CEC Continuing Education Center

DesignNews

Prototyping and Programming ESP32 Wearable Devices

DAY 1 : Introduction to Wearable Devices

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Webinar Logistics

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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:

- Wearable Devices Overview
- Research Driven Applications
- M5Core ESP32 IoT Controller Architecture
- Lab: Setup of UiFlow Software – Hello World Application

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 Devices Overview

"We're living in a moment where wearable device technologies are just starting to become a part of our everyday lives. They live on our wrists and in our glasses. They track our activities and transport us into virtual worlds. But this is just the beginning. There is still a lot that has yet to be revealed" (Hartman, 2014) .

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

Research Driven Applications

Wearable technologies are impacted by microelectronics and communication technologies (Bonfiglio & De Rossi, 2011). Outside factors that have influenced research-driven applications of Wearable technologies include:

- Microelectronics miniaturization has a major influence on wearable technologies development
- Demography
- Lifestyle
- Emergence of huge mass markets

Research Driven Applications. . .

Aesthetics (attractiveness) vs. usability with different age groups impacts the development of wearable devices (Nash, 2017).

- Aligns with demography
- Lifestyle

Human-Computer Interaction (HCI) plays a role in the attractiveness and usability of wearable device design.

- HCI is the field of study that focuses on optimizing:
  a) user-computer engagement
  b) designing interactive computer interfaces that satisfy user needs.

Question 1

Outside factors that have influenced research-driven applications of wearable technologies include education and training industry.

a) True

b) False

Research Driven Applications. . .

The influence HCI has on wearable devices is focused on

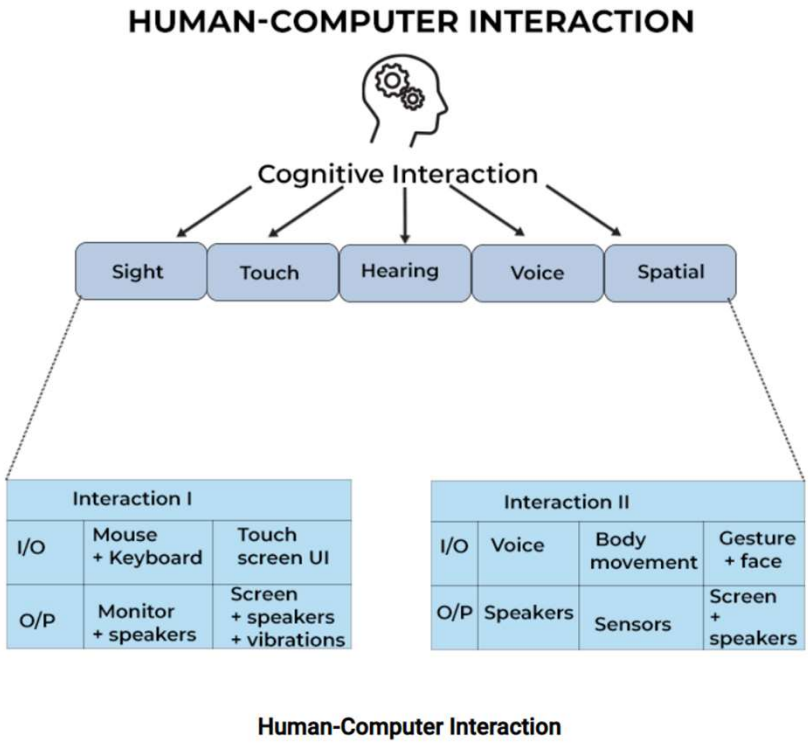
- designing
- implementing
- evaluating interactive interfaces

Human-Computer Interaction (HCI) aims to enhance user experience using computing devices. This includes:

a) user-interface design
b) user-centered design
c) user-experience design

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/

Research Driven Applications. . .



Human-Computer Interaction

Segway to:

Emergence of Huge Mass Markets

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/

Research Driven Applications. . .

