# Digital Clock through Arduino

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## 1 Components

| Component | Value | Quantity |
|---|---|---|
| Breadboard | | 1 |
| Resistor | ≥ 220Ω | 2 |
| Arduino | Uno | 1 |
| Seven Segment Display | Common Anode | 2 |
| Jumper Wires | | 20 |

TABLE 1.0

## 2 Hardware Connections

The breadboard can be divided into 5 segments. In each of the green segements, the pins are internally connected so as to have the same voltage. Similarly, in the central segments, the pins in each column are internally connected in the same fashion as the blue columns.

**Problem 2.1.** Plug the display to the breadboard in Fig. 2.1

The seven segment display in Fig. 2.2 has eight pins, $a, b, c, d, e, f, g$ and *dot* that take an active LOW input, i.e. the LED will glow only if the input is connected to ground. Each of these pins

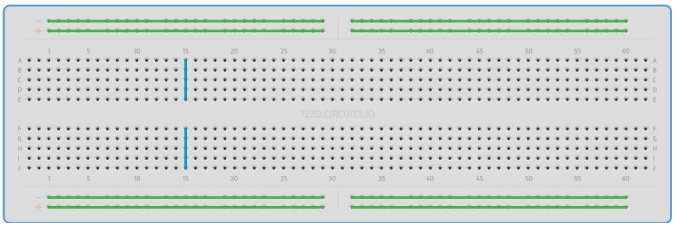

Fig. 2.1

is connected to an LED segment. The *dot* pin is reserved for the · LED.

**Problem 2.2.** Connect one end of the resistor to the COM pin of the display and the other end to an extreme pin of the breadboard.

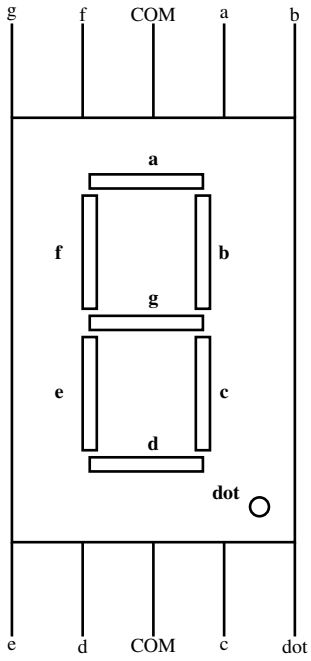


Fig. 2.2

The Arduino Uno has some ground pins, analog input pins A0-A3 and digital pins D1-D13 that can

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be used for both input as well as output. It also has two power pins that can generate $3.3V$ and $5V$. In the following exercises, only the GND, $5V$ and digital pins will be used.

**Problem 2.3.** Connect the 5V pin of the arduino to an extreme pin that is in the same segment as the 1K resistor pin.

**Problem 2.4.** Connect the GND pin of the arduino to the opposite extreme pin of the breadboard

**Problem 2.5.** Connect the D2-D8 pins of the arduino to the $a-g$ pins of the seven segment display.

**Problem 2.6.** Connect the D9 pin of the arduino to the free COM pin of the seven segment display.

**Problem 2.7.** Connect the Arduino to the computer.

## 3 Display Control through Arduino Software

**Problem 3.1.** Execute the following code. What do you observe?

```
//Declarations
int A=0,B=0,C=0,D=0,a,b,c,d,e,f,g,
   W,X,Y,Z,i,j,thisPin;
int ledPins
   []={2,3,4,5,6,7,8,9,10};
int pinCount=9;
int r0;
unsigned int initialtime, elapsed;
void showit(int x);

void setup()
{
//Declaring output pins
for( thisPin=0;thisPin < pinCount;
    thisPin++)
{
pinMode(ledPins[thisPin], OUTPUT);
}
}
void loop()
{
//Decade Counting
for( r0=0;r0<=9;r0++)
{
initialtime=millis();
//Counting 1000 milliseconds
for(elapsed=0;elapsed<=1000;
   elapsed=millis()-initialtime)
{
//Keep display on
digitalWrite(9,HIGH);

//Write number to display
showit(r0);

}//end counting 10 sec
} //end counting 1 sec
}// end void

//Display logic
void showit(int x)
{
int D,C,B,A;

//Decimal to Binary conversion
A=x%2;
x=x/2;
B=x%2;
x=x/2;
C=x%2;
x=x/2;
D=x%2;

//BCD to seven segement decoder
a=(!D&&!C&&!B&&A)||(!D&&C&&!B&&!A)
    ;
b=(!D&&C&&!B&&A)||(!D&&C&&B&&!A);
c=(!D&&!C&&B&&!A);
d=(!D&&!C&&!B&&A)||(!D&&C&&!B&&!A)
    ||(!D&&C&&B&&A);
e=(!D&&!C&&!B&&A)||(!D&&!C&&B&&A)
    ||(!D&&C&&!B&&!A)||(!D&&C&&!B&&A
    )||(!D&&C&&B&&A)||(D&&!C&&!B&&A)
    ;
f=(!D&&!C&&!B&&A)||(!D&&!C&&B&&!A)
    ||(!D&&!C&&B&&A)||(!D&&C&&B&&A);
g=(!D&&!C&&!B&&!A)||(!D&&!C&&!B&&A
    )||(!D&&C&&B&&A);

//Writing to display
digitalWrite(2,a);
digitalWrite(3,b);
digitalWrite(4,c);
digitalWrite(5,d);
digitalWrite(6,e);
digitalWrite(7,f);
digitalWrite(8,g);
}
```

