CEC Continuing Education Center

DesignNews

Prototyping and Programming ESP32 Wearable Devices

DAY 5 : Wearable Bluetooth Controller

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Dr. Don Wilcher

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Course Kits

Starter Kit M5GO IoT V2.6

Core2 ESP32 For AWS IoT EDUKIT

Agenda:

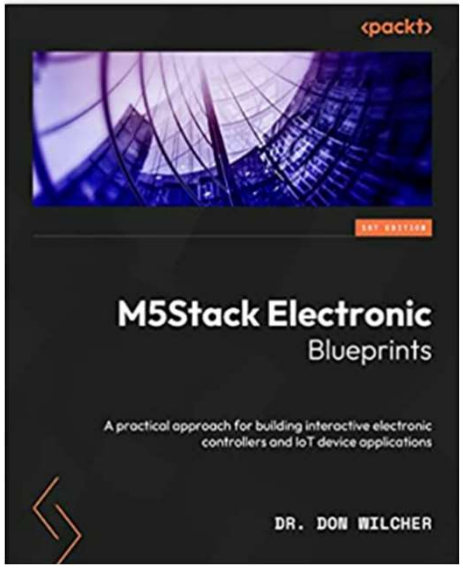
- ESP32 Microcontroller Bluetooth Chipset
- UiFlow BLE Coding Blocks Pallet Overview
- M5Stack Core 2 BLE and the Nordic Semiconductor nrF Toolbox
- Lab: Building a Wearable M5Stack BLE receiver-controller

Wearable Technologies :

"Progress in wearable technologies for monitoring is driven by the same factors that were behind the transition from desktop computing and communication tools to portable devices providing processing and ubiquitous connectivity, namely changes in social and economical factors" (Bonfiglio & De Rossi, 2011).

Wearable Audible/Alert Devices Demonstrators

The following information is from the forth coming book title:



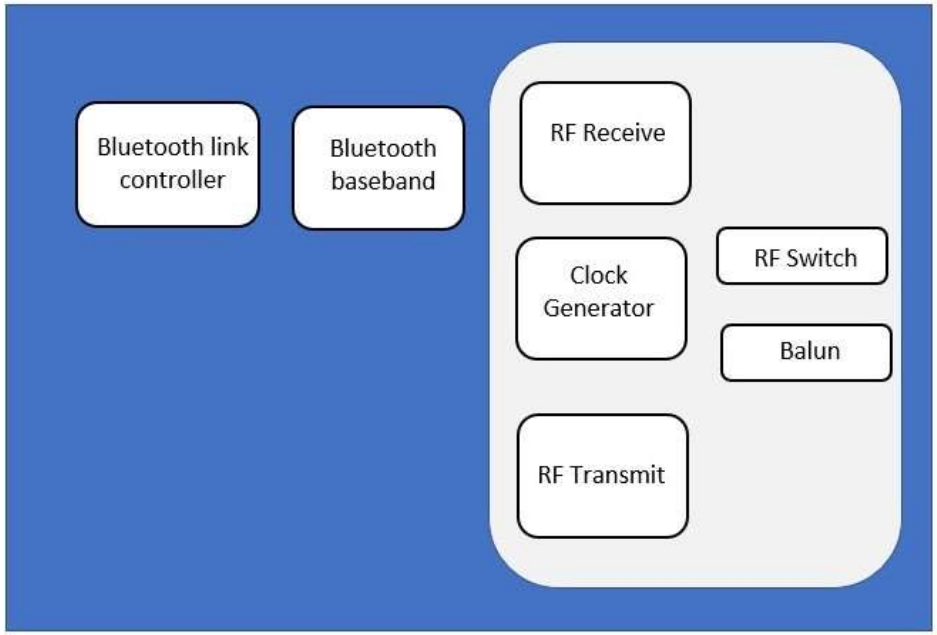
https://www.amazon.com/M5Stack-Electronic-Blueprints-interactive-applications/dp/1803230304/ref=sr_1_1?crid=OVYB3O0IQ5OU&keywords=dr.+don+wilcher&qid=1667169860&sprefix=%2Caps%2C191&sr=8-1

ESP32 Microcontroller Bluetooth Chipset

- The M5Stack Core 2 uses an ESP32-DOWDQ6-V3 microcontroller incorporating a 240MHz, dual-core microprocessor.
- A dual-core microprocessor provides efficiency in computation and managing input and output (I/O) operations of the microchip using two central processing units (CPUs).
- This family of ESP32 microcontrollers, the chip has a Bluetooth chipset consisting of a link controller and baseband.
- The Bluetooth link controller handles the physical layer packets and all communication timing.
- The link controller implements the link, the low-level real-time_protocol that operates Bluetooth communications.

ESP32 Microcontroller Bluetooth Chipset. . .

ESP32 Bluetooth Chipset Architecture



Question 1

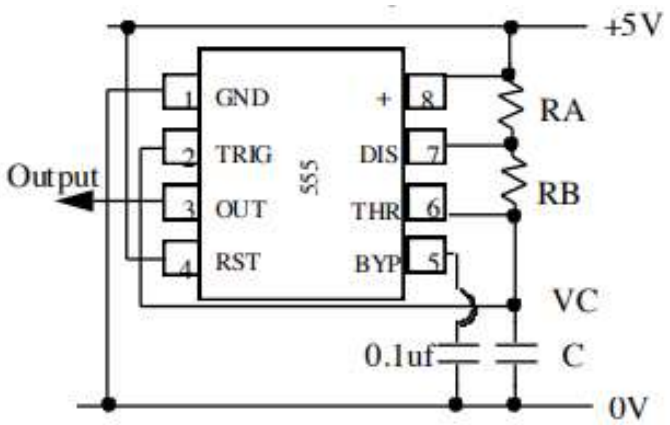
What type of microcontroller is used by the M5Stack Core 2?

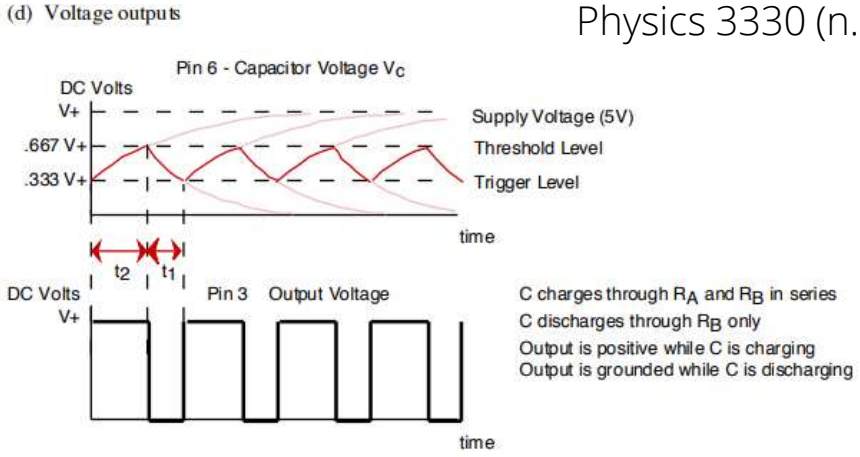
a) ESP32-DOWD06-V1
b) ESP32-S3-DOWD06-V2
c) ESP32-DOWD06-V2
d) none of the above

ESP32 Microcontroller Bluetooth Chipset. . .

