module/
http://www.instructables.com/id/Arduino-AND-Bluetooth-HC-05-Connecting-easily/?ALLSTEPS
https://arduino-info.wikispaces.com/BlueTooth-HC05-HC06-Modules-How-To
https://www.arduino.cc/en/Tutorial/ArduinoToBreadboard

Definitions:

- **ATMega328p:** 8-Bit 20 MHz RISC microcontroller with 32KB flash memory, 23 I/O Pins. Used on board of the Arduino UNO board, which is programmed directly from a PC using the Arduino Bootloader.
    - Board Pinout (including Arduino board mapping) is shown in figure 1 in appendix A.
    - Datasheet brief: http://www.atmel.com/Images/Atmel-42735-8-bit-AVR-Microcontroller-ATmega328-328P_Summary.pdf
    - Datasheet complete: http://www.atmel.com/Images/Atmel-42735-8-bit-AVR-Microcontroller-ATmega328-328P_datasheet.pdf

- **HC-05:** A Bluetooth breakout board that contains a EGBT-045MS/EGBT-046S/BT400-6B Bluetooth module, this breakout board (shown under figure 2 in appendix B) is only necessary to rewire the complex Bluetooth module onboard (BT400-6B) to make easier to interface with the ATMega328P MCU. The pinout for this HC-05 board is shown under figure 3 in appendix B. The advantage of this breakout board is that various compatible Bluetooth modules can be simply mounted on the board without changing the circuitry or scripts.

- **EGBT-045MS:** Is a CSR-based Bluetooth module with an on-board antenna. The module has an on-board MCU inside the radio chip (which I do not intend to use), and an operation range of 3 to 4.1 Volts. The module's radio chip is the CSR BC417.
    - Board is shown in figure 4 in appendix B.
    - Board pinout is shown in figure 5 in appendix B.
    - Board datasheet: http://www.rasmicro.com/Bluetooth/EGBT-045MS-046S%20Bluetooth%20Module%20Manual%20rev%201r0.pdf
    - Connection of board to 5V microcontroller requires voltage regulation, connection scheme shown in figure 6.

- **CSR BC417:** is a single chip radio and baseband IC for Bluetooth 2.4GHz systems.
    - Datasheet: https://cdn.sparkfun.com/datasheets/Wireless/Bluetooth/CSR-BC417-datasheet.pdf
    - Chip is shown in figure 7 in appendix A.

Project Stages:

- **Stage 1: On-board development:**
  - Wire the circuit according to figure 8 in appendix A.
  - Use the ATMega328P MCU unit on-board of the Arduino UNO board to program an HC-05 Bluetooth module using the code shown in Appendix B.
  - Test Bluetooth interface with the Android via app: https://play.google.com/store/apps/details?id=arduino.bluetooth.terminal&feature=search_result#?t=W251bGwsMSwxLDEsImFyZHVpbm8uYmx1ZXRvb3RoLnRlcm1pbmFsIl0.
  - Instructions reference: http://www.instructables.com/id/Arduino-AND-Bluetooth-HC-05-Connecting-easily/?ALLSTEPS
- **Stage 2: Breakaway ATMega328P from Arduino UNO:**
  - Wire up the circuit shown in figure 9 in appendix A to upload the bootloader onto the MCU.
  - Upload bootloader following instructions in reference
  - Wire up the circuit shown in figure 10 in appendix A to upload the test script onto the standalone ATMega328P MCU.
  - Instructions reference: https://www.arduino.cc/en/Tutorial/ArduinoToBreadboard
- **Stage 3: Connecting HC-05 board to standalone ATMega328P:**
  - Supply the MCU with a 5V input source via pin 7.
  - Upload appendix B script onto the standalone MCU using steps in stage 2.
  - Wire up the circuit shown in figure 11 in appendix A.
  - Repeat the test with the Android app in stage 2.

