

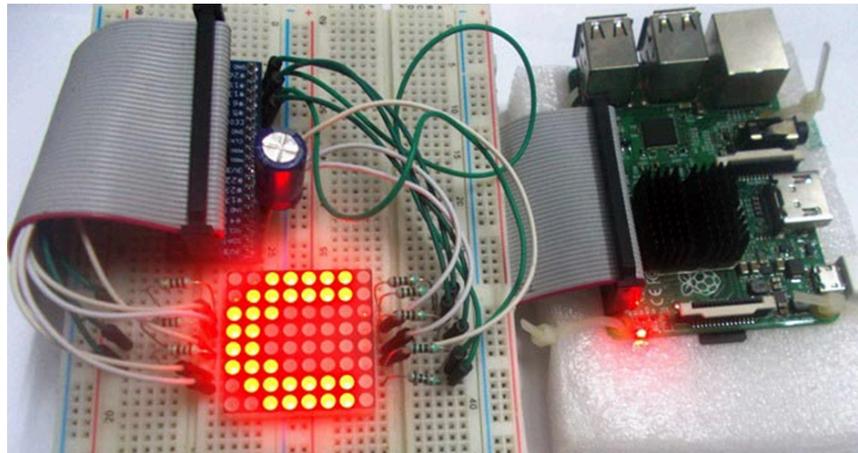
# 5.LED Grid Module: Program the 8X8 Grid with Different Formulas

Remark:

Signature:

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We have created a series of Raspberry Pi Tutorials, in which we have covered Interfacing of Raspberry Pi with all the basic components like LED, LCD, button, DC motor, Servo Motor, Stepper Motor, ADC, shift Register, etc. We have also published some simple Raspberry Pi projects for beginners, along with some good IoT projects. Today, in continuation of these tutorials, we are going to Control the 8x8 LED Matrix Module by Raspberry Pi. We will write a python program to show characters on the matrix module.



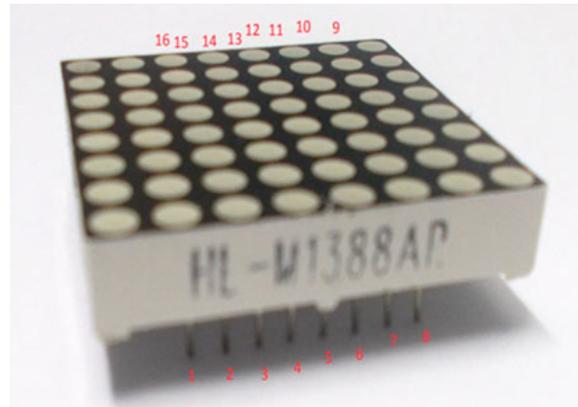
## Components Required:

Here we are using Raspberry Pi 2 Model B with Raspbian Jessie OS. All the basic Hardware and Software requirements are previously discussed, you can look it up in the Raspberry Pi Introduction and Raspberry PI LED Blinking for getting started, other than that we need:

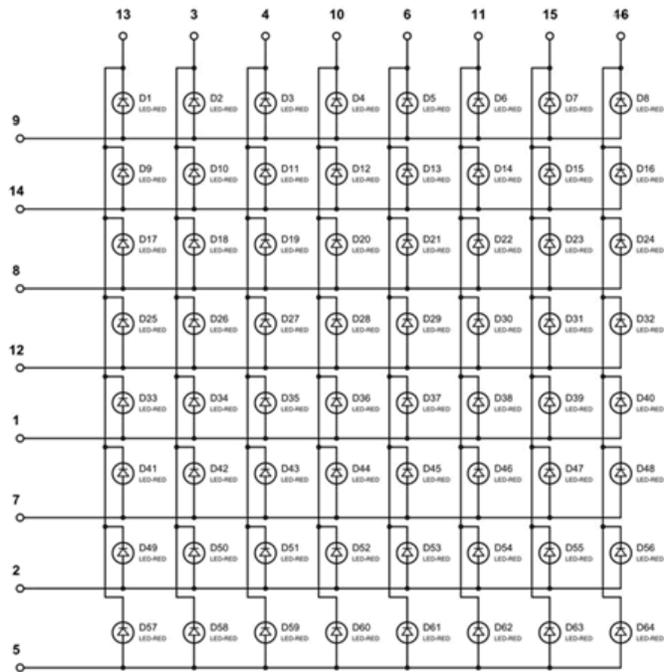
- Raspberry Pi Board
- Power supply (5v)
- 1000uF capacitor (connected across power supply)
- 1K $\Omega$  resistor (8 pieces)