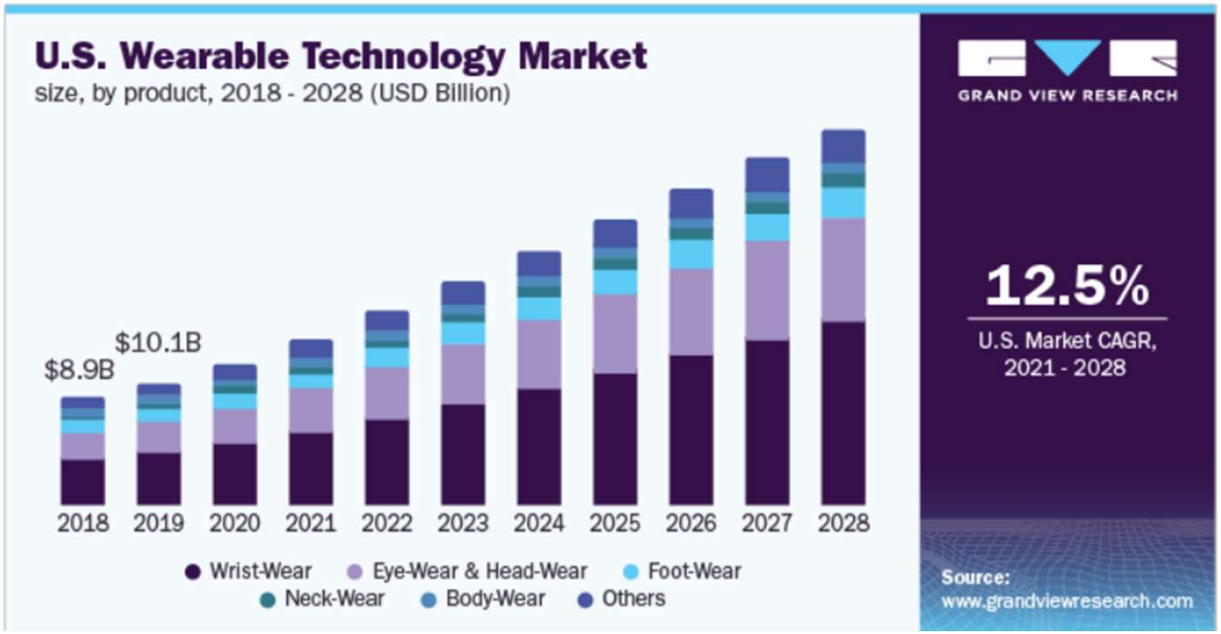
Emergence of Huge Mass Markets

The global wearable technology market size was valued at
  a) $40.65 billion
  b) in 2020 and is expected to expand at a
Compound Annual Growth Rate (CAGR) of
  a) 13.8%
  b) 2021 to 2028
U.S Wearable Technology Market size, CAGR by-product 2018-2028:

Grand View Research. (2022, October 30). *Wearable technology, market size, share & trends analysis reports by product*. https://www.grandviewresearch.com/industry-analysis/wearable-technology-market

Research Driven Applications. . .

Emergence of Huge Mass Markets



Grand View Research. (2022, October 30). Wearable technology, market size, share & trends analysis reports by product. https://www.grandviewresearch.com/industry-analysis/wearable-technology-market

Question 2

The global wearable technology market size was valued at _____ in 2020.

a) $41.65 billion
b) $30.05 billion
c) $40.65 billion
d) none of the above

Research Driven Applications. . .

