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DesignNews

Getting Hands-On With the M5Stack Core Platform

DAY 4: Exploring M5Stack Core Wi-Fi Applications

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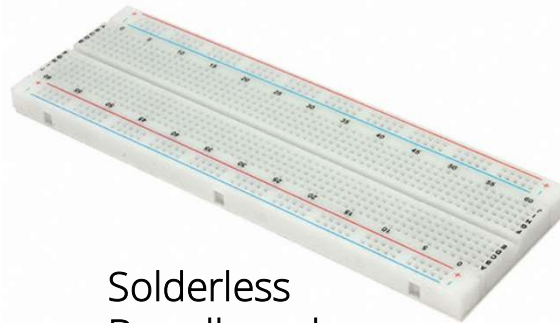
Dr. Don Wilcher

Visit 'Lecturer Profile' in your console for more details.

Course Kit and Materials

M5Go IoT Starter Kit V2.6
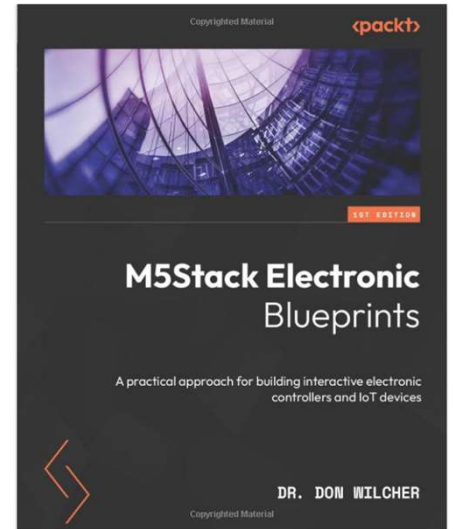
Solderless Breadboard

2 Channel SPST Relay Unit

Adafruit Parts Pal Kit

M5Stack Electronic Blueprints

A practical approach for building interactive electronic controllers and IoT devices

DR. DON WILCHER

Agenda:

- Seminal Research Perspective on Communication Systems
- ESP32 with Wi-Fi Introduction
- M5Stack Core Wi-Fi Setup
- Build a basic M5Stack Core Wi-Fi scanner
- Creating M5Stack access point and web server

M5Stack Core UIs

"An important note in designing and developing M5Stack Core UIs is simplicity. Simplicity is the design consideration consisting of using the important UI elements for communicating features and functions of your M5Stack Core device. (Wilcher, 2023, p. 24)."

A Seminal Research Perspective on Communication Systems. . .

- According to Shannon (1948), the Father of Information Theory, a Communication System has five components.
    - a) information source: The device that produces the message or data to be communicated.
    - b) transmitter: The device that sends the message or data to a receiving point for processing.
    - c) channel: The medium that carriers the message or data to a receiving point for processing.
    - d) receiver: The device that processes the message or data sent through a channel.
    - e) destination: The person or thing for whom the message is intended.

Shannon, C.E. (1948). A mathematical theory of communication. *The Bell System Technical Journal, 27,* 379- 656.

A Seminal Research Perspective on Communication Systems. . .

INFORMATION SOURCE   TRANSMITTER   RECEIVER   DESTINATION

SIGNAL   RECEIVED SIGNAL

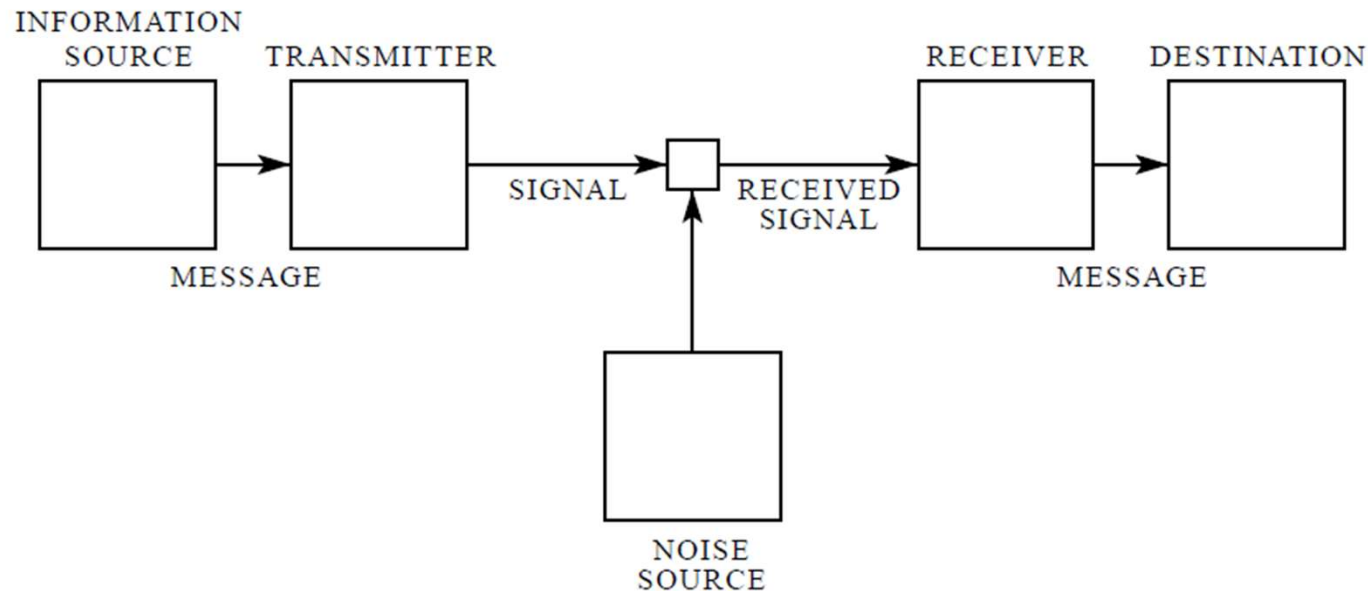MESSAGE   MESSAGE

NOISE SOURCE

Fig. 1—Schematic diagram of a general communication system.

