Standalone ATMEGA328P from Arduino

Alok Ranjan Kesari† and G V V Sharma*

Contents

***Abstract*—This manual shows how to use the ATMEGA328P microcontroller of the arduino for an embedded system. The ATMEGA328P is first programmed using the arduino board and then taken out of the board and plugged into a breadboard along with a seven segment display. Additional circuitry is assembled on the breadboard for powering the IC and using it for a decade counter. Soldering this arrangement on a PCB results in a standalone embedded device.**

1 Components

Component	Value	Quantity
Breadboard		1
Jumper Wires		20
Resistor	220 Ohm	3
	10K Ohm	1
Capacitor	10 uF	2
	22 pF	2
Crystal	16 Mhz	1
ATMEGA328P		1
Seven Segment Display		1
LED		2

TABLE 1.0

*The author is with the Department of Electrical Engineering, Indian Institute of Technology, Hyderabad 502285 India e-mail: gadepall@iith.ac.in. † The author was an intern at IIT Hyderabad in the summer of 2017 e-mail: alok.kesari@yahoo.co.in.

2 Software

Run the following program on the arduino.

```
//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);
}
```

3 Hardware Setup

Problem 3.1. Take the ATMEGA328P IC from the Arduino board and plug it into the breadboard.

Problem 3.2. Plug the seven segment display in Fig. 3.2 into the breadboard.

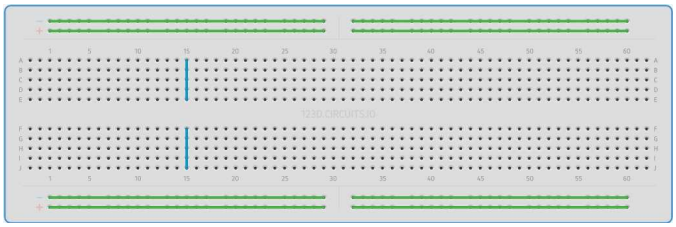

Fig. 3.1

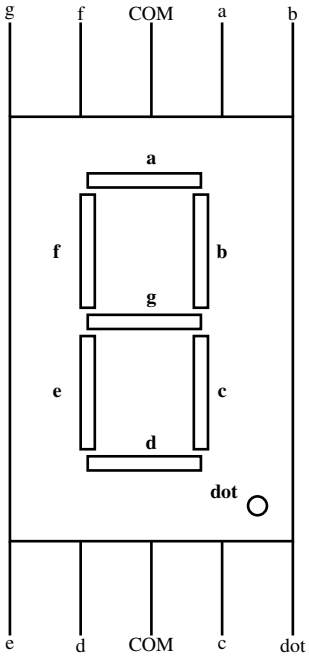

Fig. 3.2

Problem 3.3. Plug the Quartz crystal between pins 9 and 10 of the ATMEGA328P.

Problem 3.4. Connect the 22pF capacitors from pin 9 and 10 to GND.

Problem 3.5. Connect the pin 1 through a 10 KΩ resistor to 5V.

Problem 3.6. Connect one end of the push button to pin 1 and the other end to GND.

Problem 3.7. Make connections according to Table 3.7.

Problem 3.8. Power up through USB.

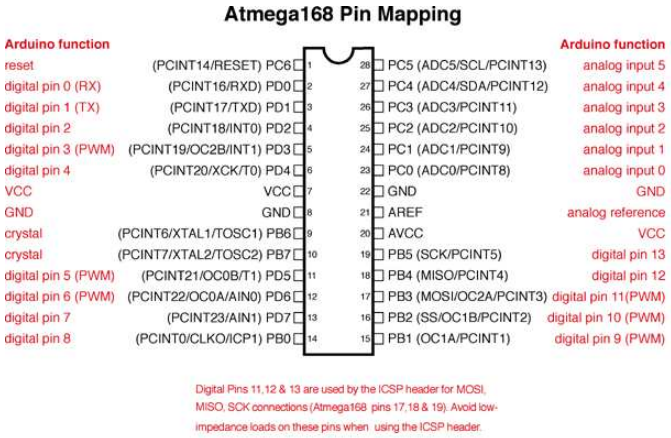

Fig. 3.6

Type	Pin No
5V	7
	20
	21
GND	8
	22
a	4
b	5
c	6
d	11
e	12
f	13
g	14

TABLE 3.7