Emergence of Huge Mass Markets

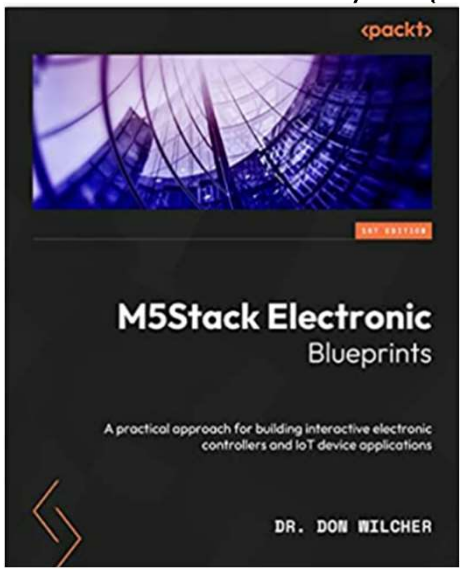
"The rising popularity of connected devices and the Internet of Things (IoT) and the rapid growth of the technologically literate population globally are anticipated to fuel the demand for wearable technology over the forecast timeframe" Grand View Research (2022).

Aligns with Demography and Lifestyle elements Bonifiglo and De Rossi (2011) discussed in their impact of wearable technologies research.

Grand View Research. (2022, October 30). *Wearable technology, market size, share & trends analysis reports by product*. https://www.grandviewresearch.com/industry-analysis/wearable-technology-market

M5 Core ESP32 IoT Controller Architecture

The following information is from my upcoming book title:



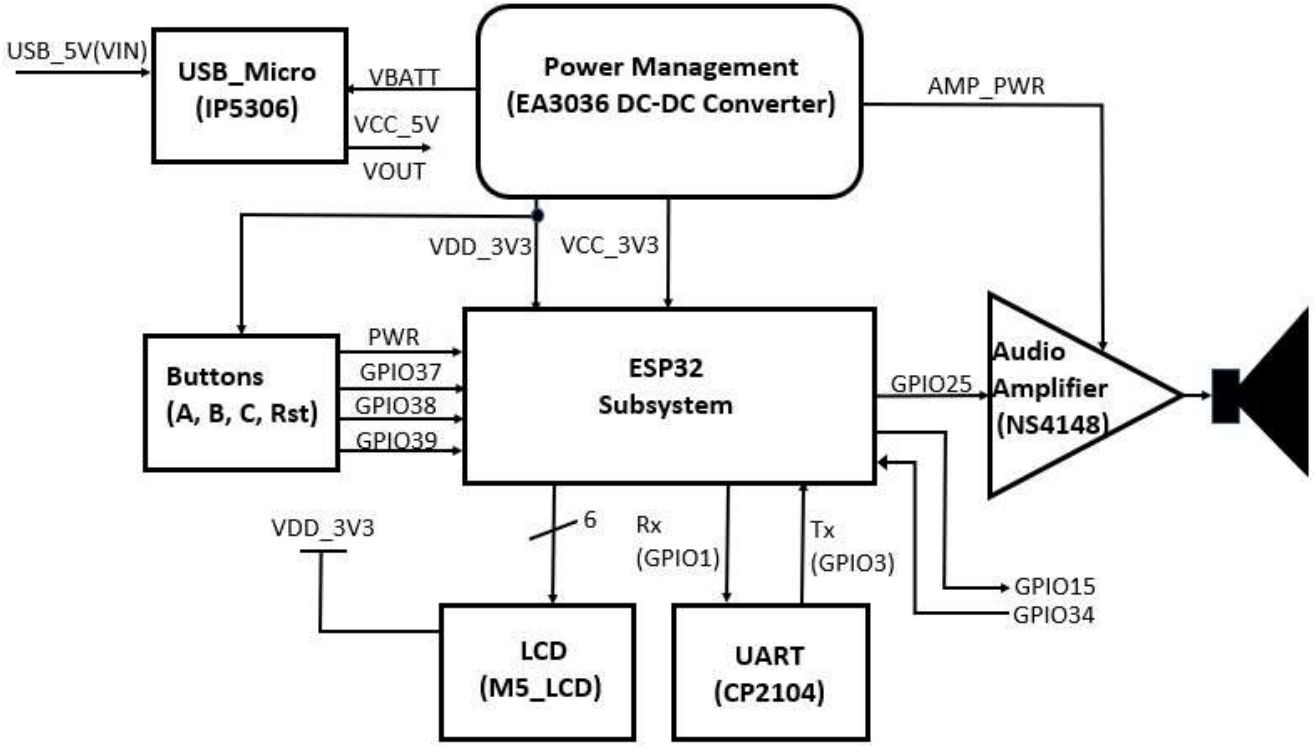
https://www.amazon.com/M5Stack-Electronic-Blueprints-interactive-applications/dp/1803230304/ref=sr_1_1?crid=OVYB3O0IQ5OU&keywords=dr.+don+wilcher&qid=1667169860&sprefix=%2Caps%2C191&sr=8-1