Advanced Project Stages:

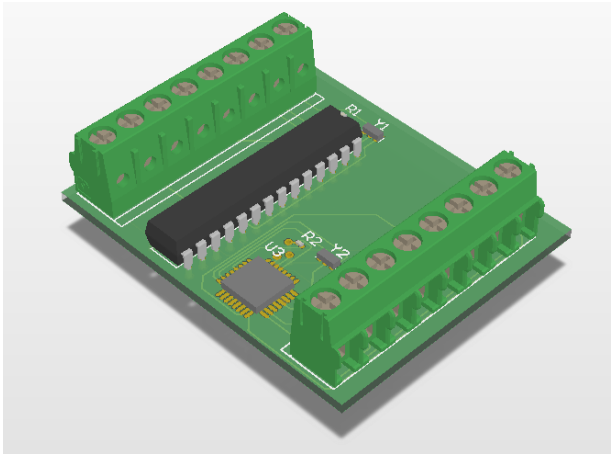
The following will be implemented if the main tests are a success.

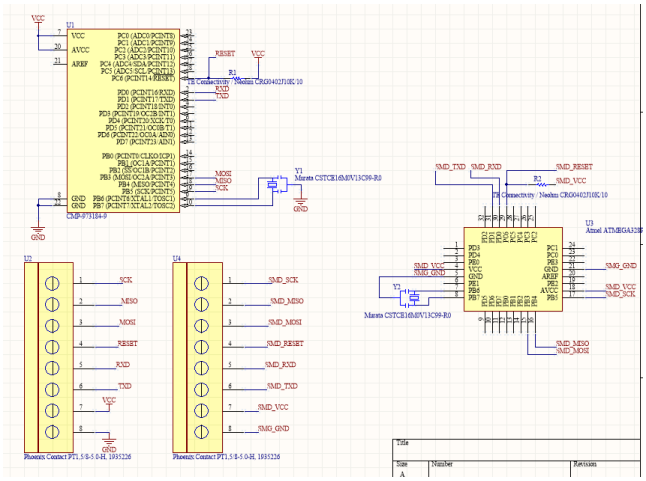
- **Stage 3: Breakaway EGBT-045MS module from HC-05 board**
  - Better for space efficiency.
  - Cheaper production cost

- **Stage 4: Use SMD ATMega328P (shown in figure 12) Package instead of 28-DIP**
  - Better for space efficiency.
  - Cheaper production cost

- **Stage 5: Test multiple Bluetooth module for maximum range**
  - Find maximum range and power efficiency (compatible) module
  - Find most cost efficient (compatible) module

- **Fabricate and test the designed programmer PCB for the ATMega328P (compatible with both SMD and 28-DIP IC's) shown below:**





Appendix A:

