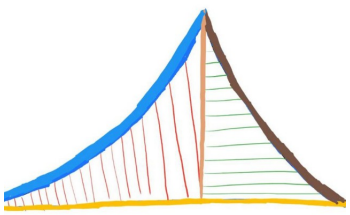
EMBEDDED SYSTEM

G. V. V. Sharma



Contents

Introduction

This book introduces Embedded Systems through using the Vaman framework.

Chapter 1

Vaman-ESP32

1.1. Measuring Unknown Resistance Using Vaman ESP

T:hrough this manual, we learn how to measure an unknown resistance through Vaman-ESP and display it on an LCD.

1.1.1. Components

Component	Value	Quantity
Resistor	220 Ohm	1
	1K	1
ESP32	Devkit V1	1
Jumper Wires		20
Bread board		1
LCD	16 X 2	1
Potentiometer	10K	1

Table 1.1.1: Components

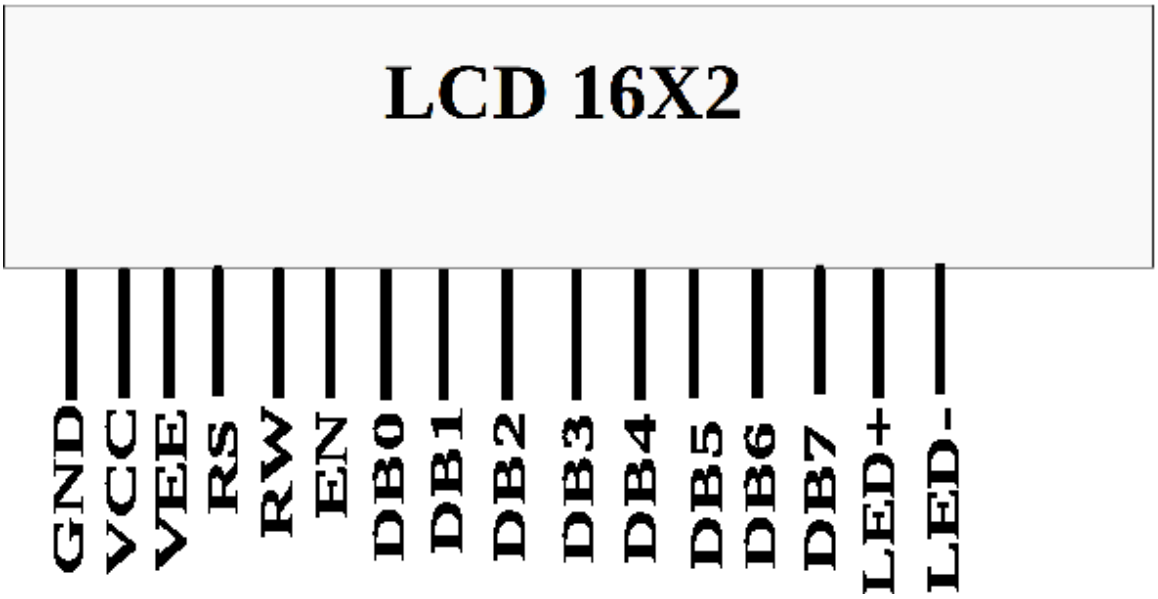


Figure 1.1.1.1: LCD pins

1.1.2. Setting up the Display

1.1.1. Plug the LCD in Fig. 1.1.1.1 to the breadboard.

1.1.2. Connect the Vaman-ESP pins to LCD pins as per Table 1.1.3.1. Make sure that all 5V sources are connected to the LCD through a 220 Ω resistance.

