Abstract

In an effort to further understand the concept of digital control using a microprocessor, a simple serial output device was developed. This device, which uses an Arduino Atmega 168 chip, controls a simple led number display, and outputs the data transmitted by a computer to the leds.

1.0 Construction

This device was constructed using an Arduino Atmega 168 controller chip and an Arduino Duemilanove circuit board. The device is controlled using a USB to serial adapter connected to the computer, through which serial commands can be sent. The display is affixed to a solderless prototyping board, and the outputs from the microprocessor are connected to the pins on the display as shown in Figure 1: schematic of hardware.

![Figure 1: Schematic of Hardware](image)

2.0 Operation

The operation of this program is simple; it merely requires a computer program capable of transmitting and receiving serial communication. The software on the microprocessor then interprets those signals and outputs the data. It will take a string of serial data, and output any numeric values to the display. In the event that the value is non-numeric, it will output an E, denoting error. Once it has completely output the string transmitted, the display is cleared, and the program continues to poll the serial port for new data. See APPENDIX I for sourcecode.
3.0 Conclusion

To better understand digital logic and controllers, as well as simple serial protocol, a simple circuit was developed and constructed which allows serial strings to be output to a hardware device, in this case a numeric output LED display. This gives the ability to read serial in cases where a full-sized and fully featured computer is not available. Numeric character values can be read entirely autonomously.
# APPENDIX I: Source code of program

```c
int A = 2;
int B = 3;
int C = 4;
int D = 5;
int E = 6;
int F = 7;
int G = 8;
int ledPin = 13;
int usbnumber = 0;
int numbytes = 0;

void setup() {
    pinMode(ledPin, OUTPUT);
    pinMode(A, OUTPUT);
    pinMode(B, OUTPUT);
    pinMode(C, OUTPUT);
    pinMode(D, OUTPUT);
    pinMode(E, OUTPUT);
    pinMode(F, OUTPUT);
    pinMode(G, OUTPUT);
    Serial.begin(9600);
}

void loop() {
    int i;
    for (i = 0; i < numbytes; i++) {
        // convert from character to integer
        int now = charToInt(value[i]);
        // write the number
        writeNumber(now);
        // output to terminal
        Serial.write(value[i]);
    }
    delay(1000);
    // clear screen
    writeNumber(-1);
}

// function to convert character variables from serial to integer values
int charToInt(int character) {
    // convert a single character into a number
    int value = static_cast<int>(character) - '0';
    return(value);
}
```

```
// output a number on the LCD
void writeNumber(int number) {
    // based upon the number shown, output the necessary pins for display
    if (number == 0) {
        digitalWrite(A, HIGH);
        digitalWrite(B, HIGH);
        digitalWrite(C, HIGH);
        digitalWrite(D, HIGH);
        digitalWrite(E, HIGH);
        digitalWrite(F, HIGH);
    } else if (number == 1) {
        digitalWrite(B, HIGH);
        digitalWrite(C, HIGH);
    } else if (number == 2) {
        digitalWrite(A, HIGH);
        digitalWrite(B, HIGH);
        digitalWrite(G, HIGH);
        digitalWrite(E, HIGH);
        digitalWrite(D, HIGH);
    } else if (number == 3) {
        digitalWrite(A, HIGH);
        digitalWrite(B, HIGH);
        digitalWrite(G, HIGH);
        digitalWrite(C, HIGH);
        digitalWrite(D, HIGH);
    } else if (number == 4) {
        digitalWrite(F, HIGH);
        digitalWrite(B, HIGH);
        digitalWrite(G, HIGH);
        digitalWrite(C, HIGH);
    } else if (number == 5) {
        digitalWrite(A, HIGH);
        digitalWrite(F, HIGH);
        digitalWrite(G, HIGH);
        digitalWrite(C, HIGH);
        digitalWrite(D, HIGH);
    } else if (number == 6) {
        digitalWrite(A, HIGH);
        digitalWrite(F, HIGH);
        digitalWrite(G, HIGH);
        digitalWrite(C, HIGH);
        digitalWrite(D, HIGH);
        digitalWrite(E, HIGH);
    } else if (number == 7) {
        digitalWrite(A, HIGH);
        digitalWrite(B, HIGH);
        digitalWrite(C, HIGH);
        digitalWrite(E, HIGH);
        digitalWrite(D, HIGH);
    } else if (number == 8) {
        digitalWrite(A, HIGH);
        digitalWrite(B, HIGH);
        digitalWrite(C, HIGH);
        digitalWrite(D, HIGH);
        digitalWrite(E, HIGH);
        digitalWrite(F, HIGH);
    } else if (number == 9) {
        digitalWrite(A, HIGH);
        digitalWrite(F, HIGH);
        digitalWrite(G, HIGH);
        digitalWrite(C, HIGH);
        digitalWrite(D, HIGH);
        digitalWrite(E, HIGH);
        digitalWrite(F, HIGH);
    } else if (number == -1) {
        digitalWrite(A, LOW);
        digitalWrite(B, LOW);
        digitalWrite(C, LOW);
        digitalWrite(D, LOW);
        digitalWrite(E, LOW);
        digitalWrite(F, LOW);
        digitalWrite(G, LOW);
    }
}
```