ESP32 Bluetooth Chipset Parts Description

- The **clock generator** within the Bluetooth chipset architecture is
  a) an electronic oscillator
  b) produces a repetitive signal for synchronizing the Bluetooth link controller with the baseband





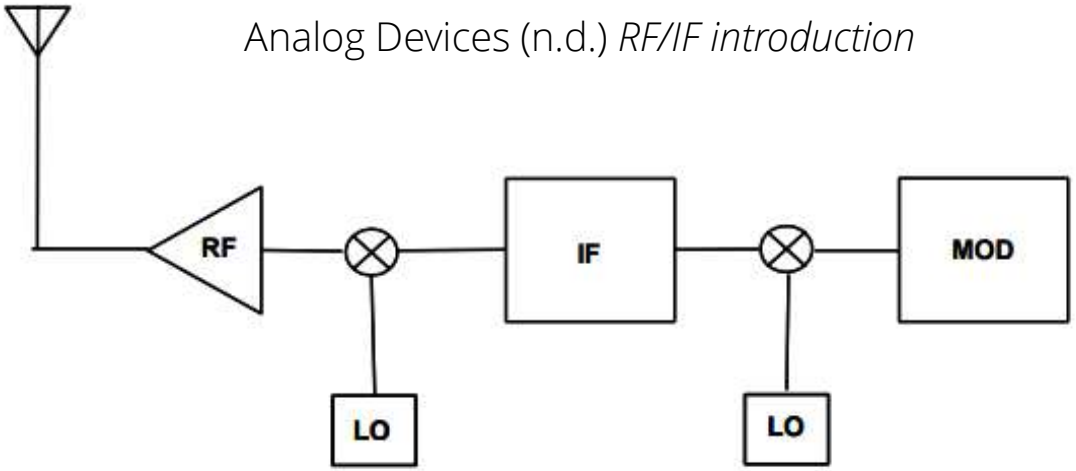
Physics 3330 (n.d.) *Lab9*

ESP32 Microcontroller Bluetooth Chipset. . .

ESP32 Bluetooth Chipset Parts Description

- The **RF transmit circuit** block allows sending a
  a) modulated signal with the appropriate carrier wave
  b) intelligence data to a designated or paired receiver

Analog Devices (n.d.) *RF/IF introduction*



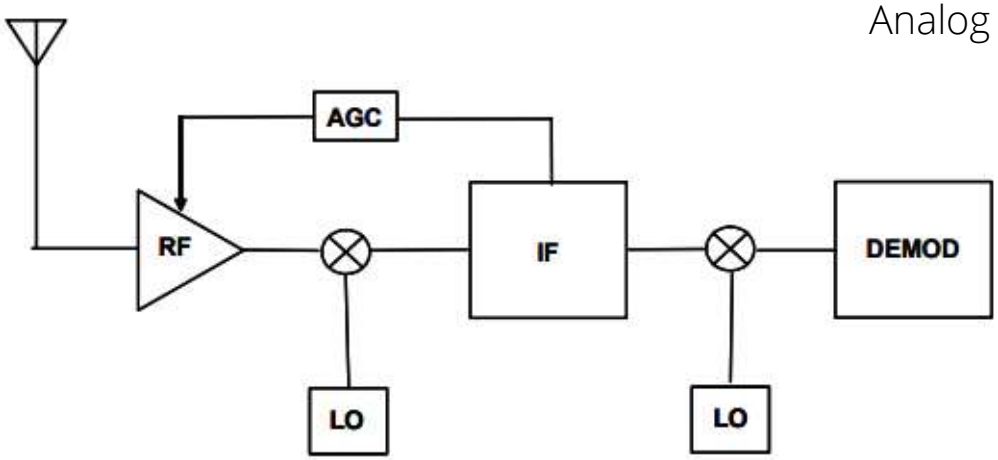
Note:
Intermediate frequency (**IF**) is a frequency to which a carrier wave is shifted as an intermediate step in transmission or reception.[1] The intermediate frequency is created by mixing the carrier signal with a local oscillator signal in a process called heterodyning

ESP32 Microcontroller Bluetooth Chipset. . .

ESP32 Bluetooth Chipset Parts Description

The **RF receive circuit** is responsible for obtaining the intelligence data from a

a) demodulated designated
b) or paired transmitter signal

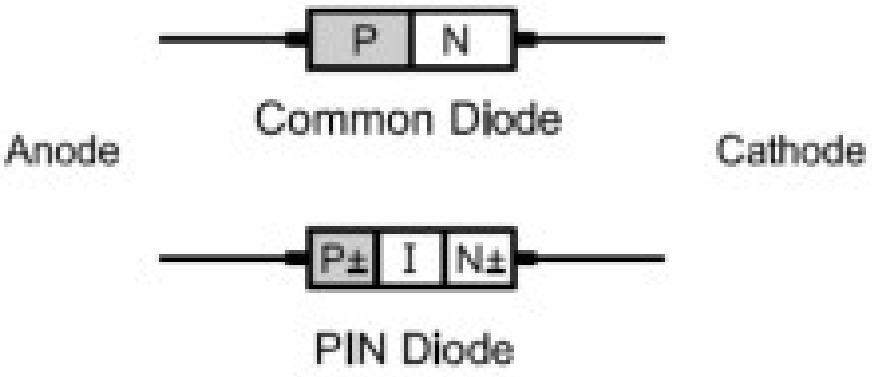


Analog Devices (n.d.) *RF/IF introduction*

ESP32 Microcontroller Bluetooth Chipset. . .

ESP32 Bluetooth Chipset Parts Description

RF switch is an electronic device used to route the 2.4GHz signal received from a designated or paired transmitter.



Rosu (n.d.) *RF switches*

An ordinary PN junction diode can be used to switch RF currents ON and OFF.

to block an RF signal of 10 V p-p,

a) the diode anode must be 10 V DC more negative than the cathode.
b) If the diode is to remain turned ON for the complete RF cycle,
c) the DC bias current must exceed the RF current.
   i. For example, if the diode is expected to pass 0.1 A of peak RF,
   ii. it must have a forward bias of at least 0.1 A DC.

Question 2

Heterodyning uses what two RF circuits?

a) Modulator, RF Switch
b) Demodulator, IF
c) IF, local oscillator
d) none of the above

ESP32 Microcontroller Bluetooth Chipset. . .