1.1.3. The Vaman pin diagram is available in Fig. 1.1.3.1

1.1.4. Execute the following code after editing the wifi credentials

```
vaman/vaman−esp/lcd/codes/setup
```

You should see the following message

```
Hi
This is CSP Lab
```

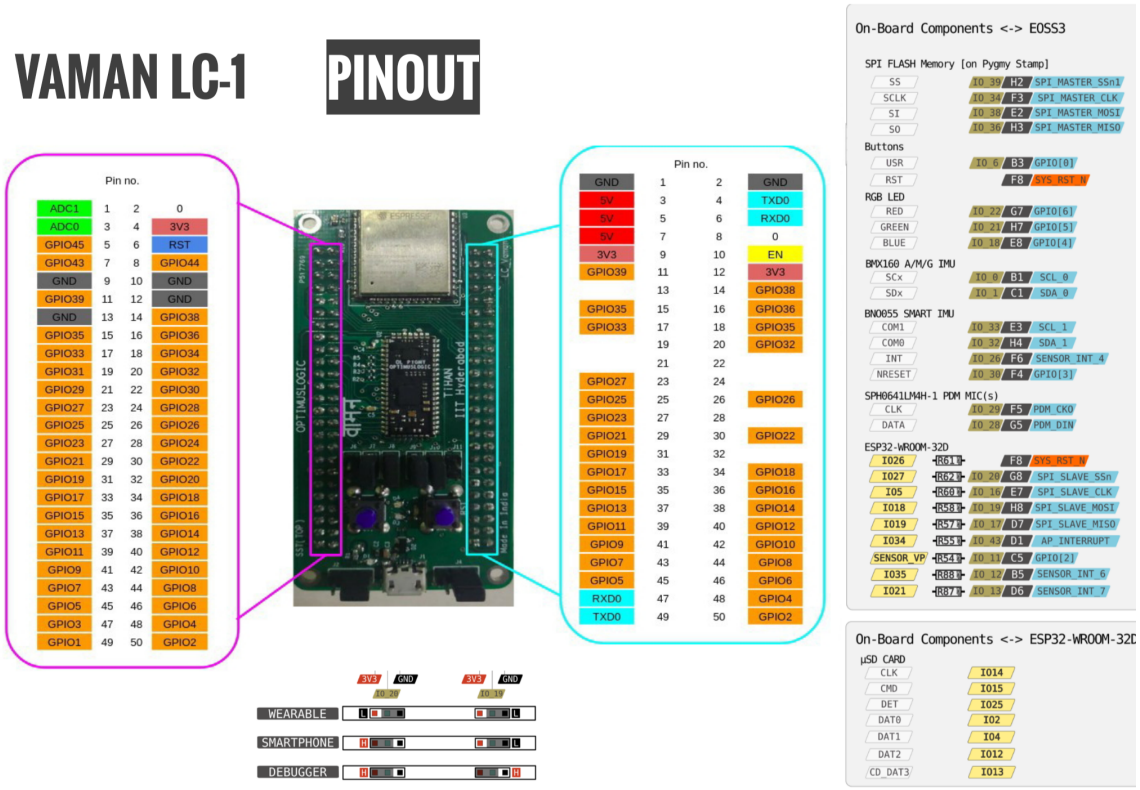


Figure 1.1.3.1: Vaman pins

ESP32	**LCD Pins**	**LCD Pin Label**	**LCD Pin Description**
GND	1	GND	
5V	2	Vcc	
GND	3	Vee	Contrast
GPIO 19	4	RS	Register Select
GND	5	R/W	Read/Write
GPIO 23	6	EN	Enable
GPIO 18	11	DB4	Serial Connection
GPIO 17	12	DB5	Serial Connection
GPIO 16	13	DB6	Serial Connection
GPIO 15	14	DB7	Serial Connection
5V	15	LED+	Backlight
GND	16	LED-	Backlight

Table 1.1.3.1: Make sure that all 5V sources are connected to the LCD through a 220 Ω resistance.

1.1.5. Modify the above code to display your name.

1.1.3. Measuring the resistance

1.1.1. Connect the 5V pin of the Vaman-ESP to an extreme pin of the Breadboard shown in Fig. 1.1.1.1. Let this pin be V_{cc}.