M5 Core ESP32 IoT Controller Architecture

The M5Core's ESP32 hardware architecture consists of four electronic subcircuits:

- Power Management
- Audio Amplifier
- ESP32 Subsystem
- USB-UART & Accessory

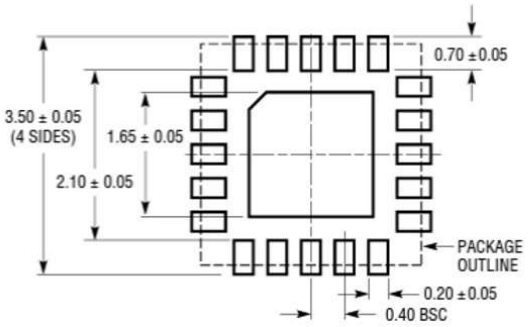
M5 Core ESP32 IoT Controller Architecture. . .

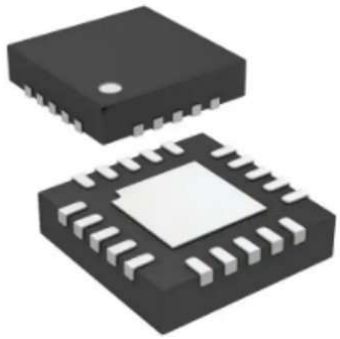


M5 Core ESP32 IoT Controller Architecture. . .

Power Management

The EA3036 DC-DC converter is responsible for providing the 3.3V (3V3) voltage source to operate the ESP32 microcontroller and supporting electronic circuit peripherals.



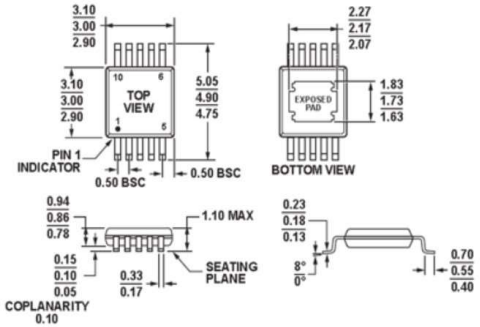


EA3036 IC Quad Flat No-lead (QFN) package

M5 Core ESP32 IoT Controller Architecture. . .

Power Amplifier

The M5 Core ESP32 IoT Controller has an audio power amplifier. The NS4148 is a 3-watt (W) class D audio power amplifier. The unique feature of the NS4148 is that the device can power down, which reduces power consumption.



The NS4148 Micro Small Outline Package(MSOP) device

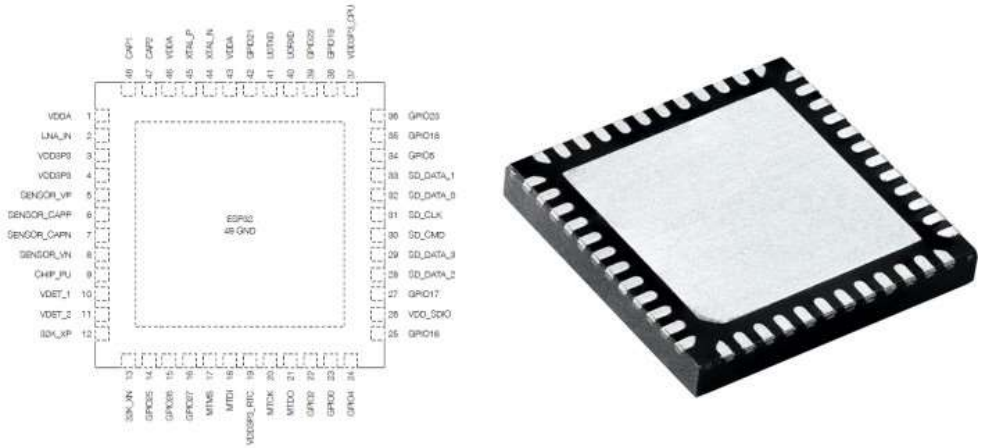
M5 Core ESP32 IoT Controller Architecture. . .