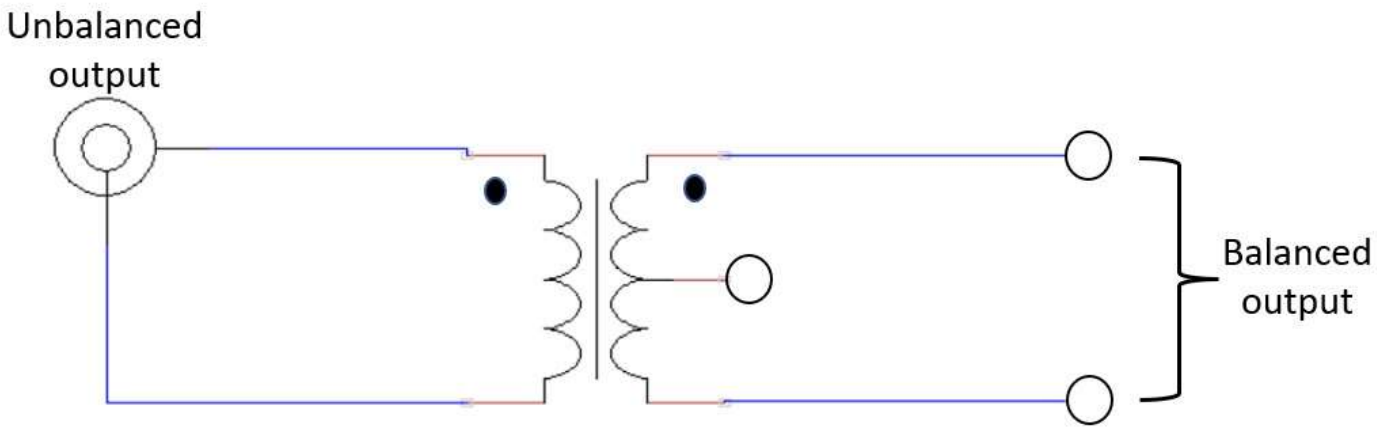
ESP32 Bluetooth Chipset Parts Description

- The balun is an electrical device that converts an unbalanced modulated received signal into
  a) a balanced or
  b) differential demodulated waveform
- Traditionally, the balun is wired to the Bluetooth antenna to achieve a differential or balanced load for RF signal integrity.

ESP32 Microcontroller Bluetooth Chipset. . .

ESP32 Bluetooth Chipset Parts Description

The Balun electrical circuit diagram concept:



Antenna Balun

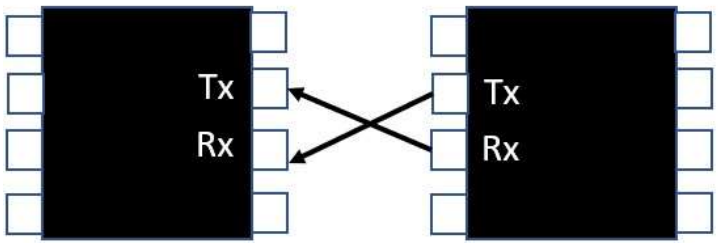
UiFlow BLE Coding Blocks Pallet

- **Init ble uart name** – Blockly code block used to Initialize and configure wireless communication settings of the specified named Bluetooth device.
- **BLE UART write** – Blockly code block used to send intelligence data using the BLE UART.
- **BLE UART remain cache** -This blockly code block is used to check the BLE UART number of data bytes.
- **BLE UART read**- Reading the BLE UART cache data can be achieved with this blockly code block.
- **BLE UART read characters**- Blockly code block allows reading n-number of The BLE UART_**cache** data.
- **BLE UART on recv** – This blockly code block allows decoding all BLE UART received data.

UiFlow BLE Coding Blocks Pallet…

UART Concept

- The Universal Asynchronous Receiver-Transmitter or UART is
  a) microelectronics device capable of providing asynchronous serial communication
  b) with a configurable data format and transmission speeds.
- The method of formatting the communication data is through a parallel-serial conversion process provided by the UART

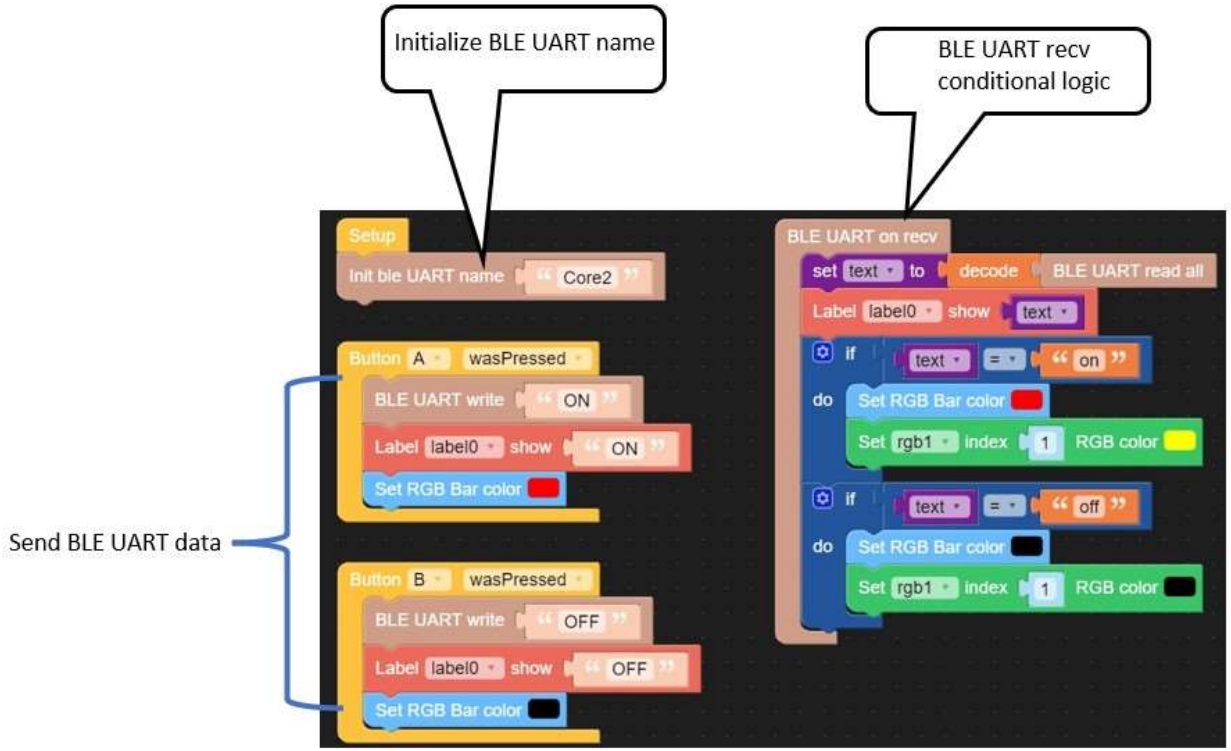


UiFlow BLE Coding Blocks Pallet…

Accessing the BLE Coding Blocks Pallet

UiFlow BLE Coding Blocks Pallet…

BLE Messaging Device Code Block



Question 3

A UART is a_____.

a) a passive circuit capable of providing asynchronous serial communication

b) a transistor driver circuit capable of providing asynchronous serial communication

c) a microelectronics device capable of providing asynchronous serial communication