1.1.2. Connect the GND pin of the Vaman-ESP to the opposite extreme pin of the Breadboard.

1.1.3. Let R_1 be the known resistor and R_2 be the unknown resistor. Connect R_1 and R_2

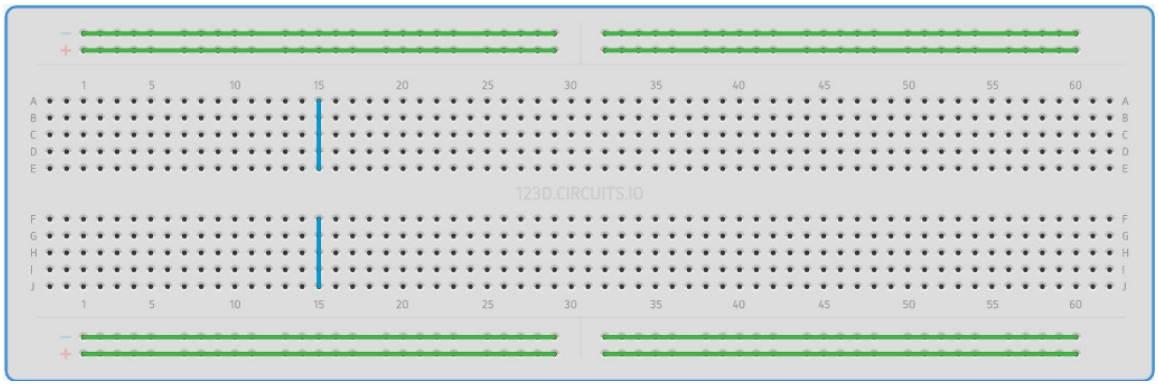


Figure 1.1.1.1: Breadboard

in series such that R_1 is connected to V_{cc} and R_2 is connected to GND. Refer to Fig. 1.1.3.1

1.1.4. Connect the junction between the two resistors to the GPIO34 pin on the Vaman-ESP.

1.1.5. Connect the Vaman-ESP to the computer so that it is powered.

1.1.6. Execute the following code after editing the wifi credentials

vaman/vaman−esp/lcd/codes/resistance

1.1.4. Explanation

1.1.1. We create a variable called analogPin and assign it to 0. This is because the voltage value we are going to read is connected to analogPin GPIO34.

1.1.2. The 12-bit ADC can differentiate 4096 discrete voltage levels, 5 volt is applied to 2 resistors and the voltage sample is taken in between the resistors. The value which we get from analogPin can be between 0 and 4095. 0 would represent 0 volts falls across