## 8x8 LED Matrix Module:

An 8\*8 LED matrix module contains 64 LED (Light Emitting Diodes) which are arranged in the form of a matrix, hence the name is LED matrix. These compact modules are available in different sizes and many colors. One can choose them based on convenience. The PIN configuration of the module is as shown in the picture. Keep in mind that the pinouts of modules are not in order so the PINs should be numbered exactly as shown in the picture for avoiding errors.



There are 8+8=16 common terminals in the LED Matrix module. Over them, we have 8 common positive terminals and 8 common negative terminals, in the form of 8 rows and 8 columns, for connecting 64 LEDs in matrix form. If the module were to be drawn in the form of circuit diagram we will have a picture as shown below:



So for 8 rows, we have 8 Common Positive Terminals (9, 14, 8, 12, 17, 2, 5). Consider the first row, the LEDs from D1 to D8 have a common positive terminal and the pin is brought out at PIN9 of the LED Matrix module. When we want one or all LEDs in a ROW to be ON, The corresponding pin of LED MODULE should be powered with +3.3v.

Similar to common positive terminals, we have 8 Common Negative Terminals as columns (13, 3, 4, 10, 6, 11, 15, 16). For grounding any LED in any column the respective common negative terminal to be grounded.

**Circuit Explanation:**

The connections which are done between **Raspberry Pi and LED matrix** module are shown in the below table.

LED Matrix Module Pin no.	Function	Raspberry Pi GPIO Pin No.

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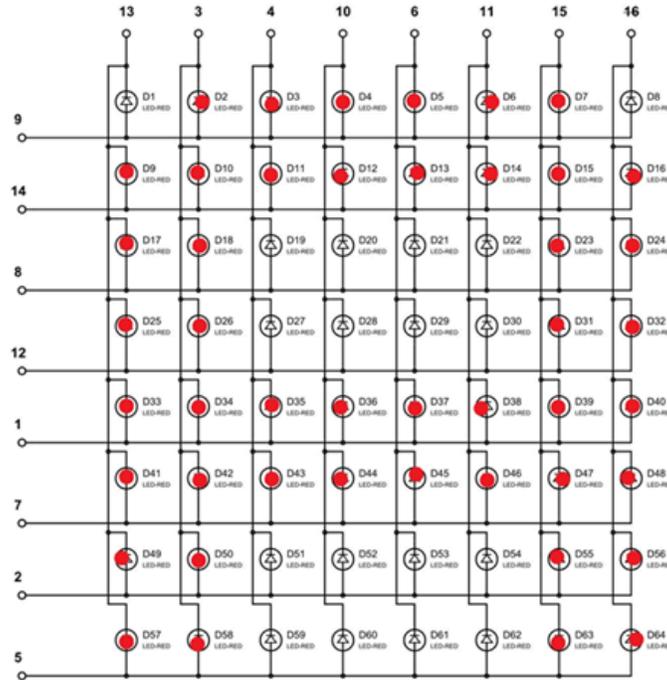
13	POSITIVE0	GPIO12
3	POSITIVE1	GPIO22
4	POSITIVE2	GPIO27
10	POSITIVE3	GPIO25
6	POSITIVE4	GPIO17
11	POSITIVE5	GPIO24
15	POSITIVE6	GPIO23
16	POSITIVE7	GPIO18
9	NEGATIVE0	GPIO21
14	NEGATIVE1	GPIO20
8	NEGATIVE2	GPIO26
12	NEGATIVE3	GPIO16
1	NEGATIVE4	GPIO19
7	NEGATIVE5	GPIO13
2	NEGATIVE6	GPIO6
5	NEGATIVE7	GPIO5