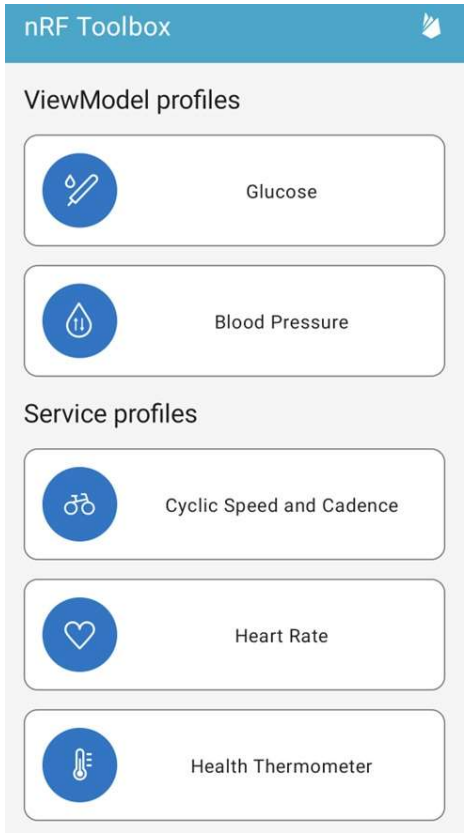
d) none of the above

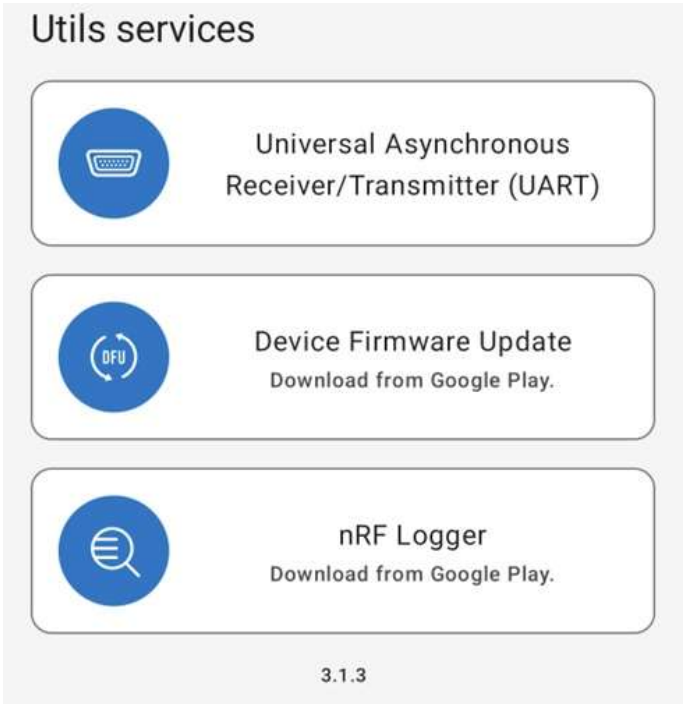
M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox

What is the nRF Toolbox?

- nRF Toolbox is a container app for our Bluetooth® Low Energy demo apps.
- The nRF Toolbox works with a wide range of the most popular Bluetooth LE accessories.
- It contains apps demonstrating the following profiles.

M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .





Available on the App Store

ANDROID APP ON Google Play

Question 4

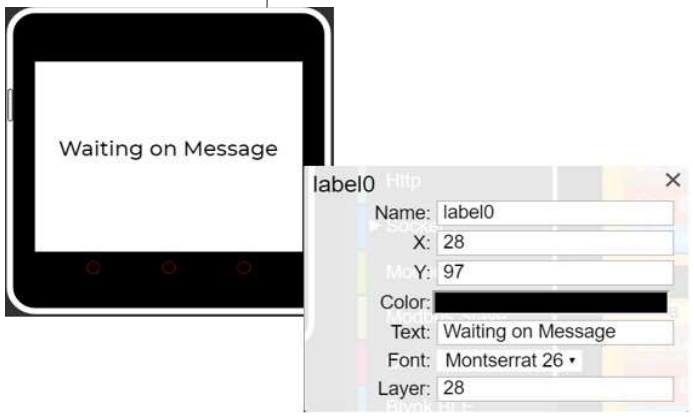
In reviewing slide 24, which nRF tool profile category is suitable for a BLE messaging device ?

a)Services
b) View Model
c) Utils Service
d)none of the above

M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .

Building a BLE Messaging Device

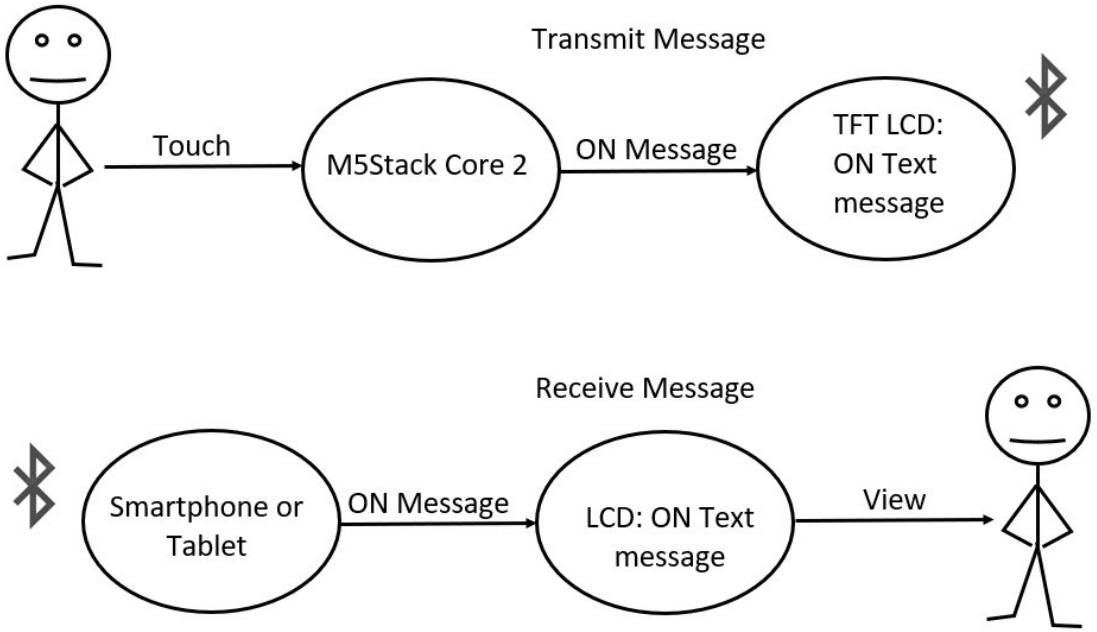
M5Stack Core 2 UI



M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .

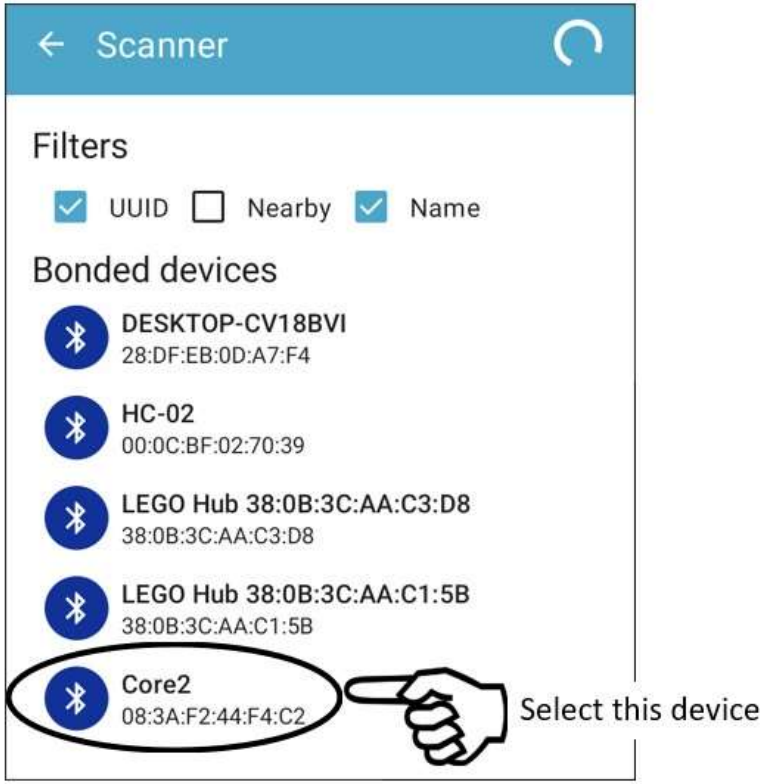
Building a BLE Messaging Device

Use Case Model Concept



M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .

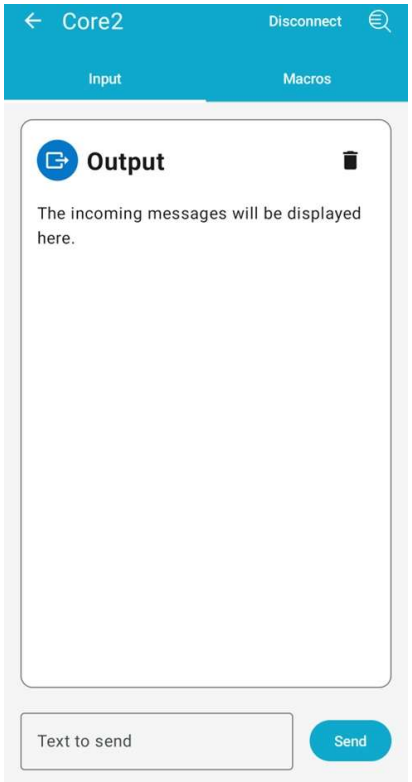
Paired Devices



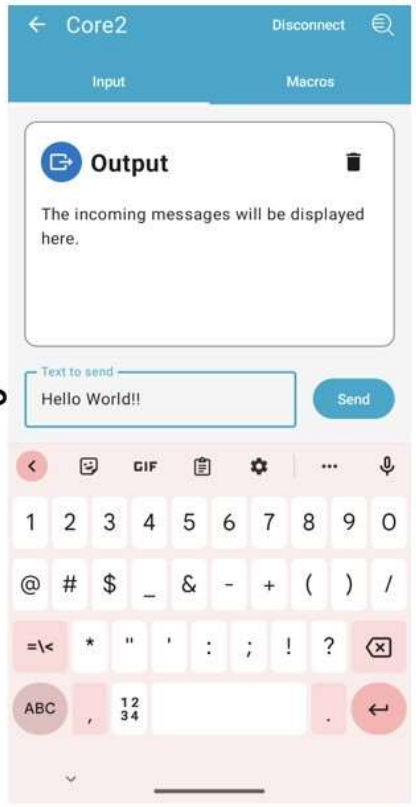
Note:

Universally Unique Identifiers, or **UUIDs** is a 128-bit label used for information in computer systems. Apple Computer in the 1980s originally used UUIDs in their Network Computing Systems (NCS).

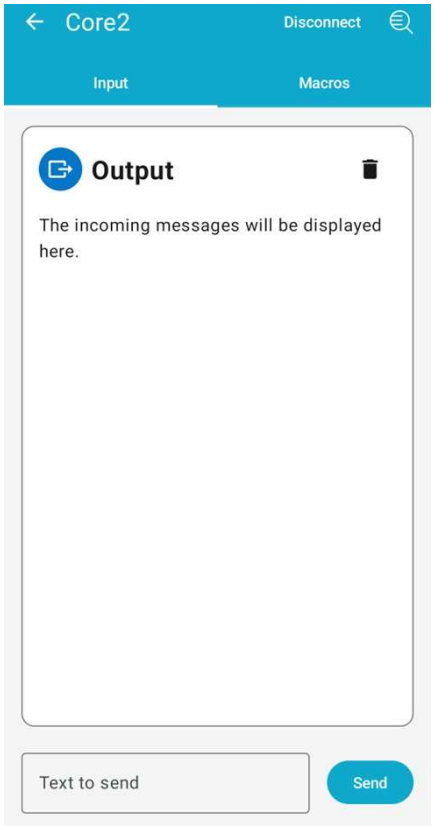
M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .



Type Text Here



M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .



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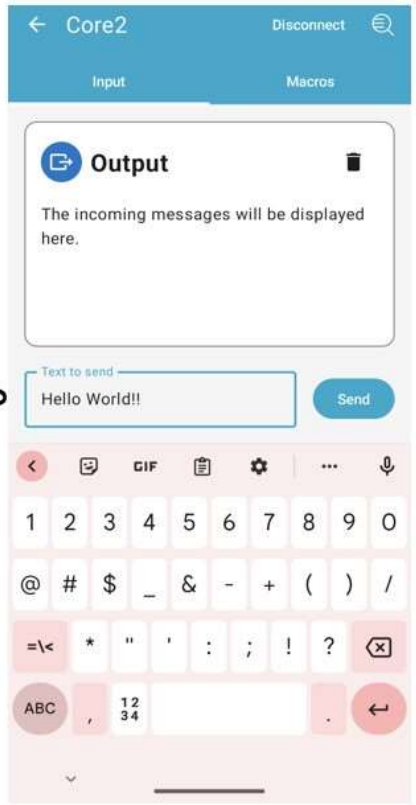
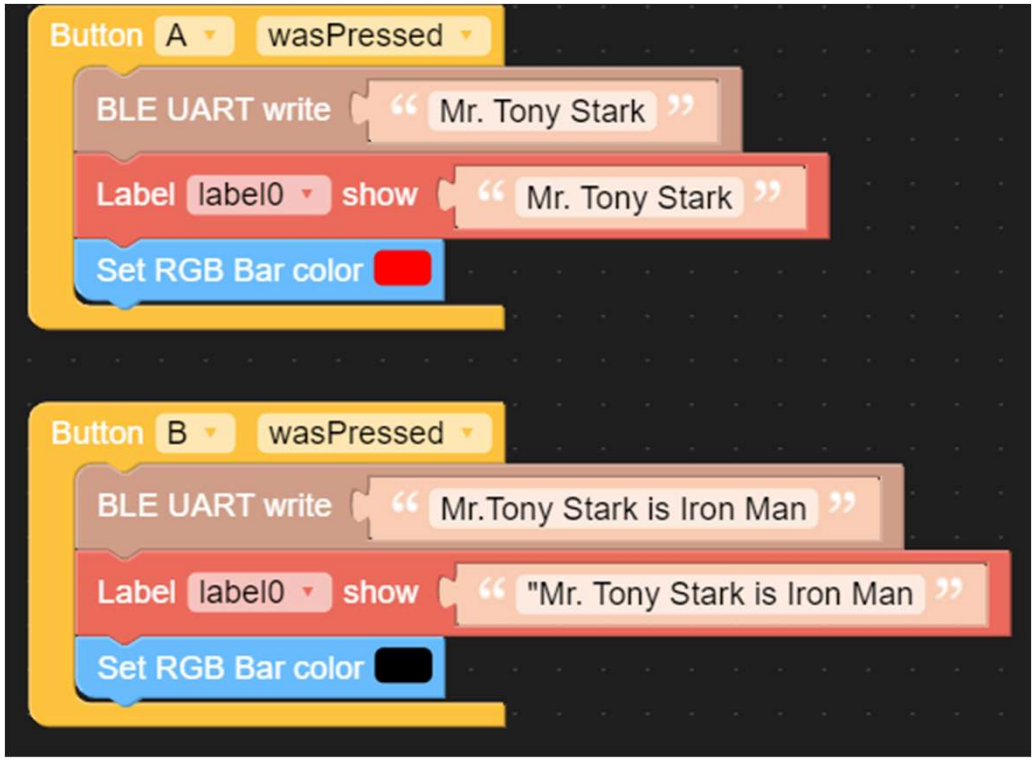