Shannon, C.E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, *27*, 379- 656.

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The Shannon's(1948) equation has been transformed into a modern equation.

Equation to calculate the number of bits in a digital systems

$$\text{Binary Coding}: \quad n = \log_2 M, \; M = \text{combinations}$$

Example: Determine the number of bits for Hexadecimal.

Solution: $\quad n = \log_2(16)$

$$= \log_{10}(16) / \log_{10}(2)$$

$$= 4 \text{ bits}$$

Shannon, C.E. (1948). A mathematical theory of communication. *The Bell System Technical Journal, 27,* 379- 656.

Question 1

Using slide 9, determine the number of bits required to manage Octal data within a Programmable Logic Controller (PLC)?
  a)4
  b)5
  c)3
  d)none of the above

ESP32 with Wi-Fi Introduction

- The M5Stack Core ESP32 microcontroller has two subsystems for its Wi-Fi system architecture.
  - a) Wi-Fi Media Access Control (MAC)
  - b) Baseband
- The Wi-Fi MAC address assigned to the network interface controller (NIC) using a unique identifier.
- The NIC allows the user to address the network used in the Wi-Fi based communication system.

Wilcher, D. (2023, p. 228). *M5Stack Electronic Blueprints*. Packt.

ESP32 with Wi-Fi Introduction. . .
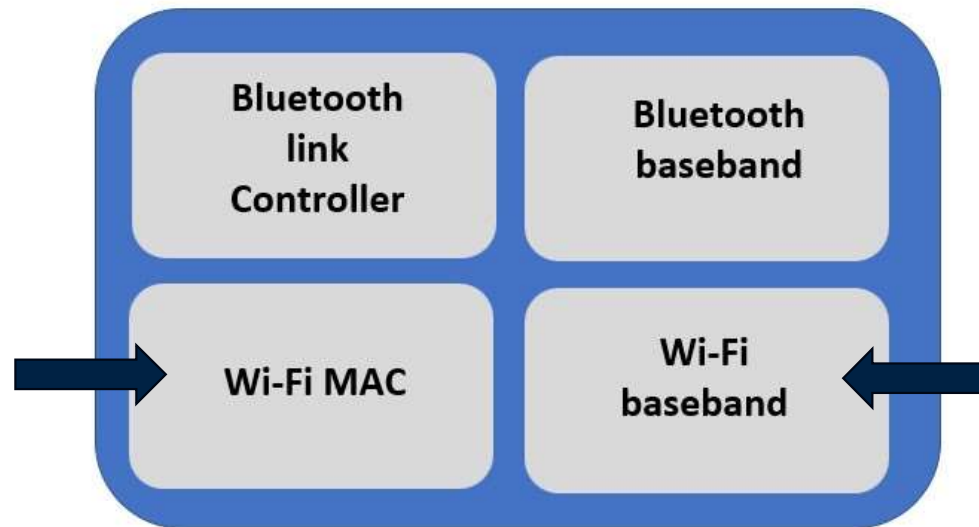
M5Stack Core MAC address

```
Chip is ESP32D0WDQ6 (revision 1)
Features: WiFi, BT, Dual Core, 240MHz, VRef calibration in efuse
MAC: b8:f0:09:c6:16:c4
```

Image courtesy of M5Stack

Wilcher, D. (2023, p. 229). *M5Stack Electronic Blueprints*. Packt.

ESP32 with Wi-Fi Introduction. . .

A unique identifier that is assigned to a NIC

Modulating signal or intelligence sent through a single channel

ESP32 Communication System Block Diagram

Image courtesy of the author

Wilcher, D. (2023, p. 229). *M5Stack Electronic Blueprints*. Packt.

Question 2

The NIC allows the user to address the network used in the Bluetooth baseband.
   a)True
   b)False

ESP32 with Wi-Fi Introduction: Baseband Communications

- The Wi-Fi baseband in a communication system is:
    - a) the modulating signal or intelligence
    - b) a single channel
- The intelligence or digital data stream is sent through as the information through a single channel media.
- The Wi-Fi baseband communication uses bidirectional communication-information.
    - a) transmitted through the single channel media
    - b) use to send and receive digital data
- The ESP32 Wi-Fi subsystem implements the transmission control protocol/internet protocol (TCP/IP)
- The full 802.11 b/g/n Wi-Fi MAC is descriptive of TCP/IP.

Wilcher, D. (2023, p. 229). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core Wi-Fi Setup

The follow steps will walk through on how to setup Wi-Fi on the M5Stack Core.

- Obtain the M5Stack Core libraries from the following website: https://docs.m5stack.com/en/quick_start/m5core/arduino
- Follow the instructions on the website to setup the Arduino IDE environment for installing the M5Stack Core libraries. Include the M5Stack Core 2 libraries as well.
- After the installation of the libraries are complete, you will see example projects. See the next slide.

Wilcher, D. (2023, p. 230). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core Wi-Fi Setup. . .