Working Explanation:

Here we will use **Multiplexing Technique** to show characters on the 8x8 LED Matrix Module. So let's discuss this multiplexing in detail. Say if we want to turn on LED D10 in

the matrix, we need to power the PIN14 of the module and ground the PIN3 of the module. With this LED D10 will turn ON as shown in below figure. This should also be checked first for MATRIX to know everything is in order.

As told we will turn ON one row in an instant,



At  $t=0m$  SEC, PIN09 is set HIGH (other ROW pins are LOW at this time) at this time, PIN3, PIN4, PIN10, PIN6, PIN11, PIN15 are grounded (other COLUMN pins are HIGH at this time)

At  $t=1m$  SEC, PIN14 is set HIGH (other ROW pins are LOW at this time) at this time, PIN13, PIN3, PIN4, PIN10, PIN6, PIN11, PIN15, PIN16 are grounded (other COLUMN pins are HIGH at this time)

At  $t=2m$  SEC, PIN08 is set HIGH (other ROW pins are LOW at this time) at this time, PIN13, PIN3, PIN15, PIN16 are grounded (other COLUMN pins are HIGH at this time)

At  $t=3m$  SEC, PIN12 is set HIGH (other ROW pins are LOW at this time) at this time, PIN13, PIN3, PIN15, PIN16 are grounded (other COLUMN pins are HIGH at this time)

At  $t=4m$  SEC, PIN01 is set HIGH (other ROW pins are LOW at this time) at this time, PIN13, PIN3, PIN4, PIN10, PIN6, PIN11, PIN15, PIN16 are grounded (other COLUMN pins are HIGH at this time)

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At t=5m SEC, PIN07 is set HIGH (other ROW pins are LOW at this time )at this time, PIN13,PIN3,PIN4,PIN10,PIN6,PIN11,PIN15,PIN16 are grounded(other COLUMN pins are HIGH at this time)

At t=6m SEC, PIN02 is set HIGH (other ROW pins are LOW at this time )at this time, PIN13,PIN3,PIN15,PIN16 are grounded(other COLUMN pins are HIGH at this time)

At t=7m SEC, PIN05 is set HIGH (other ROW pins are LOW at this time )at this time, PIN13,PIN3,PIN15,PIN16 are grounded(other COLUMN pins are HIGH at this time)

At this speed, the display will be seen as continuously showing “A” character as shown in figure.

The **Python Program for showing Characters on LED Matrix using Raspberry Pi** is given below. The program is well explained by comments. Port Values for each character are given in the program. You can show whatever characters you want by just changing the 'pinp' values in the 'for loops' in the given program. Also check the Demo Video below.