M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .

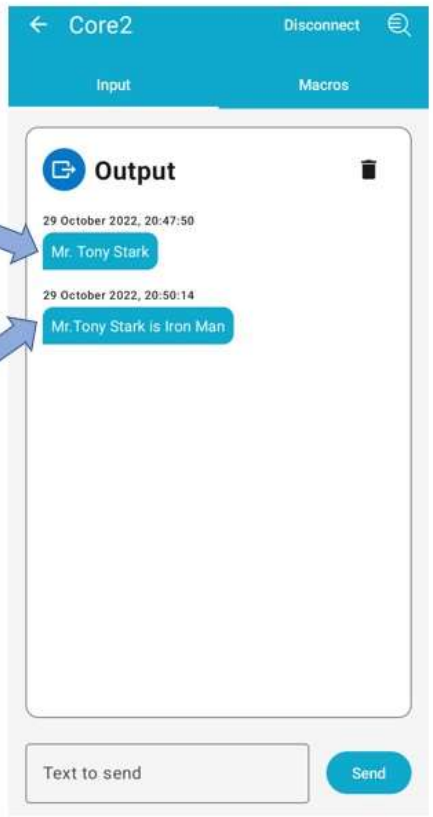
Programming M5Stack Core 2 Buttons Blockly Code



M5Stack Core 2 BLE and the Nordic Semiconductor nRF Toolbox. . .

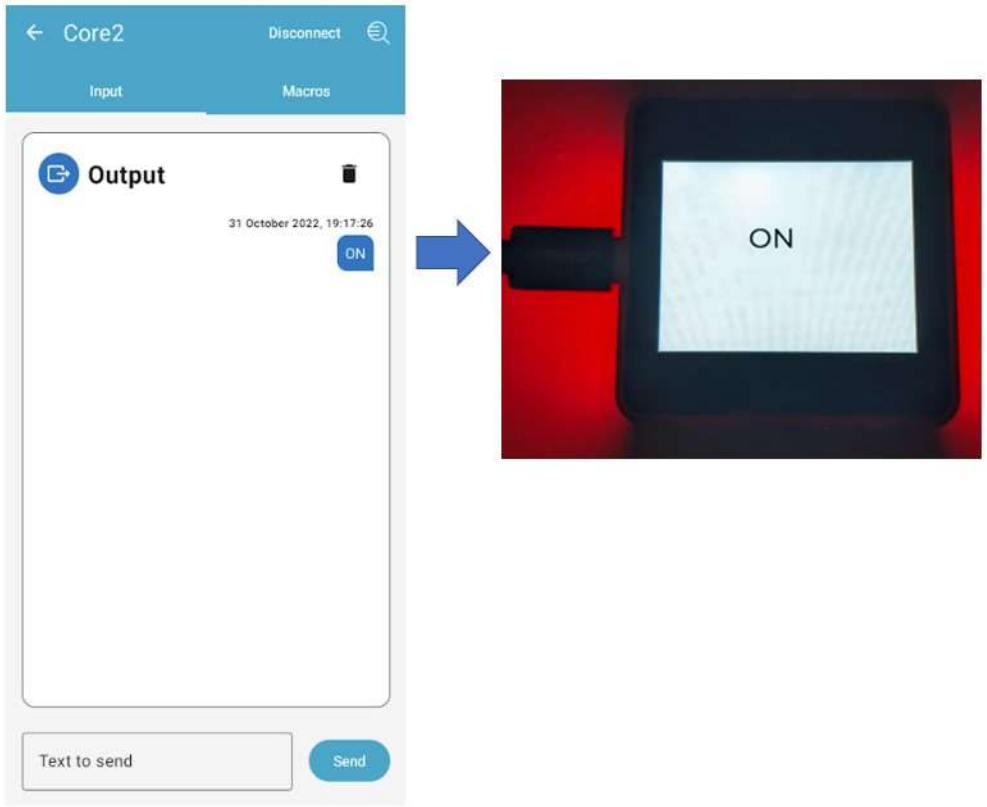
Programming M5Stack Core 2 Buttons Blockly Code

Transmit



Receive

Lab: Build a Wearable M5Stack BLE receiver-controller



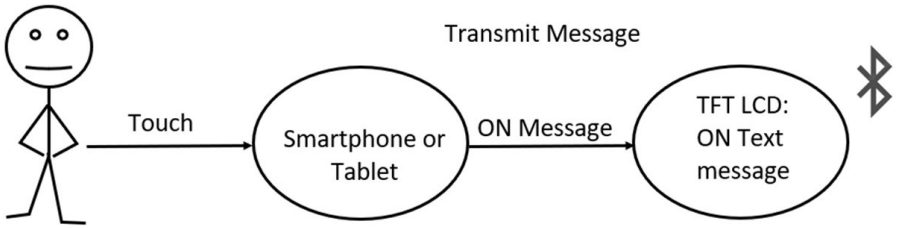
Lab: Build a Wearable M5Stack BLE receiver-controller. . .

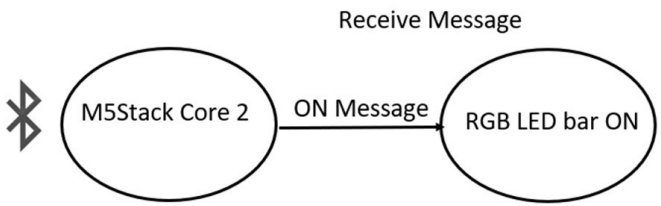
Big IDEAS (Learning Objectives):

1. The participant will be able to develop Blockly Code software for the M5Core 2 ESP32 controller.
2. The participant will be able to add and program and add BLE UART blockly code blocks to a low energy project.
3. The participant will be able to setup communication with the M5 Core 2 ESP32 controller.
4. The participant will be able to build and run a BLE receiver-controller.