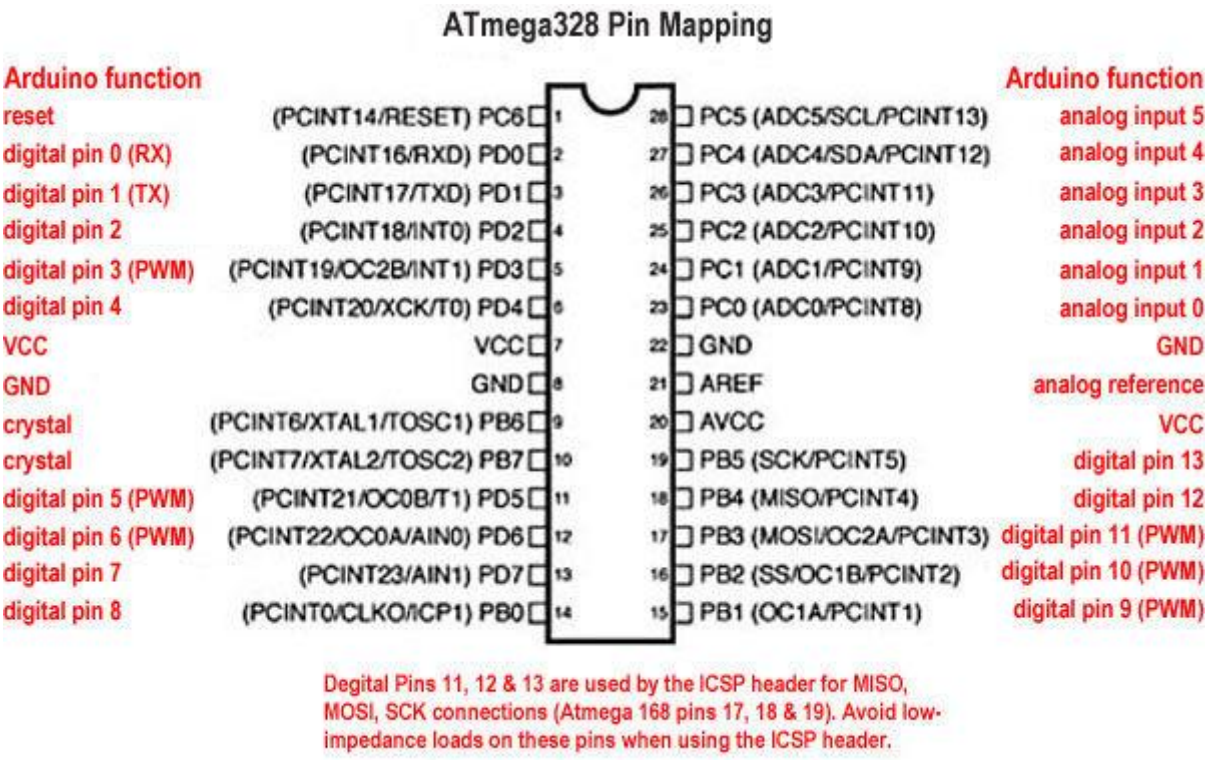


Figure 1

ATMega328P Pinout for the 28-DIP package
Source: instructables.com

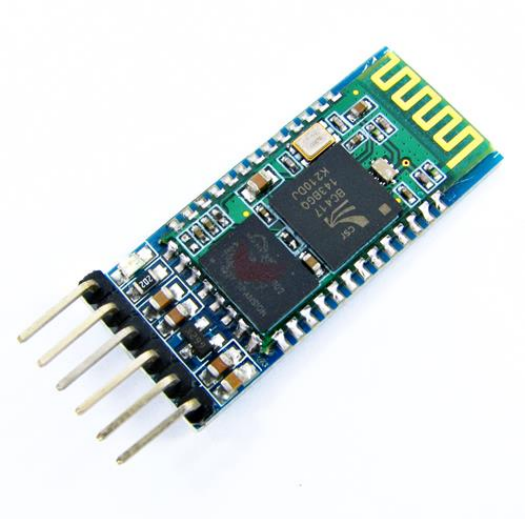


Figure 2

HC-05 breakout board with mounted Bluetooth module
Source: http://blog.roman-mueller.ch/