Code

```
import RPi.GPIO as IO #calling for header file which helps in using GPIO's of PI
import time          #calling for time to provide delays in program

IO.setwarnings(False) #do not show any warnings

x=1

y=1

IO.setmode (IO.BCM) #programming the GPIO by BCM pin numbers. (like PIN29
as'GPIO5')

IO.setup(12,IO.OUT) #initialize GPIO12 as an output.

IO.setup(22,IO.OUT) #initialize GPIO22 as an output.

IO.setup(27,IO.OUT)

IO.setup(25,IO.OUT)

IO.setup(17,IO.OUT)

IO.setup(24,IO.OUT)

IO.setup(23,IO.OUT)
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IO.setup(18,IO.OUT)
IO.setup(21,IO.OUT)
IO.setup(20,IO.OUT)
IO.setup(26,IO.OUT)
IO.setup(16,IO.OUT)
IO.setup(19,IO.OUT)
IO.setup(13,IO.OUT)
IO.setup(6,IO.OUT)

IO.setup(5,IO.OUT)
PORTVALUE = [128,64,32,16,8,4,2,1]
#value of pin in each port
A=[0,0b01111111,0b11111111,0b11001100,0b11001100,0b11001100,0b11111111,0
b01111111]
B=[0,0b00111100,0b01111110,0b11011011,0b11011011,0b11011011,0b11111111,0
b11111111]
C=[0,0b11000011,0b11000011,0b11000011,0b11000011,0b11100111,0b01111110,0
b00111100]
D=[0,0b01111110,0b10111101,0b11000011,0b11000011,0b11000011,0b11111111,0
b11111111]
E=[0,0b11011011,0b11011011,0b11011011,0b11011011,0b11011011,0b11111111,0
b11111111]
F=[0,0b11011000,0b11011000,0b11011000,0b11011000,0b11011000,0b11111111,0
b11111111]
G=[0b00011111,0b11011111,0b11011000,0b11011011,0b11011011,0b11011011,0b1
1111111,0b11111111]
H=[0,0b11111111,0b11111111,0b00011000,0b00011000,0b00011000,0b11111111,0
b11111111]
I=[0b11000011,0b11000011,0b11000011,0b11111111,0b11111111,0b11000011,0b1
1000011,0b11000011]
J=[0b11000000,0b11000000,0b11000000,0b11111111,0b11111111,0b11000011,0b1
1001111,0b11001111]
K=[0,0b11000011,0b11100111,0b01111110,0b00111100,0b00011000,0b11111111,0
b11111111]
L=[0b00000011,0b00000011,0b00000011,0b00000011,0b00000011,0b00000011,0b1
1111111,0b11111111]
M=[0b11111111,0b11111111,0b01100000,0b01110000,0b01110000,0b01100000,0b
11111111,0b11111111]
N=[0b11111111,0b11111111,0b00011100,0b00111000,0b01110000,0b11100000,0b1
1111111,0b11111111]
```

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O=[0b01111110,0b11111111,0b11000011,0b11000011,0b11000011,0b11000011,0b
11111111,0b01111110]
P=[0,0b01110000,0b11111000,0b11001100,0b11001100,0b11001100,0b11111111,0
b11111111]
Q=[0b01111110,0b11111111,0b11001111,0b11011111,0b11011011,0b11000011,0b
11111111,0b01111110]
R=[0b01111001,0b11111011,0b11011111,0b11011110,0b11011100,0b11011000,0b1
1111111,0b11111111]
S=[0b11001110,0b11011111,0b11011011,0b11011011,0b11011011,0b11011011,0b1
111011,0b01110011]
T=[0b11000000,0b11000000,0b11000000,0b11111111,0b11111111,0b11000000,0b1
1000000,0b11000000]
U=[0b11111110,0b11111111,0b00000011,0b00000011,0b00000011,0b00000011,0b1
1111111,0b11111110]
V=[0b11100000,0b11111100,0b00011110,0b00000011,0b00000011,0b00011110,0b1
1111100,0b11100000]
W=[0b11111110,0b11111111,0b00000011,0b11111111,0b11111111,0b00000011,0b
11111111,0b11111110]
X=[0b01000010,0b11100111,0b01111110,0b00111100,0b00111100,0b01111110,0b1
1100111,0b01000010]
Y=[0b01000000,0b11100000,0b01110000,0b00111111,0b00111111,0b01110000,0b1
1100000,0b01000000]
Z=[0b11000011,0b11100011,0b11110011,0b11111011,0b11011111,0b11001111,0b1
1000111,0b11000011]
def PORT(pin): #assigning GPIO state by taking 'pin' value