ESP32 Subsystem

The heart of the M5 Core ESP32 IoT controller is a 2.4 Gigahertz (GHz) Wi-Fi and Bluetooth combination microcontroller. The ESP32 microcontroller is supported by 20 external components that enable features of the M5 Core to interact with the end user.

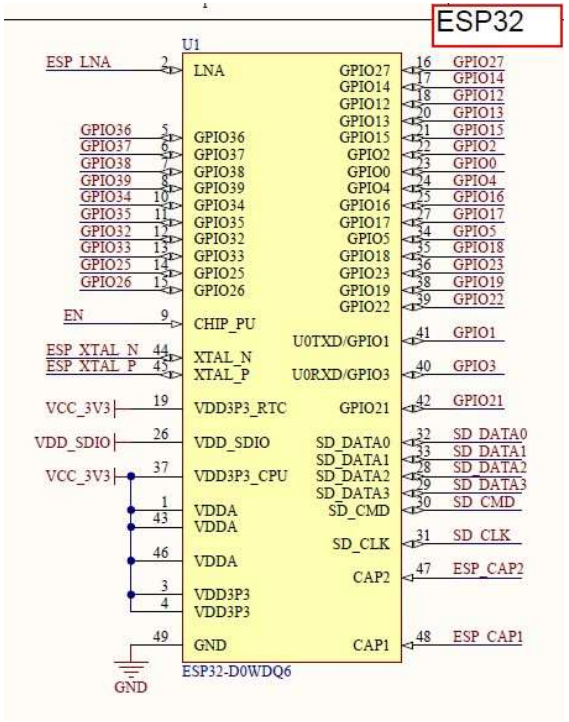
M5 Core ESP32 IoT Controller Architecture. . .

ESP32 Subsystem



ESP32 pinout and QFN48 package

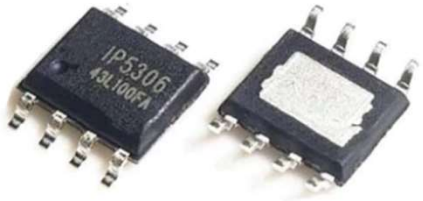
ESP32 subsystem circuit schematic diagram



M5 Core ESP32 IoT Controller Architecture. . .

USB-UART and Accessory

The method used to communicate internally and externally with the M5Stack Core uses a universal serial bus (USB) or universal asynchronous receiver transmitter (UART) circuits. The external port A allows units that have inter-integrated circuit capabilities (I2C) to communicate with the ESP32 microcontroller.