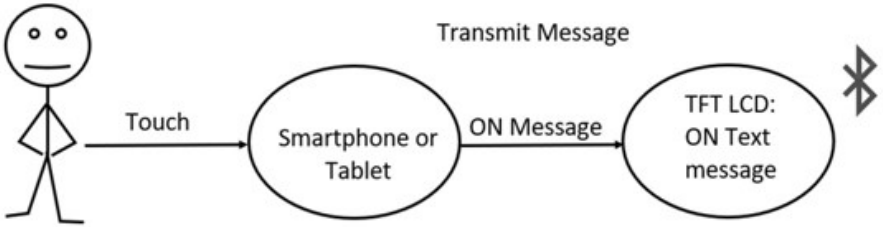
Lab: Build a Wearable M5Stack BLE receiver-controller. . .

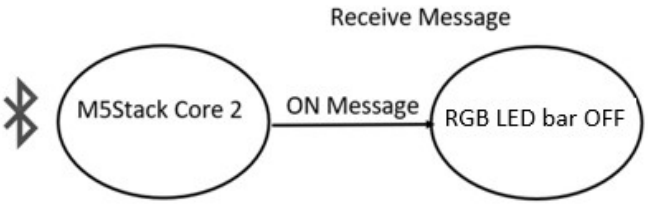
Wearable BLE receiver-controller device: Use Case Models





Device ON

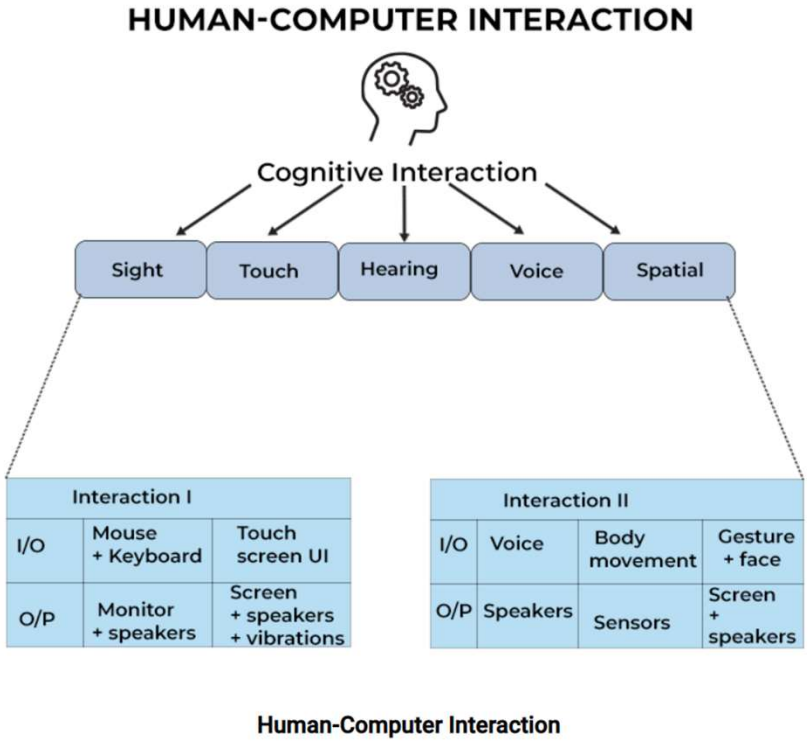




Device OFF

Lab: Build a Wearable M5Stack BLE receiver-controller. . .

What is Human Computer Interaction (HCI)?. .



Human-Computer Interaction

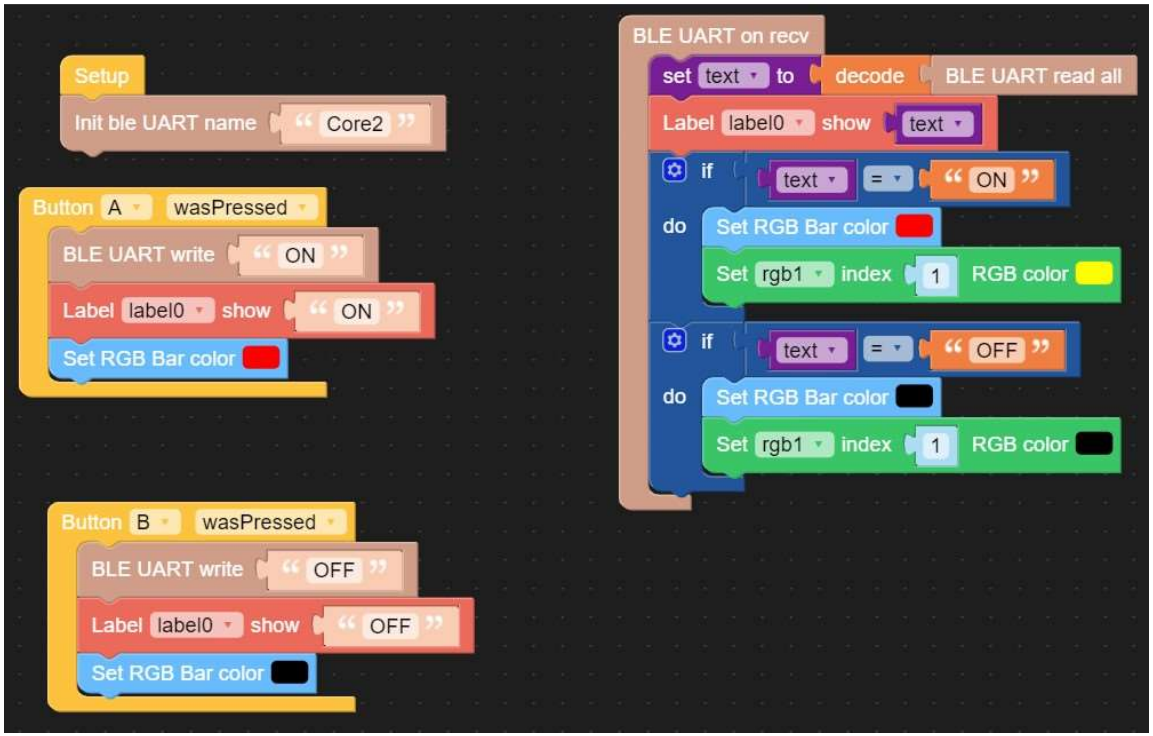
Segway to:

UI Design Basics

Kanade, V. (2022, July 22). *What is hci (human-computer interaction)? Meaning, importance, examples, and goals*. https://www.spiceworks.com/tech/artificial-intelligence/articles/what-is-hci/

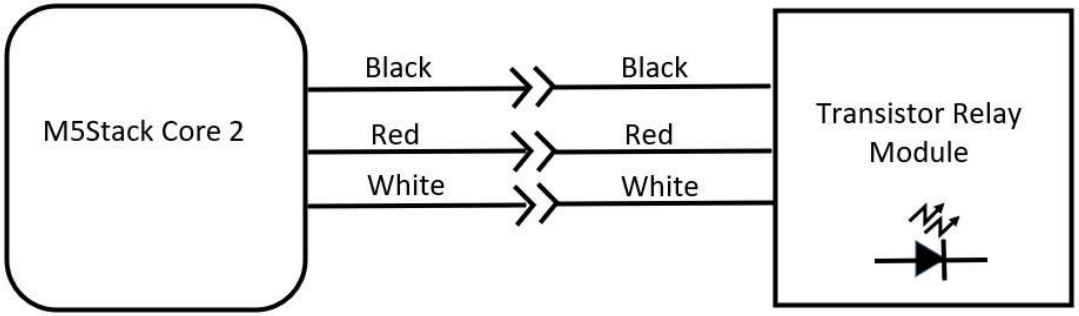
Lab: Build a Wearable M5Stack BLE receiver-controller. . .