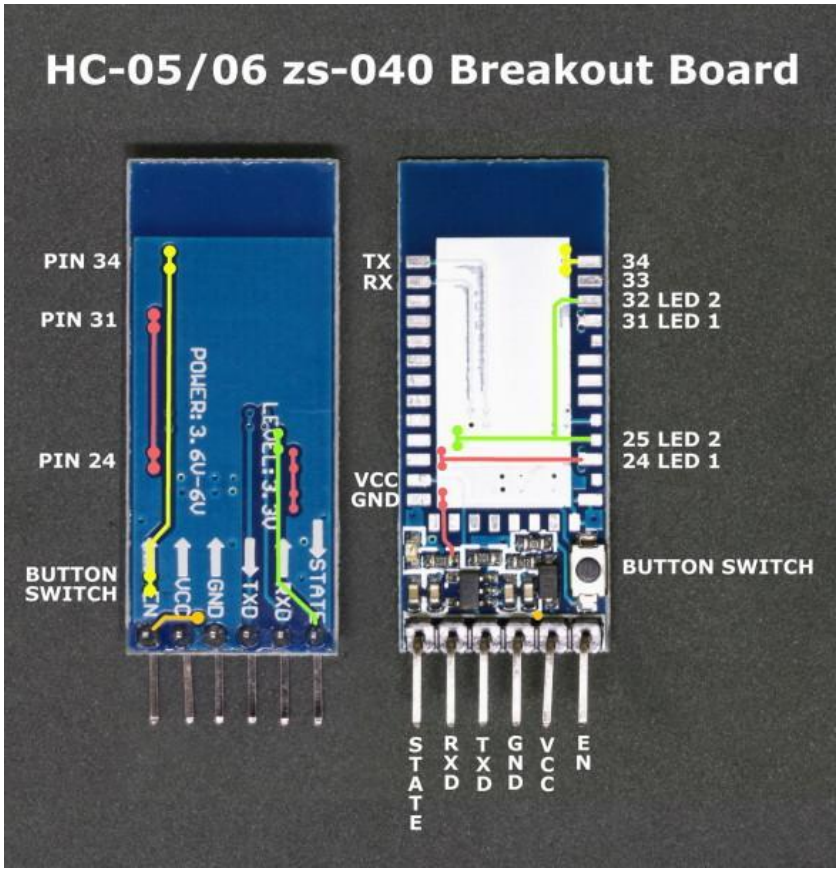


Figure 3

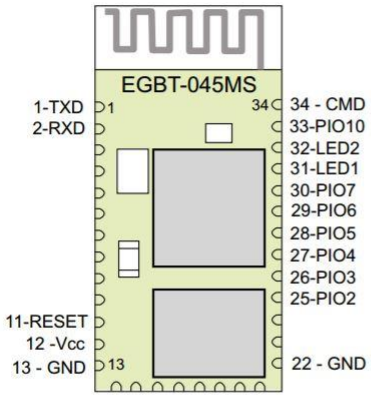
HC-05 breakout board

Source: http://www.martyncurrey.com/hc-05-and-hc-06-zs-040-bluetooth-modules-first-look/

Figure 5

EGBT-046S Bluetooth module

Source: http://www.rasmicro.com/Bluetooth/EGBT-045MS-046S%20Bluetooth%20Module%20Manual%20rev%201r0.pdf



PIN	ID	DESCRIPTION
1	TXD	UART TXD Output
2	RXD	UART RXD Input
11	RESET	RESET Input
12	Vcc	+3.1 to 4.2VDC Power Input
13	GND	Common Ground
22	GND	Common Ground
25	PIO2	User programmable I/O
26	PIO3	User programmable I/O
27	PIO4	User programmable I/O
28	PIO5	User programmable I/O
29	PIO6	User programmable I/O
30	PIO7	User programmable I/O
33	PIO10	User programmable I/O
31	LED1	LED Status Indicator
32	LED2	LED Status Indicator
34	CMD	Command Mode

Note:
All unassigned pins must be left unconnected.

Figure 6

EGBT-046S Bluetooth module Pinout
Source: http://www.rasmicro.com/Bluetooth/EGBT-045MS-046S%20Bluetooth%20Module%20Manual%20rev%201r0.pdf