A wireless signal approach
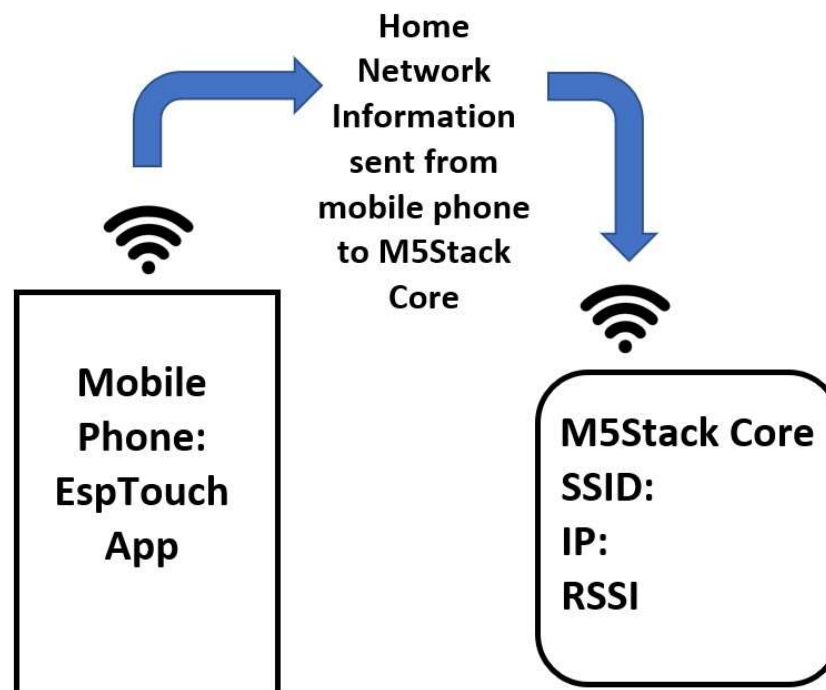
Home Network Information sent from mobile phone to M5Stack Core

Mobile Phone: EspTouch App

M5Stack Core SSID: IP: RSSI
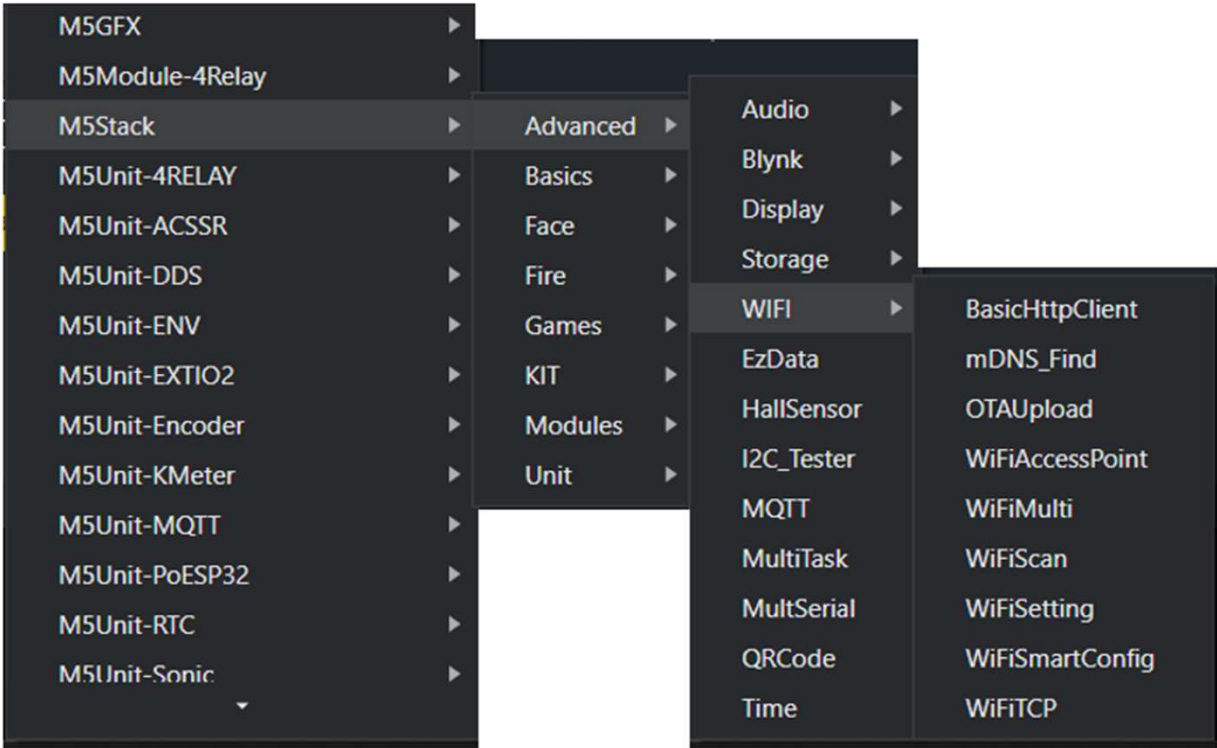
Image courtesy of the author

Wilcher, D. (2023, p. 234). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core Wi-Fi Setup. . .

Image courtesy of the author

Wilcher, D. (2023, p. 230). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core Wi-Fi Setup. . .