    if(pin&0x01 == 0x01):
        IO.output(21,0) #if bit0 of 8bit 'pin' is true pull PIN21 low
    else:
        IO.output(21,1) #if bit0 of 8bit 'pin' is false pull PIN21 high
    if(pin&0x02 == 0x02):
        IO.output(20,0) #if bit1 of 8bit 'pin' is true pull PIN20 low
    else:
        IO.output(20,1) #if bit1 of 8bit 'pin' is false pull PIN20 high
    if(pin&0x04 == 0x04):
        IO.output(26,0) #if bit2 of 8bit 'pin' is true pull PIN26 low
    else:
        IO.output(26,1) #if bit2 of 8bit 'pin' is false pull PIN26 high
    if(pin&0x08 == 0x08):
        IO.output(16,0)
    else:
        IO.output(16,1)
    if(pin&0x10 == 0x10):
        IO.output(19,0)
    else:
        IO.output(19,1)

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if(pin&0x20 == 0x20):
    IO.output(13,0)
else:
    IO.output(13,1)
if(pin&0x40 == 0x40):
    IO.output(6,0)
else:
    IO.output(6,1)
if(pin&0x80 == 0x80):
    IO.output(5,0)
else:
    IO.output(5,1)
def PORTP(pinp): #assigning GPIO logic for positive terminals by taking 'pinp' value
    if(pinp&0x01 == 0x01):
        IO.output(12,1) #if bit0 of 8bit 'pinp' is true pull PIN12 high
    else:
        IO.output(12,0) #if bit0 of 8bit 'pinp' is false pull PIN12 low
    if(pinp&0x02 == 0x02):
        IO.output(22,1) #if bit1 of 8bit 'pinp' is true pull PIN22 high
    else:
        IO.output(22,0) #if bit1 of 8bit 'pinp' is false pull PIN22 low
    if(pinp&0x04 == 0x04):
        IO.output(27,1) #if bit2 of 8bit 'pinp' is true pull PIN27 high
    else:
        IO.output(27,0) #if bit2 of 8bit 'pinp' is false pull PIN27 low
    if(pinp&0x08 == 0x08):
        IO.output(25,1)
    else:
        IO.output(25,0)
    if(pinp&0x10 == 0x10):
        IO.output(17,1)
    else:
        IO.output(17,0)
    if(pinp&0x20 == 0x20):
        IO.output(24,1)
    else:
        IO.output(24,0)
    if(pinp&0x40 == 0x40):
        IO.output(23,1)
    else:
        IO.output(23,0)
    if(pinp&0x80 == 0x80):
        IO.output(18,1) #if bit7 of 8bit 'pinp' is true pull PIN18 high
    else:
        IO.output(18,0) #if bit7 of 8bit 'pinp' is false pull PIN18 low
while 1:
    for y in range (100): #execute loop 100 times
        for x in range (8): #execute the loop 8 times incrementing x value from zero to seven

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```

pin = PORTVALUE[x] #assigning value to 'pin' for each digit
PORT(pin); #mapping appropriate GPIO
pinp= C[x] #assigning character 'C' value to 'pinp'
PORTP(pinp); #turning the GPIO to show character 'C'
time.sleep(0.0005) #wait for 0.5msec
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= I[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= R[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= C[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= U[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= I[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= T[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):

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```
for x in range (8):
    pin = PORTVALUE[x]
    PORT(pin);
    pinp= D[x]
    PORTP(pinp);
    time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= I[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= G[x]
        PORTP(pinp);
        time.sleep(0.0005)

for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= E[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= S[x]
        PORTP(pinp);
        time.sleep(0.0005)
for y in range (100):
    for x in range (8):
        pin = PORTVALUE[x]
        PORT(pin);
        pinp= T[x]
        PORTP(pinp);
        time.sleep(0.0005)
pinp= 0
PORTP(pinp);
time.sleep(1)
```