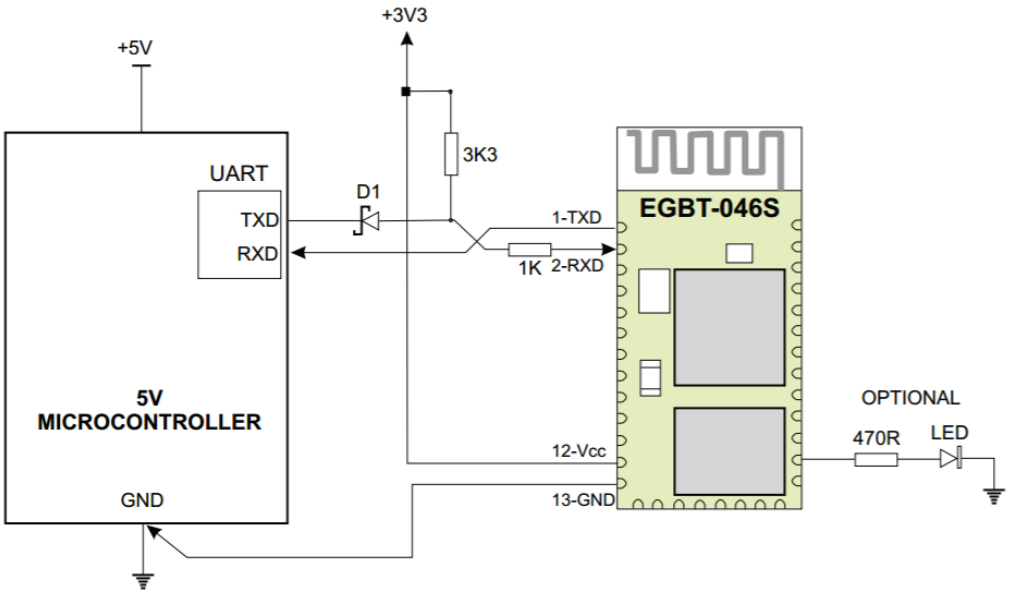


Figure 6

EGBT-046S Bluetooth module connection to a 5V microcontroller
Source: http://www.rasmicro.com/Bluetooth/EGBT-045MS-046S%20Bluetooth%20Module%20Manual%20rev%201r0.pdf

Figure 7

CSR B417 radio chips
Source: http://www.alibaba.com

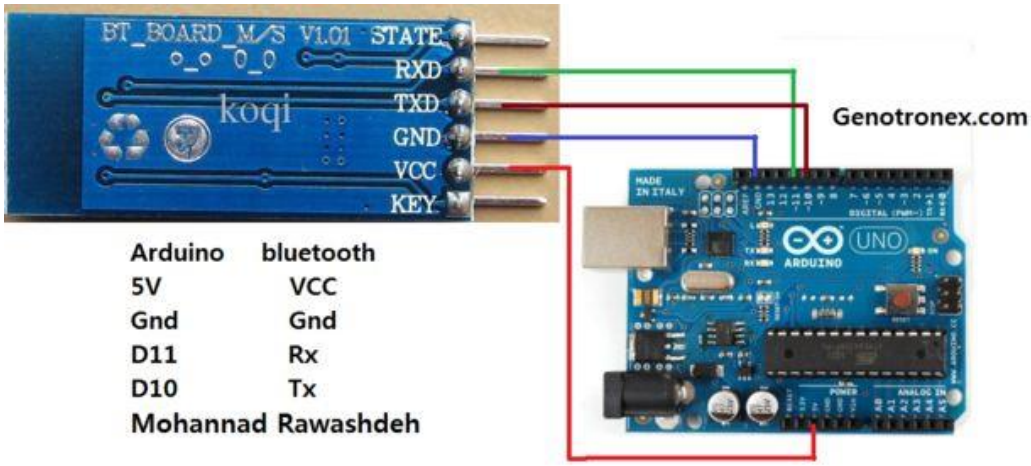


Figure 8

Stage 1 test circuit
Source: http://www.instructables.com/id/Arduino-AND-Bluetooth-HC-05-Connecting-easily/?ALLSTEPS

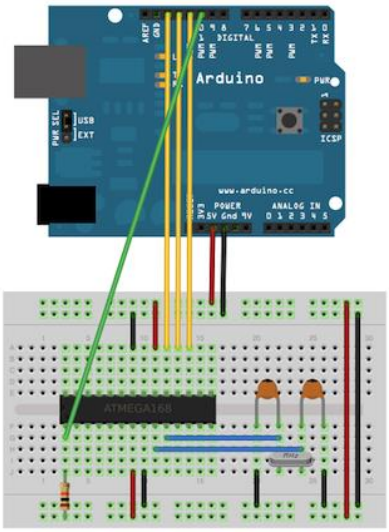


Figure 9

Stage 2 bootloader circuit (Notethis is for ATMega168, see figure 13 to map)
Source: https://www.arduino.cc/en/Tutorial/ArduinoToBreadboard