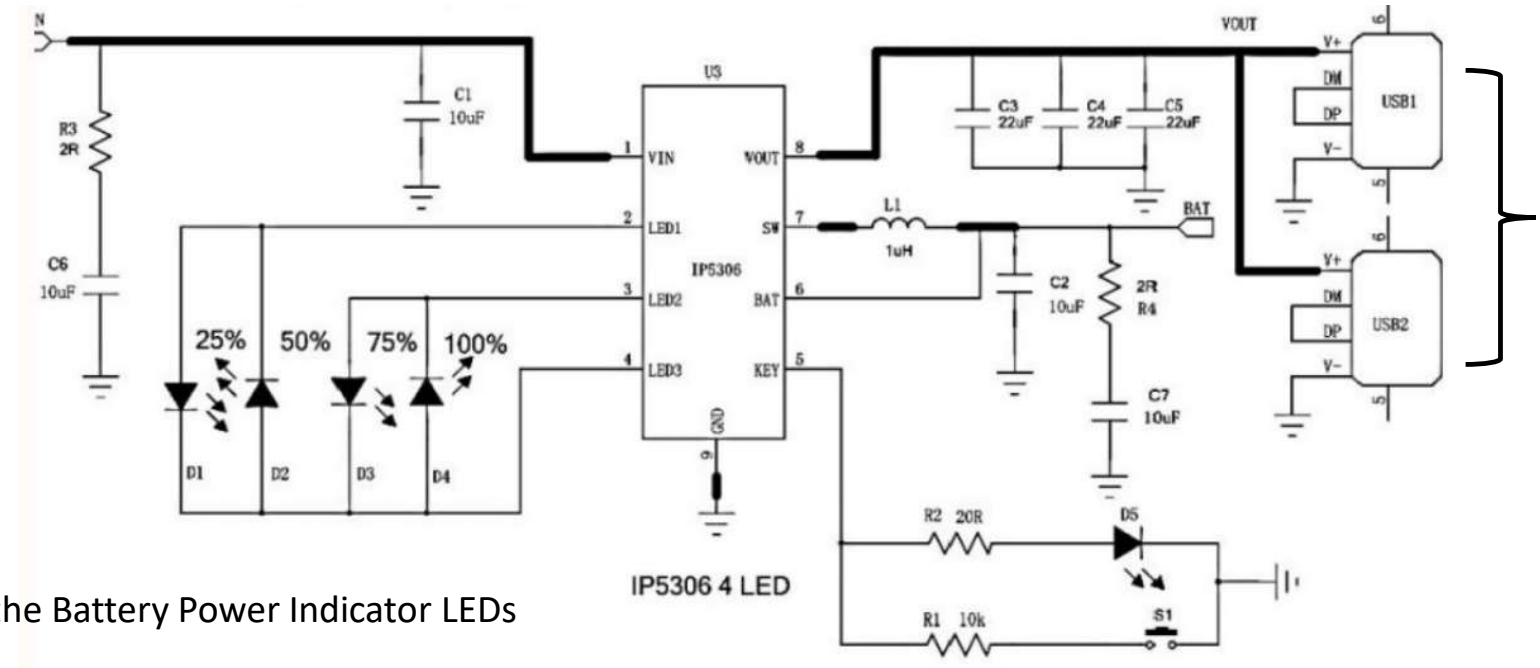


IP5306 Power Management IC (SOIC-8pin)

M5 Core ESP32 IoT Controller Architecture. . .