With the projects installed from the library, you will install the Esptouch from Espressif on a mobile device.
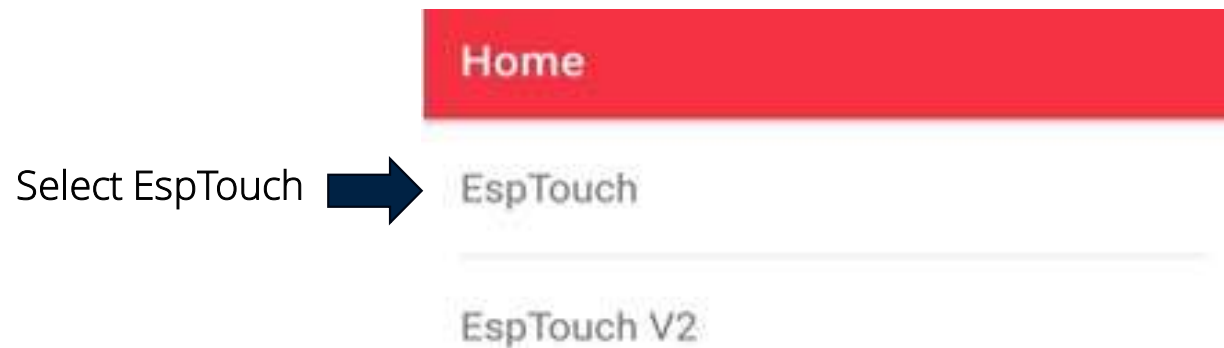
Select EspTouch ➡️

Home
EspTouch
EspTouch V2

Image courtesy of Espressif

Wilcher, D. (2023, p. 234). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core Wi-Fi Setup. . .

Enter your Wi-Fi SSID and Password

Tap here and enter 1 into the box and check the checkbox on your mobile device view

Image courtesy of Espressif

Wilcher, D. (2023, p. 235). *M5Stack Electronic Blueprints*. Packt.

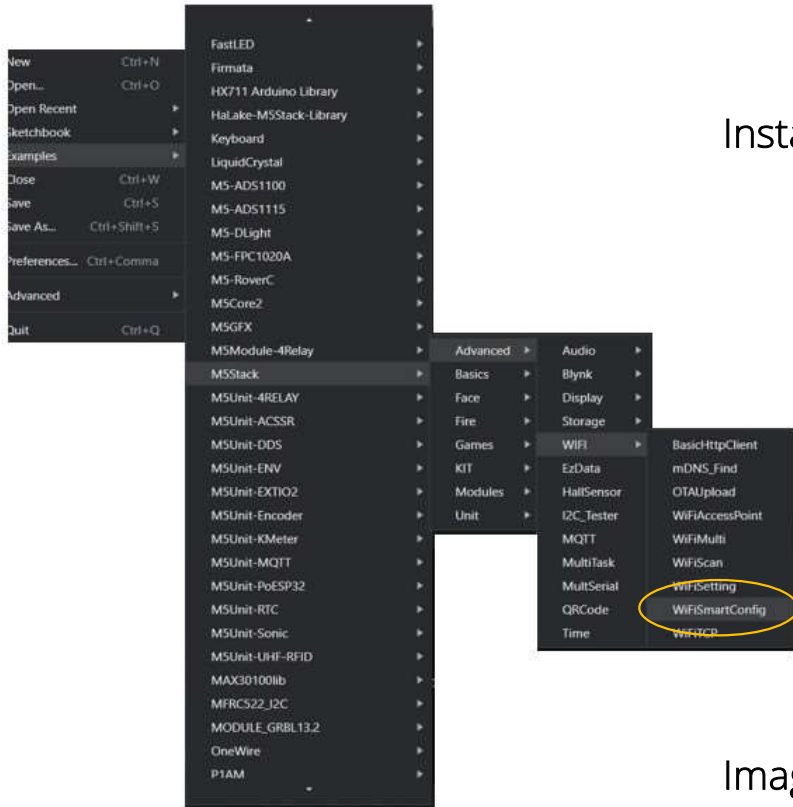# Question 3

What integer value is used within the Device Count textbox to allow mobile device connectivity?
  a)2
  b)3
  c)1
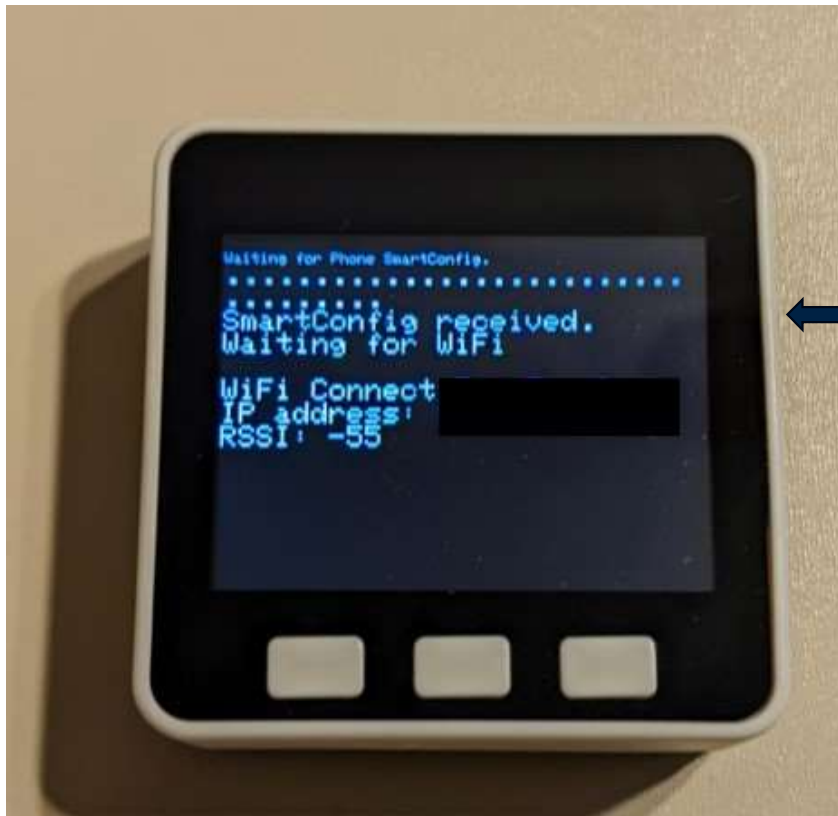 d)none of the above

M5Stack Core Wi-Fi Setup. . .