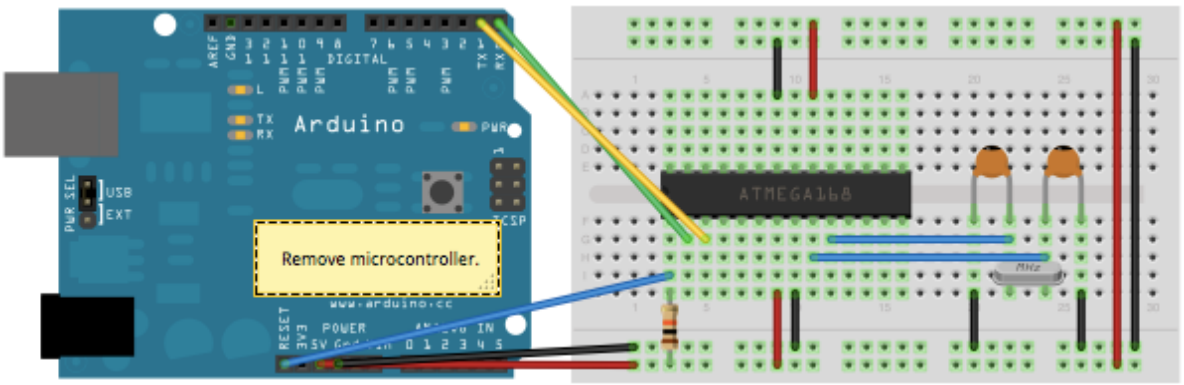


Figure 10

Stage 2 script uploading circuit (Note this is for ATMega168, see figure 13 to map)
Source: https://www.arduino.cc/en/Tutorial/ArduinoToBreadboard

