भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology
Hyderabad

Pi for Schools

Teaching Learning Center
IIT Hyderabad

G V V Sharma*

Contents

***Abstract*—The objective of the manual is to introduce the RaspberryPi to beginners by programming the GPIO pins to build a decade counter .**

1 Display Control through Hardware

1.1 Components

The components required for this manual are listed in Table 1.0

Component	Value	Quantity
Breadboard		1
Resistor	$\geq 220\Omega$	1
Pi	Model B, Rev 3	1
Seven Segment Display	Common Anode	1
Jumper Wires	Female-Male	20

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.

1.2 Software Setup

The following commands will install the Wiring Pi module

```
sudo apt-get install git-core
sudo apt-get update
sudo apt-get upgrade
cd
git clone git://git.drogon.net/
    wiringPi
cd ~/wiringPi
./build
```

1.3 Powering the Display

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 1.1. Plug the display to the breadboard in Fig. 1.1

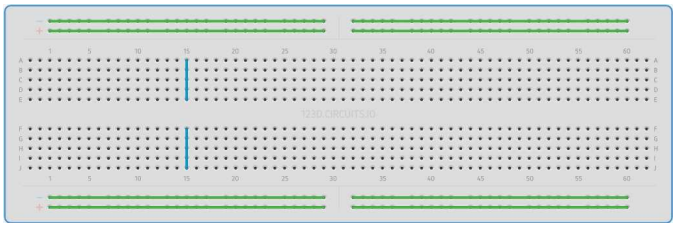

Fig. 1.1

The seven segment display in Fig. 1.2 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 is connected to an LED segment. The *dot* pin is reserved for the · LED.

Problem 1.2. Connect one end of the resistor to the COM pin of the display and the other end to an extreme pin of the breadboard.

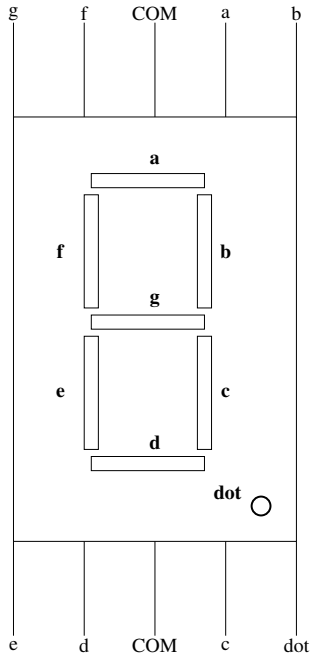

Fig. 1.2

The Raspberry Pi 3 has 40 pins (see Figs. 2.1.1 and 2.1.2), which include power pins that can generate 5V and 3.3V, GND pins, PWM pins, pins for wired communication and some free pins for digital I/O. In the following exercises, only the GND, 5*V* and digital I/O pins will be used.

Problem 1.3. Connect pin 2 (5V) of the Pi to an extreme pin that is in the same segment as the resistor pin.

Problem 1.4. Connect pin 6 (GND) of the Pi to the opposite extreme pin of the breadboard

Problem 1.5. Connect the *dot pin of the display to a pin in the same segment as the GND pin. What do you observe?*

1.4 Controlling the Display

Fig. 1.6 explains how to get decimal digits using the seven segment display.

Problem 1.6. Generate the number 1 on the display by connecting only the pins *b* and *c* to GND.

Problem 1.7. Repeat the above exercise to generate the number 2 on the display.

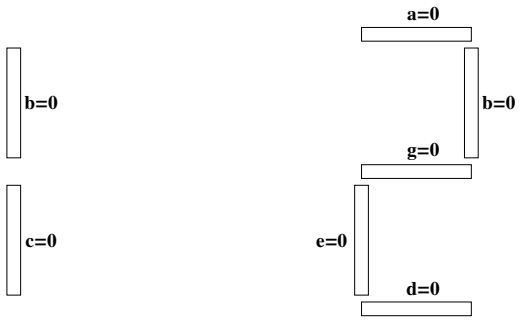

Fig. 1.6

Problem 1.8. Table 1.8 summarizes the process of generating the decimal digits. 0 means connecting to ground and 1 means not connecting. Complete Table 1.8 for all numbers between 0-9.

a	b	c	d	e	f	g	decimal
1	0	0	1	1	1	1	1
0	0	1	0	0	1	0	2

TABLE 1.8

Problem 1.9. Now generate all numbers between 0-9 on the display using the above table.