Installing (WiFiSmartConfig) to M5Stack Core

Open the example code
(WiFiSmartConfig) and upload to
the M5Stack Core

Image courtesy of the author

Wilcher, D. (2023, p. 236). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core Wi-Fi Setup. . .

A low fidelity Wi-Fi scanner

After installing (uploading) the WiFiSmartConfig code to the M5Stack Core, your WiFi Network IP address will appear on the TFT LCD.

Image courtesy of the author

Wilcher, D. (2023, p. 238). *M5Stack Electronic Blueprints*. Packt.

Building a Wi-Fi M5Stack Core Scanner

Another version of a Wi-Fi scanner can be evaluated using a firmware burner.

a) requires the M5Stack firmware - **M5Burner software**
b) firmware can be obtained from the following URL link:
   https://docs.m5stack.com/en/download
c) The M5Burner software is available for the following operating systems
   i. Windows
   ii. macOS
   iii. Linux

Wilcher, D. (2023, p. 241). *M5Stack Electronic Blueprints*. Packt.

Building a Wi-Fi M5Stack Core Scanner. . .

| UIFLOW FIRMWARE BURNING TOOL

NO	Name	Download
1	M5Burner Win10 x64 v3.0	⬇
2	M5Burner MacOS x64 v3.0	⬇
3	M5Burner Linux x64 v3.0	⬇

Download and install the UIFlow Firmware Burning Tool to your laptop or desktop personal computer.

Image courtesy of M5Stack

Wilcher, D. (2023, p. 241). *M5Stack Electronic Blueprints*. Packt.

Building a Wi-Fi M5Stack Core Scanner. . .

Attach the M5Stack Core and install the latest version of the UIFlow Firmware.

The UIFlow Core Firmware Splash screen

Image courtesy of M5Stack

Wilcher, D. (2023, p. 241). *M5Stack Electronic Blueprints*. Packt.

Building a Wi-Fi M5Stack Core Scanner. . .

To obtain the Wi-Fi scanner application, press Button A (^) to view the list of Micropython applications

With Button C (v), scroll to the wifi_scanner.py app. Press Button B on the M5Stack Core to select the app.

Images courtesy of the author

Wilcher, D. (2023, p. 243). *M5Stack Electronic Blueprints*. Packt.

Creating M5Stack Access and Web Server Point

Conceptual Diagram

Image courtesy of the author

Wilcher, D. (2023, p. 250. *M5Stack Electronic Blueprints*. Packt.
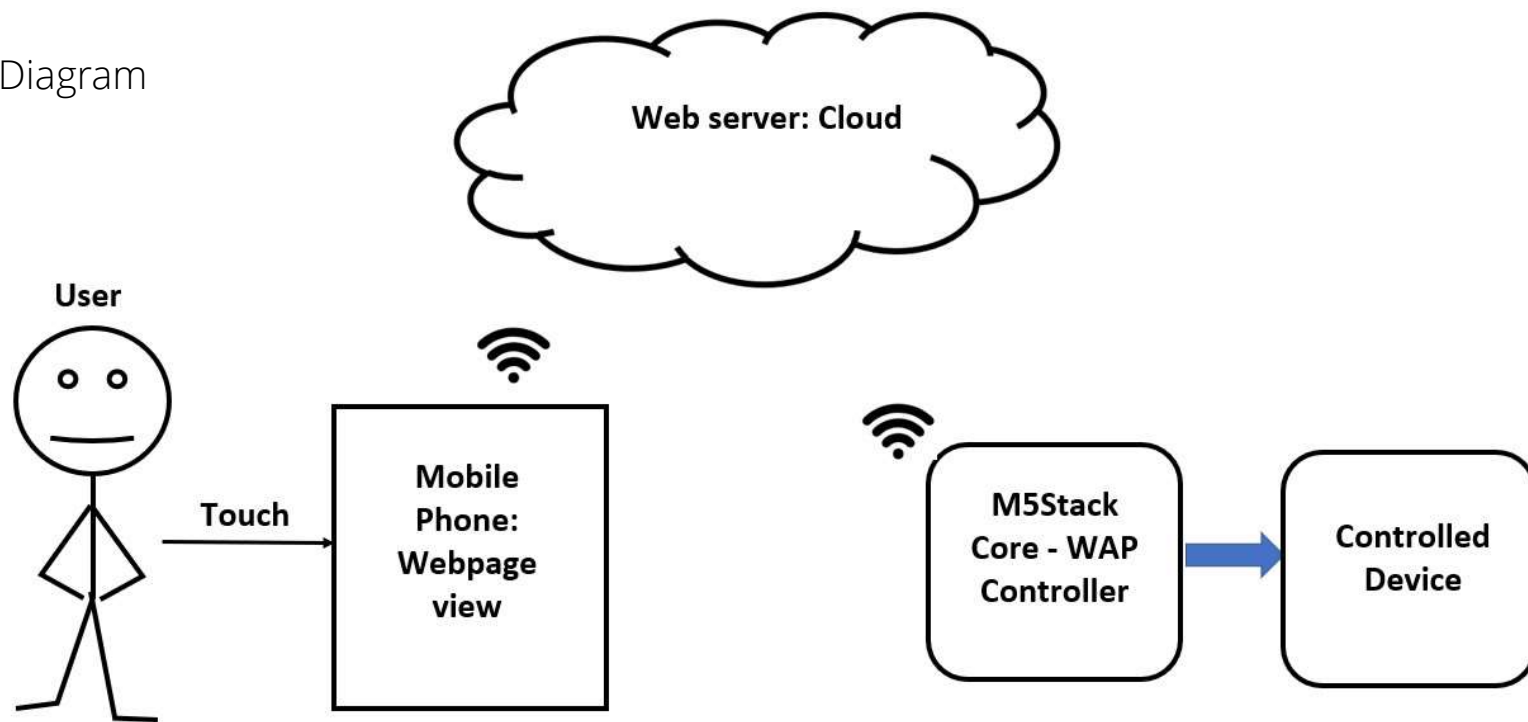
Creating M5Stack Access Point and Web Server. . .