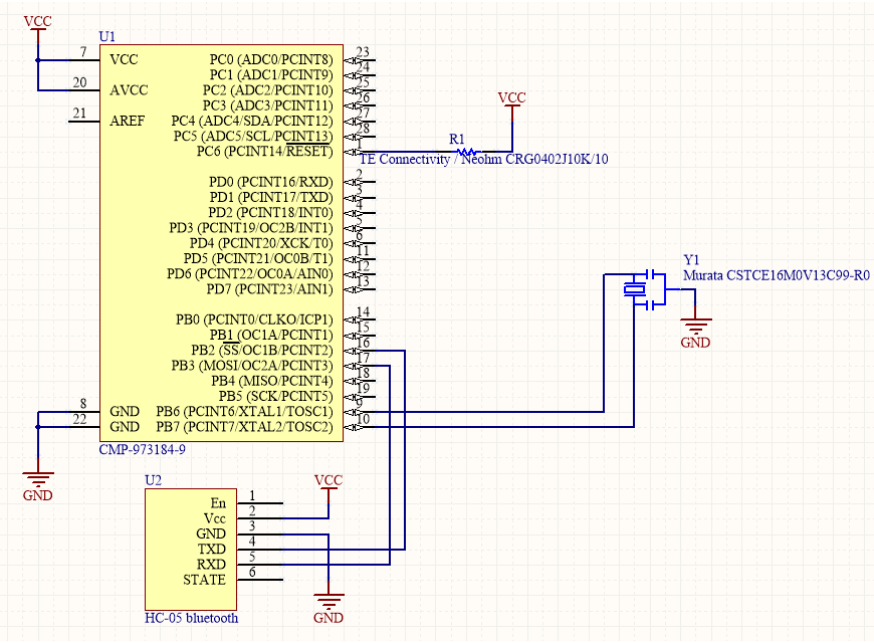


Figure 11

Stage 3 test circuit

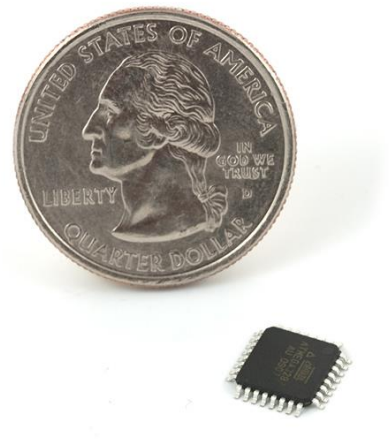


Figure 12

ATMega328P SMD Package

Source: https://www.sparkfun.com/products/retired/9261

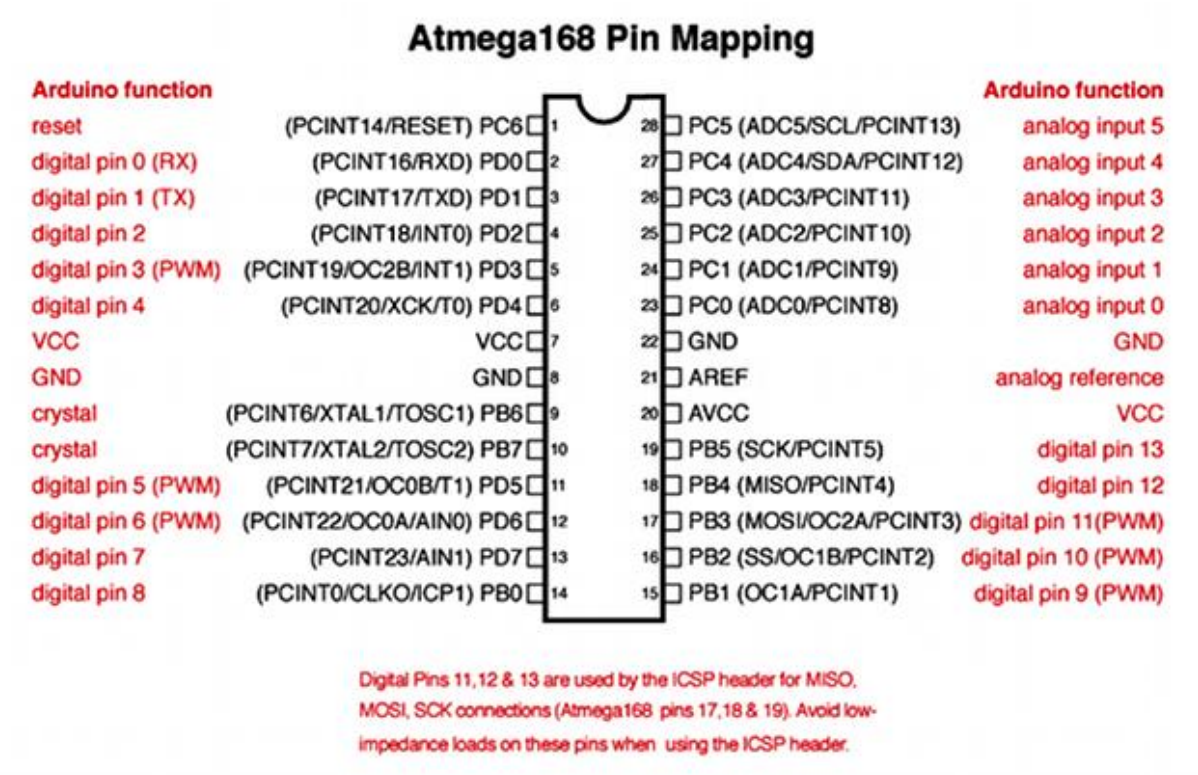


Figure 13

ATMega168 Pinout with Arduino UNO board mapping

Source: http://academy.kaziunas.com/tutorials/hello_arduino.php

Appendix B:

```
#include <SoftwareSerial.h>          // import the serial library

SoftwareSerial Genotronex(10, 11);  // RX, TX
int ledpin=13;                       // led on D13 will show blink on / off
int BluetoothData;                   // the data given from Computer

void setup() {
        // put your setup code here, to run once:
        Genotronex.begin(9600);
        Genotronex.println("Bluetooth On please press 1 or 0 blink LED..");
        pinMode(ledpin,OUTPUT);
}

void loop()
{
  // put your main code here, to run repeatedly:
      if (Genotronex.available()){
            BluetoothData=Genotronex.read();

            if(BluetoothData=='1'){        // if number 1 pressed ....
                  digitalWrite(ledpin,1);
                  Genotronex.println("LED  On D13 ON ! ");
            }

            if (BluetoothData=='0'){            // if number 0 pressed ....
                  digitalWrite(ledpin,0);
                  Genotronex.println("LED  On D13 Off ! ");
            }
      }
      delay(100);       // prepare for next data ...
}
```

Code source: http://www.instructables.com/id/Arduino-AND-Bluetooth-HC-05-Connecting-easily/?ALLSTEPS