Programming M5Stack Core 2 BLE receiver-controller Blockly Code

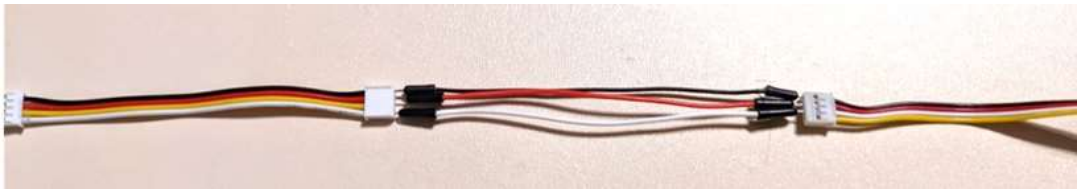


Lab: Build a Wearable M5Stack BLE receiver-controller. . .

M5Stack Core 2 – Transistor Relay Module Electrical Wiring Diagram

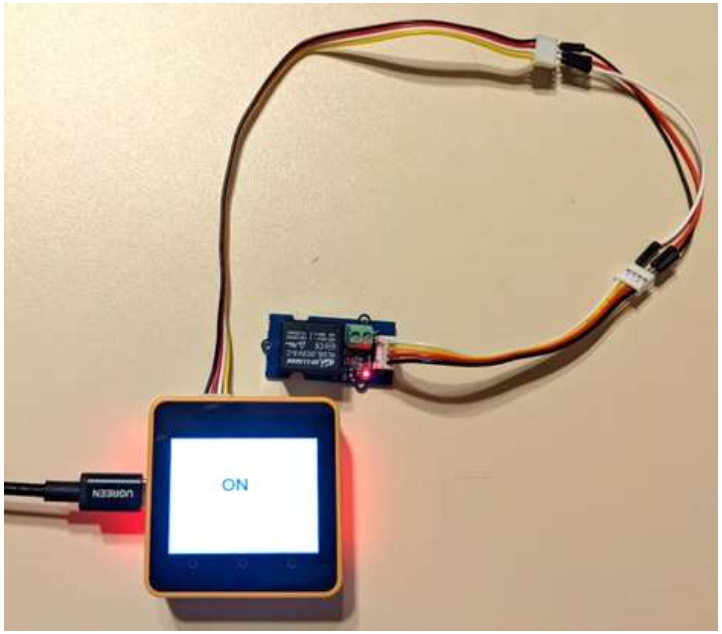


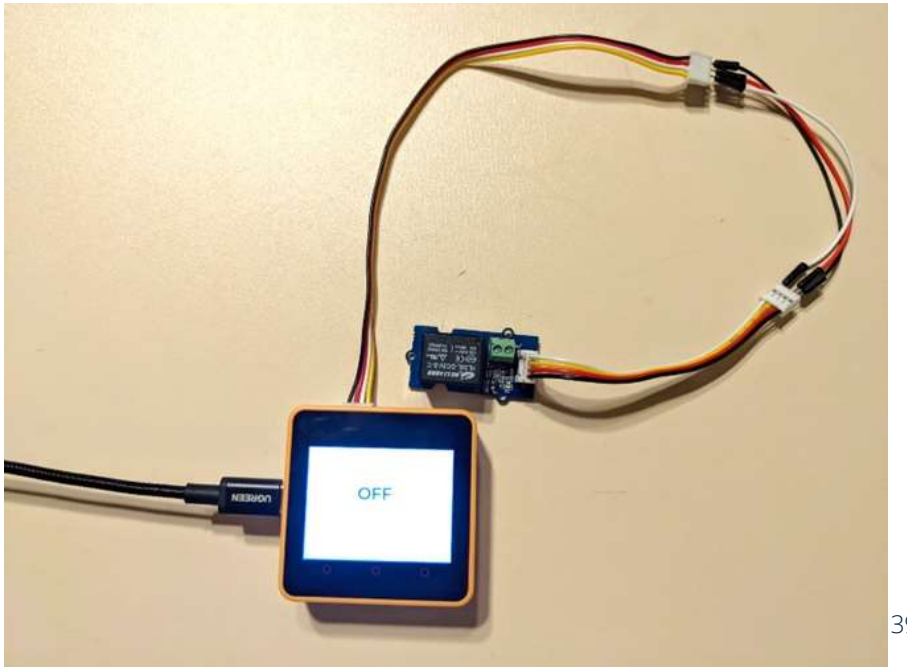
Inline jumper wires



Lab: Build a Wearable M5Stack BLE receiver-controller. . .

Operational M5Stsack BLE receiver controller





Question 5

In reviewing slide 39 and referencing slide 37, which Blockly Code Block provides the ON control function.

a) Button A pressed
b) Button B pressed
c) BLE UART on recv
d) none of the above

Thank you for attending
Please consider the resources below:

Analog Devices (n.d.) *RF/IF introduction.* https://www.analog.com/media/en/training-seminars/design-handbooks/Basic-Linear-Design/Chapter4.pdf

Bonfiglio, A , & De Rossi, D.(Eds). (2011). *Wearable monitoring systems.* Springer.

Hartman, K. (2014). *Wearable electronics: Design, prototype, and wear your own interactive garments*. Maker Media.

Kanade, V. (2022, July 22). *What is hci (human-computer interaction)? Meaning, importance, examples, and goals*. https://www.spiceworks.com/tech/artificial-intelligence/articles/what-is-hci/

Klemmer, S. (2012). *Lecture 2- The power of prototyping|hci|*. https://www.youtube.com/watch?v=IyMT91wUO54

M5Stack Electronic Blueprints:

https://www.amazon.com/M5Stack-Electronic-Blueprints-interactive-applications/dp/1803230304/ref=sr_1_1?crid=OVYB3O0IQ5OU&keywords=dr.+don+wilcher&qid=1667169860&sprefix=%2Caps%2C191&sr=8-1

Nash, M. (2017). Hci design and age groups. *HOHONU,15*, 39-43.

Thank you for attending

Please consider the resources below:

Rakes, C.D. (1998). *Alarms: 55 electronic projects and circuits*. Tab Books.

Rosu, J. (n.d). *RF switches.* https://www.qsl.net/va3iul/RF_Switches/RF_Switches.pdf

Schon, S., Allaert, I., Frebel, L.,Guntram Geser, E.M, Hornung, V., & Vloet, F.(2020). *Making social innovators. Workshop design for and with young social innovators from 6 to 16years* (DOIT Handbook). Horizon 2020 project.

UiFlow Code download website: https://shop.m5stack.com/pages/download

Ulrich, K. T., Eppinger, S. D., & Yang. M.C. (2020). *Product Design and Development.* McGraw-Hill.

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