Conceptual Diagram

Web server: Cloud

User

Touch

Mobile Phone: Webpage view

M5Stack Core - WAP Controller

G26

GND

R1 220Ω

LED1
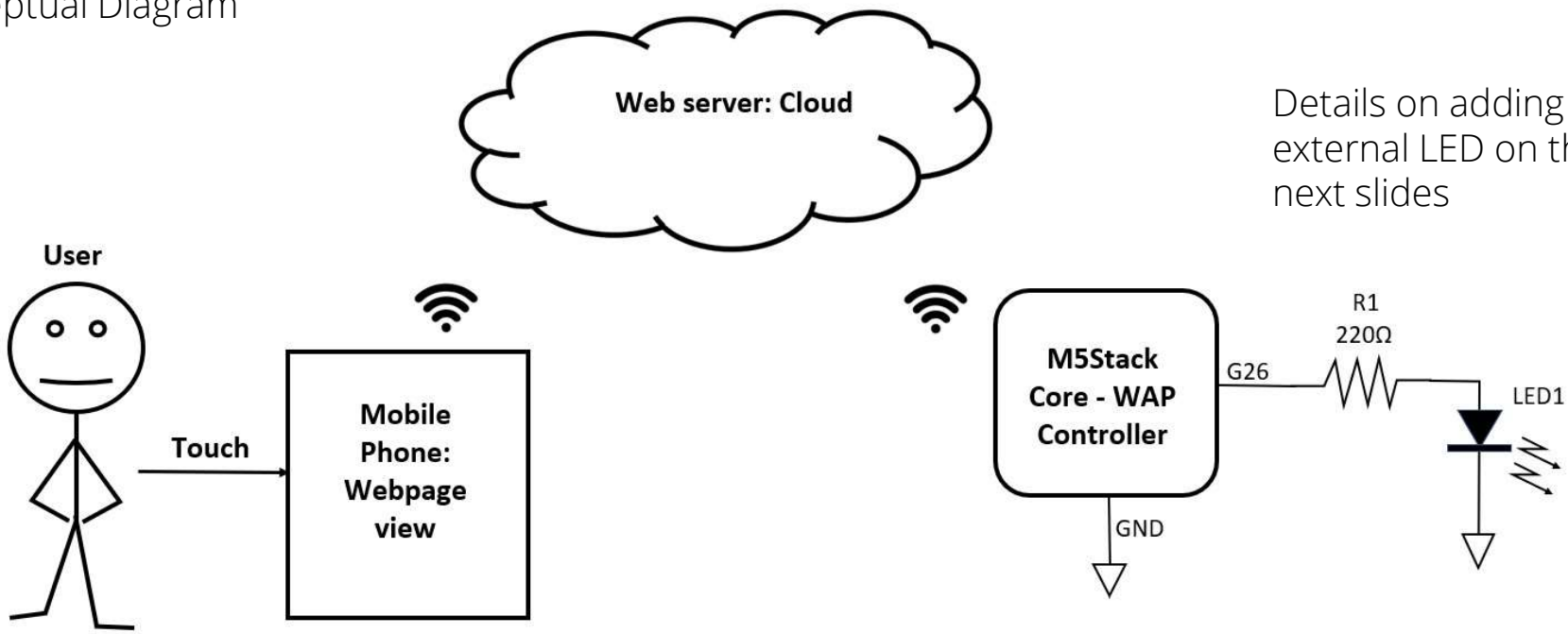
Details on adding an external LED on the next slides