**Problem 3.2.** Connect one more display to the breadboard and complete the hardware setup. A parallel connection from the D2-D8 pins should be made to the $a-g$ pins of this display.

**Problem 3.3.** Connect the D10 pin of the arduino to the free COM pin of the second display and execute the following code. What do you observe?

```
// Declaration
int A=0,B=0,C=0,D=0,a,b,c,d,e,f,g,
   W,X,Y,Z,i,j,thisPin;
int ledPins
   []={2,3,4,5,6,7,8,9,10};
int pinCount=9,r0,r1;
int low_pins[]={9,10};
int cnt[2];
unsigned int initialtime, elapsed
   =0;
void showit(int x);

// the setup function runs once
   when you press reset or power
   the board

void setup()
{
// initialize digital pin 2 to 10
   as an output
for( thisPin=0;thisPin < pinCount;
    thisPin++)
{
pinMode(ledPins[thisPin], OUTPUT);
}
}
// the loop function runs over and
    over again forever.
void loop()
{
// count 0 to 5, every 10 seconds
for(r1=0;r1<=5;r1++)
{
//count 0 to 9 with 1 second
   interval
for(r0=0;r0<=9;r0++)
{
//  number of milliseconds since
   the program started.
initialtime=millis();
elapsed = initialtime;
//ensuring delay of 1 second
while (elapsed - initialtime <=
   1000)
{
elapsed = millis();

cnt[0] = r0;
cnt[1] = r1;

// Multiplexing Displays
for( i=0;i<2;i++)
{
// turn all the LED(s) LOW
        for(j=0;j<2;j++)
                digitalWrite(
                   low_pins[j],LOW)
                   ;

digitalWrite(low_pins[i],HIGH);
// display digits
showit(cnt[i]);
//allow numbers to be displayed on
    LED before switching
delay(2);
}//end of multiplexing displays
}//end of waiting for 1 second
}//end decade count loop
}//end 0-5 count
}


// function for display decoder
void showit(int x){
int D,C,B,A;
// logic for decimal to binary
A=x%2;
x=x/2;
B=x%2;
x=x/2;
C=x%2;
x=x/2;
D=x%2;
a=(!D&&!C&&!B&&A)||(!D&&C&&!B&&!A)
   ;
b=(!D&&C&&!B&&A)||(!D&&C&&B&&!A);
c=(!D&&!C&&B&&!A);
d=(!D&&!C&&!B&&A)||(!D&&C&&!B&&!A)
   ||(!D&&C&&B&&A);
e=(!D&&!C&&!B&&A)||(!D&&!C&&B&&A)
```

```
    ||(!D&&C&&!B&&!A)||(!D&&C&&!B&&A
    )||(!D&&C&&B&&A)||(D&&!C&&!B&&A)
    ;
f=(!D&&!C&&!B&&A)||(!D&&!C&&B&&!A)
    ||(!D&&!C&&B&&A)||(!D&&C&&B&&A);
g=(!D&&!C&&!B&&!A)||(!D&&!C&&!B&&A
    )||(!D&&C&&B&&A);
digitalWrite(2,a);
digitalWrite(3,b);
digitalWrite(4,c);
digitalWrite(5,d);
digitalWrite(6,e);
digitalWrite(7,f);
digitalWrite(8,g);
}
```

**Problem 3.4.** Connect 4 more displays and build a 24 hour digital clock.