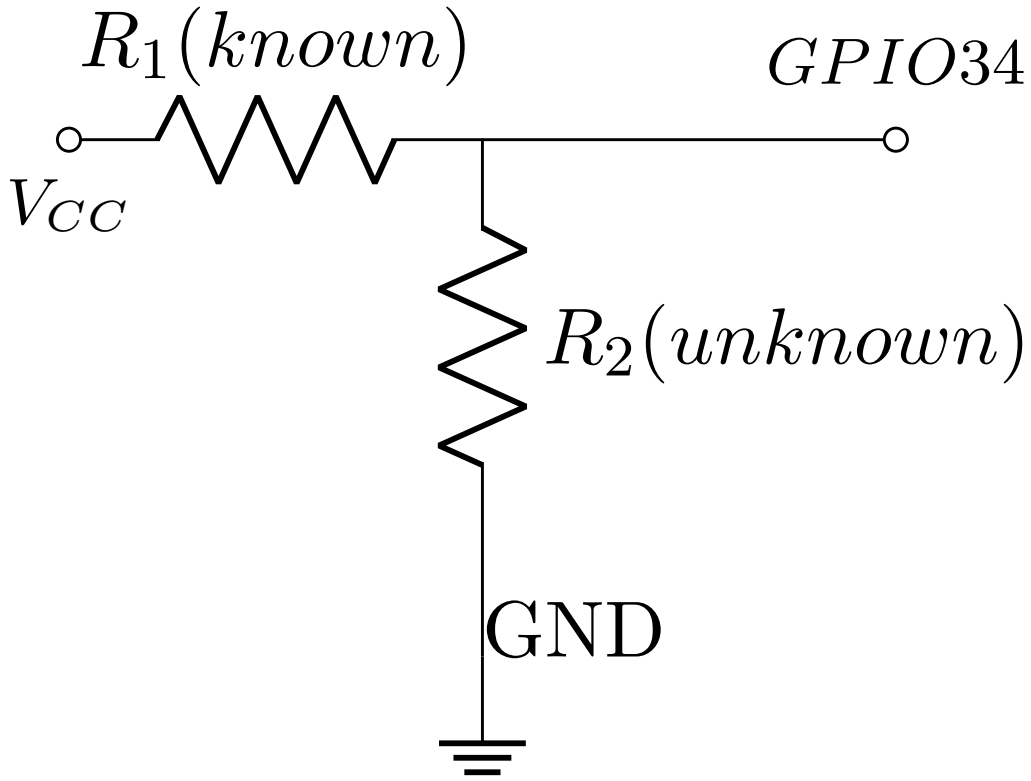


Figure 1.1.3.1: Voltage Divider

the unknown resistor. A value of 4095 would mean that practically all 5 volts falls across the unknown resistor.

1.1.3. V_{out} represents the divided voltage that falls across the unknown resistor.

1.1.4. The Ohm meter in this manual works on the principle of the voltage divider shown in Fig. 1.1.3.1.

$$V_{out} = \frac{R_1}{R_1 + R_2} V_{in} \tag{1.1.4.1}$$

$$\Rightarrow R_2 = R_1 \left(\frac{V_{in}}{V_{out}} - 1 \right) \tag{1.1.4.2}$$

In the above, $V_{in} = 5\text{V}$, $R_1 = 220\Omega$.

1.1.5. Repeat the exercise with another unknown resistance.

1.2. Ohm meter using Vaman-ESP Web Server

T:hrough this manual, we learn how to measure an unknown resistance through Vaman-ESP and monitoring Unknown resistance through Vaman-ESP webserver.

1.2.1. Components

1.2.2. Measuring the resistance

1.2.1. Connect the 5V pin of the Vaman-ESP to an extreme pin of the Breadboard shown in Fig. 1.1.1.1. Let this pin be V_{cc}.

1.2.2. Connect the GND pin of the Vaman-ESP to the opposite extreme pin of the Bread-

Component	Value	Quantity
Resistor	220 Ohm	1
	1K	1
Vaman	LC	1
Jumper Wires		5
Bread board		1

Table 1.2.1: Components

board.

1.2.3. Let R_1 be the known resistor and R_2 be the unknown resistor. Connect R_1 and R_2 in series such that R_1 is connected to V_{cc} and R_2 is connected to GND. Refer to Fig. 1.1.3.1

1.2.4. Connect the junction between the two resistors to the GPIO34 pin on the vaman-ESP.

1.2.5. Connect the vaman-ESP to the computer so that it is powered.

1.2.6. Execute the following code after editing the wifi credentials

```
vaman/vaman−esp/webserver/codes
```

1.2.7. After flashing the code to vaman-ESP, the board will be connected to the wifi credentials provided.

1.2.8. Now connect the same WiFi credentials to the laptop for accessing the IP address, which can be accessed by

```
ifconfig
nmap −sn 192.168.x.x/24
```

1.2.9. Change the IP address in the second command accordingly with the IP address provided by first command.

1.2.10. By the above commands the IP address of vaman-ESP will be diplayed.

1.2.11. Now the vaman-ESP will be hosting a webserver

1.2.12. Inorder to access the webserver type the IP address of the vaman-ESP in the web browser.

1.2.13. In the website loaded by the IP address of vaman-ESP the Unknown resitance is displayed as shown in Fig. 1.2.13.1