Image courtesy of the author

Wilcher, D. (2023, p. 250). *M5Stack Electronic Blueprints*. Packt.
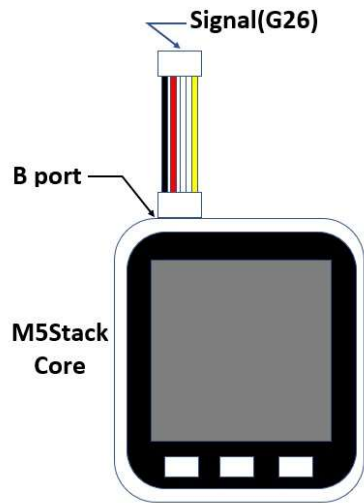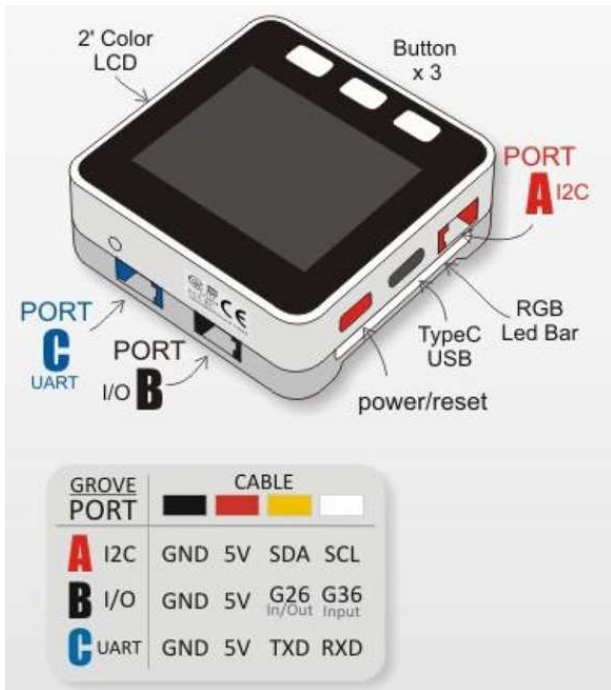
Creating M5Stack Access Point and Web Server
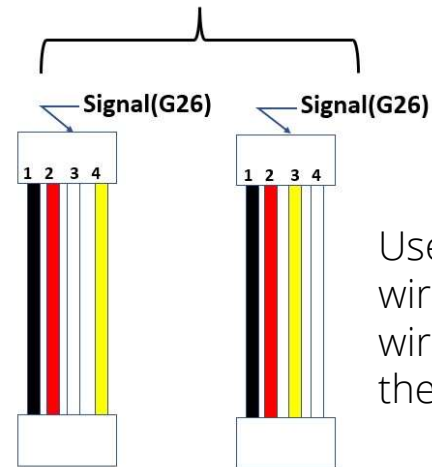
Use one of these wiring harnesses to wire the LED circuit to the B-port.

Image courtesy of the author

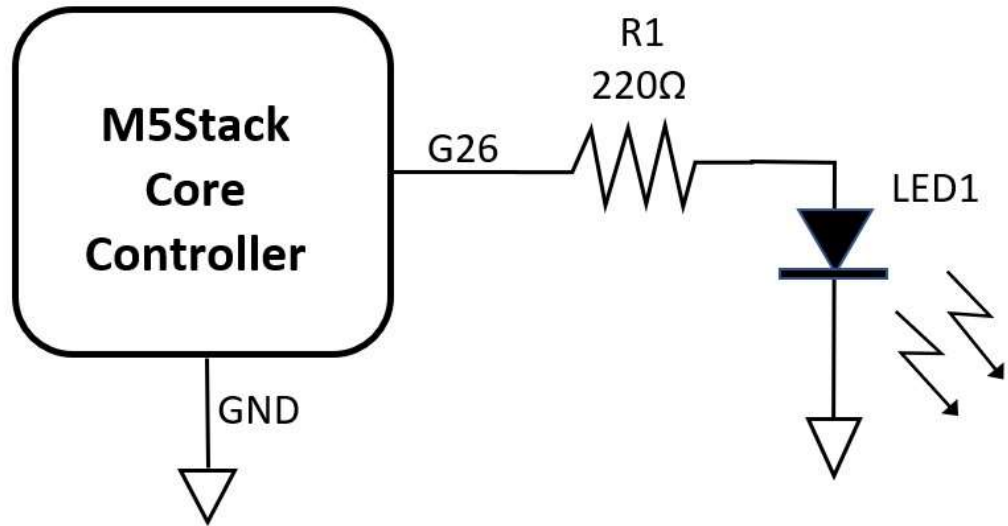Wilcher, D. (2023, p. 250). *M5Stack Electronic Blueprints*. Packt.

Creating M5Stack Access Point and Web Server...

Electronic schematic for the LED diagram
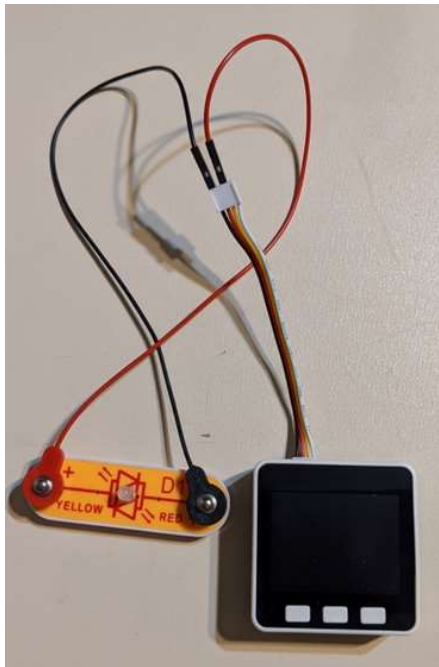
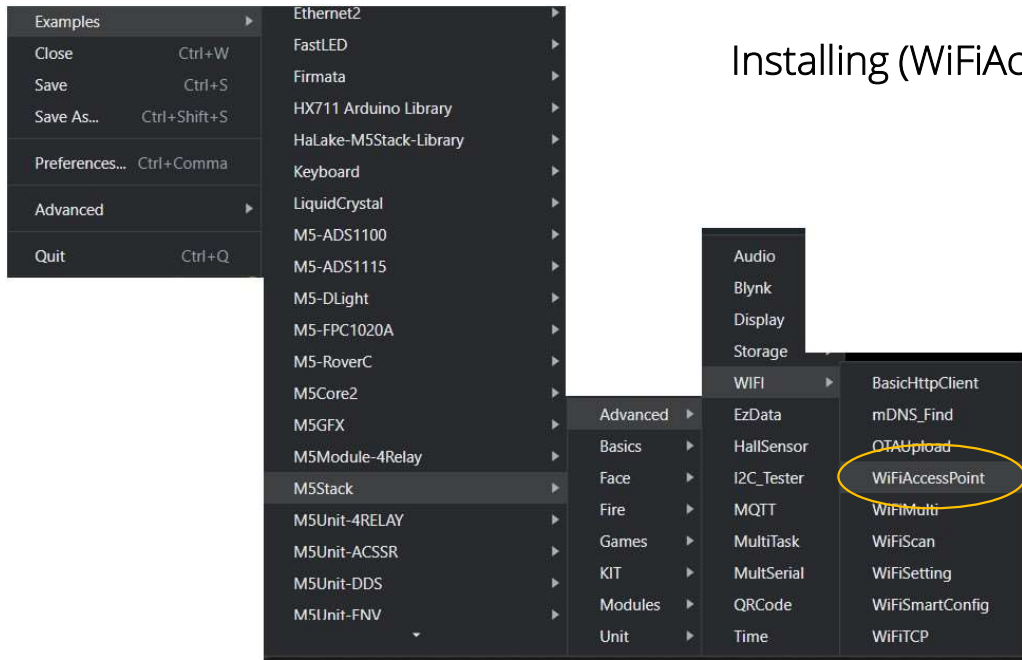Adding a LED to the M5Stack Core