2 Display Control through Software

2.1 Driving the Segments

Problem 2.1.

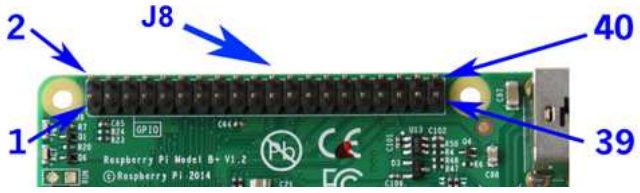

Fig. 2.1.1: GPIO pin snapshot on Pi.

Problem 2.2. Connect the a-g pins of the display to the GPIO pins 0-6 of the Pi shown in 2.1.1 and 2.1.2.

Problem 2.3. Type the following C code and excute. What do you observe?

Solution:

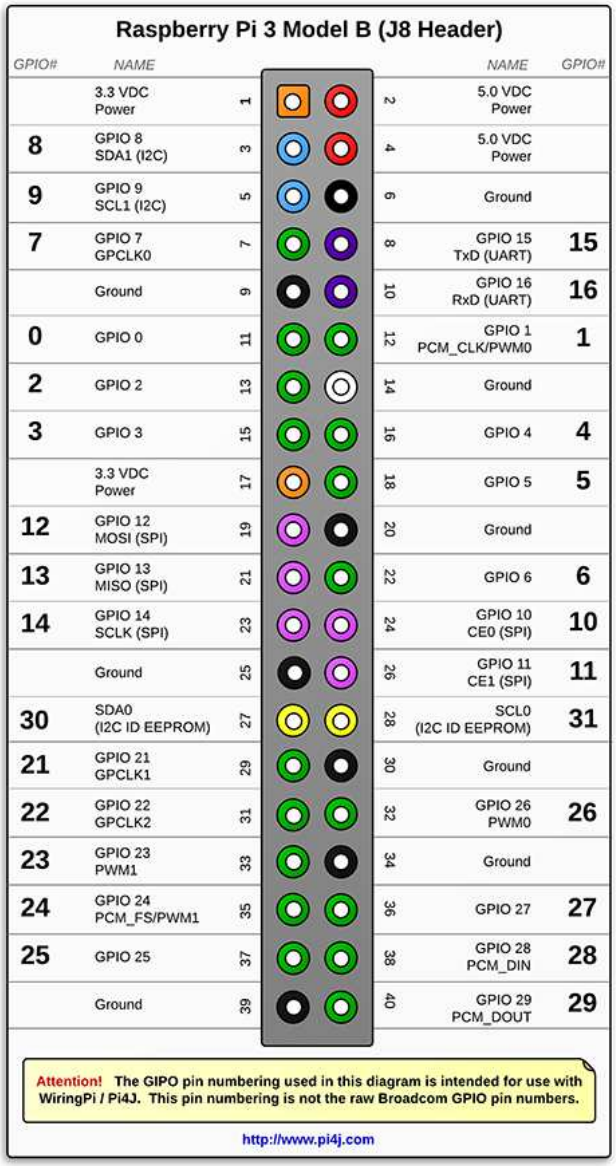

Fig. 2.1.2: GPIO Wiring Pi pin configuration.

```
#include <wiringPi.h>

void sevenseg(int a,int b,int c,
   int d,int e,int f,int g)
{
  digitalWrite(0, a);
  digitalWrite(1, b);
  digitalWrite(2, c);
  digitalWrite(3, d);
  digitalWrite(4, e);
  digitalWrite(5, f);
  digitalWrite(6, g);
}

int main (void)
{
  wiringPiSetup () ;
  pinMode (0, OUTPUT) ;
  pinMode (1, OUTPUT) ;
  pinMode (2, OUTPUT) ;
  pinMode (3, OUTPUT) ;
  pinMode (4, OUTPUT) ;
  pinMode (5, OUTPUT) ;
  pinMode (6, OUTPUT) ;

  for (;;)
  {

sevenseg(1,0,0,1,1,1,1);
}
}
//Command for raspberry pi
//gcc -Wall -o test seven_seg_disp
   .c -lwiringPi
//followed by
// sudo ./test
```

Problem 2.4. Now generate the numbers 0-9 by modifying the above program.

Problem 2.5. Suitably modify the above program to obtain a decade counter.