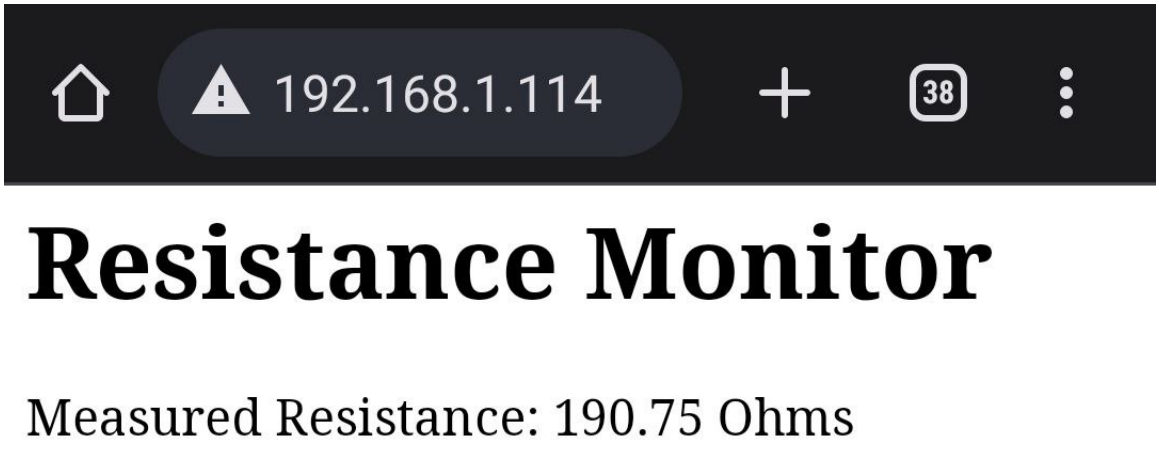


Figure 1.2.13.1: Website

1.2.14. Repeat the exercise with another unknown resistance.

1.3. I2C Communication Between Vaman-ESP and Arduino

T:hrough this manual, we will learn how to setting up the vaman-ESP as a Master and Arduino as a Slave using I2C protocol.

1.3.1. Components

Component	Value	Quantity
ESP32	Devkit V1	1
Arduino	UNO	1
Connecting Wires		30
LCD	16 X 2	1

Table 1.3.1:

1.3.2. Setting up the Master and Slave

1.3.1. Connect the vaman-ESP pins to Arduino pins as per Table 1.3.1.1.

I2C	ESP32	Arduino
SDA	GPIO 21	A4
SDC	GPIO 22	A5
	VCC	VCC
	GND	GND

Table 1.3.1.1:

1.3.2. Connect the vaman-ESP pins to LCD pins as per Table 1.3.2.1.

1.3.3. The Vaman pin diagram is available in Fig. 1.1.3.1

ESP32	**LCD Pins**	**LCD Pin Label**	**LCD Pin Description**
GND	1	GND	
5V	2	Vcc	
GND	3	Vee	Contrast
GPIO 19	4	RS	Register Select
GND	5	R/W	Read/Write
GPIO 23	6	EN	Enable
GPIO 18	11	DB4	Serial Connection
GPIO 17	12	DB5	Serial Connection
GPIO 16	13	DB6	Serial Connection
GPIO 15	14	DB7	Serial Connection
5V	15	LED+	Backlight
GND	16	LED-	Backlight

Table 1.3.2.1:

1.3.4. Configure Arduino Uno as a Slave using the following code.

vaman/vaman−esp/I2C/codes/I2C_Sender_Arduino/src/main.cpp

1.3.5. Now configure vaman-ESP as a Master using the following code.

vaman/vaman−esp/I2C/codes/I2C_Reciever_ESP32/src/main.cpp