Images courtesy of the author

Wilcher, D. (2023, p. 250). *M5Stack Electronic Blueprints*. Packt.

Question 4

In Creating a M5Stack Access Point and Webserver devices, what port is used to provide a Control Signal (G26) for wireless operation?
  a) D port
  b) C port
  c) A port
  d) none of the above

Creating M5Stack Access Point and Web Server...

Installing (WiFiAccessPoint) to M5Stack Core

Open the example code (WiFiAccessPoint) and upload it to the M5Stack Core

Image courtesy of the author

Wilcher, D. (2023, p. 250). *M5Stack Electronic Blueprints*. Packt.

Creating M5Stack Access Point and Web Server. . .

Adding the Wi-Fi network login credentials

```
22      // Set these to your desired credentials.
23      const char *ssid     = "";
24      const char *password = "";
```

Image courtesy of the author

Wilcher, D. (2023, p. 254). *M5Stack Electronic Blueprints*. Packt.

Creating M5Stack Access Point and Web Server. . .

WiFiAccessPoint code uploaded to the M5Stack Core

```
Output

Writing at 0x000d2753... (100 %)
Wrote 816992 bytes (521787 compressed) at 0x00010000 in 7.4 seconds (effective 881.4 kbit/s)...
Hash of data verified.

Leaving...
Hard resetting via RTS pin...
```
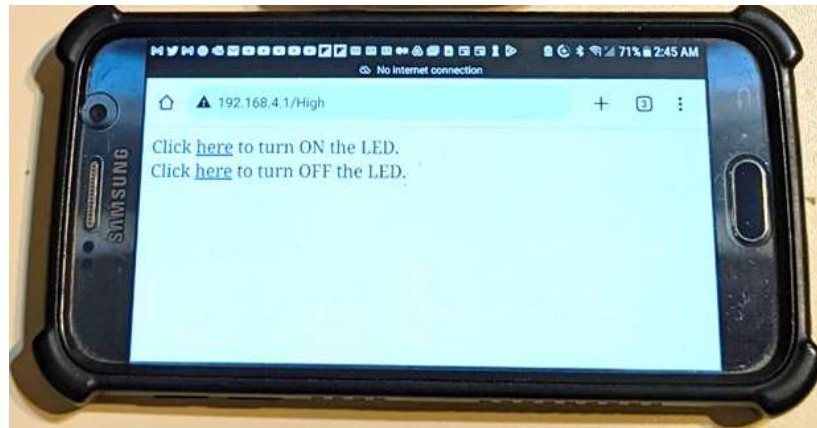
Image courtesy of the author

Wilcher, D. (2023, p. 255). *M5Stack Electronic Blueprints*. Packt.

Creating M5Stack Access Pointe and Web Server. . .

WiFi Access Point

Web Server-Controller

Images courtesy of the author

Wilcher, D. (2023, pp. 255 - 257). *M5Stack Electronic Blueprints*. Packt.

Web Server-Controller
in operation

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Question 5

What example is M5Stack Code app used to create an M5Stack Core Wireless Access point?
  a)WiFiScan
  b)WiFiSetting
  c)WiFiSmartConfig
  d)none of the above

Thank you for attending

Please consider the resources below:

Bellucci, A., Aedo, I., & Diaz, P. (2017). ECCE toolkit: Prototyping ping sensor-based interaction. *Sensors, 17(3), 438.* https://doi.org/10.3390/s17030438

Bonfiglio, A., & DeRossi, D. (Eds.). (2011). Wearable monitoring systems. Springer. https://link.springer.com/book/10.1007/978-1-4419-7384-9

· Shannon, C.E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, *27*, 379- 656. https://people.math.harvard.edu/~ctm/home/text/others/shannon/entropy/entropy.pdf

Wilcher, D. (2023). M5Stack electronic blueprints. Packt.

M5Stack Electronic Blueprints Code:

https://github.com/PacktPublishing/M5Stack-Electronic-Blueprints

Thank You