USB-UART and Accessory

The IP5306 USB-I2C communication circuit schematic diagram



USB-UART ports

D1-D4 are the Battery Power Indicator LEDs

Question 3

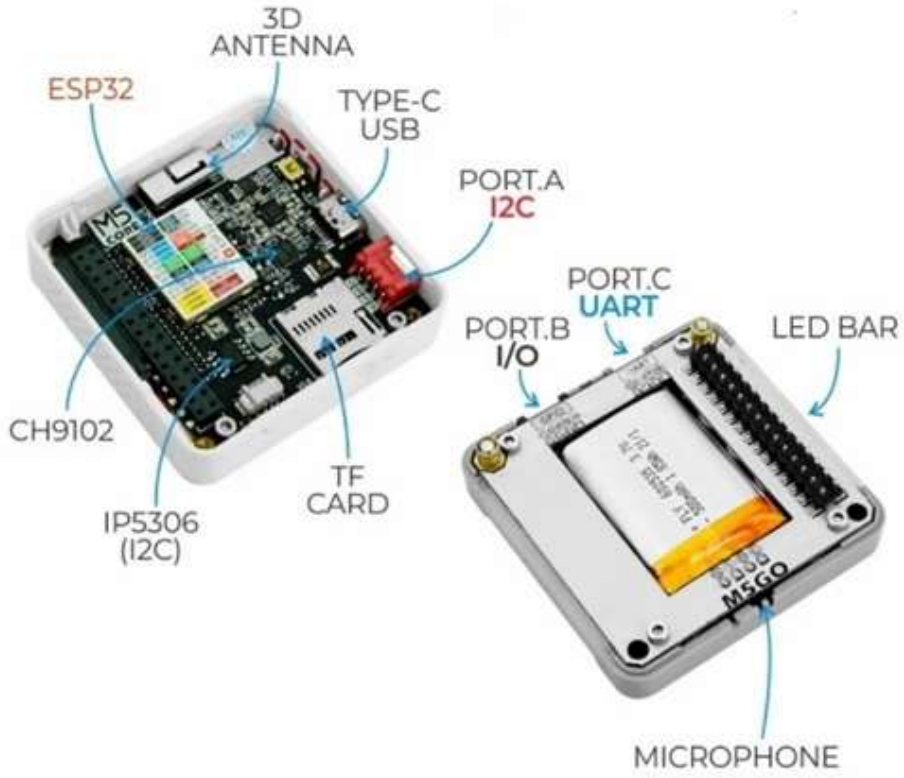
The M5 Core's ESP32 hardware architecture consists of five electronic subcircuits.

a) True

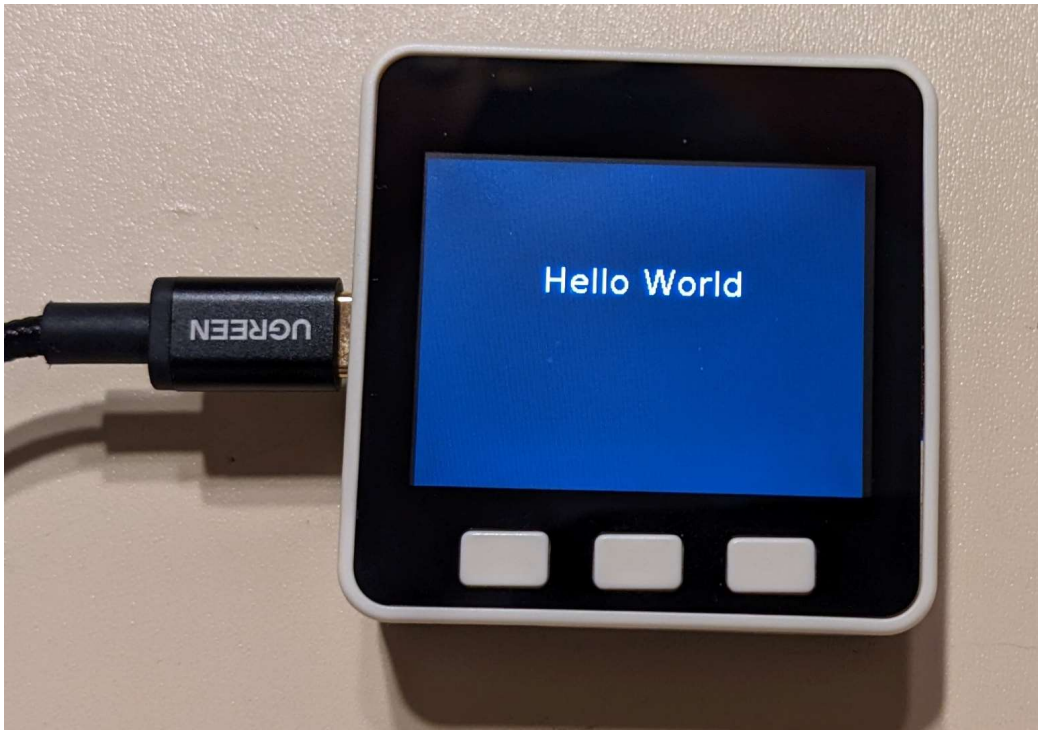
b) False

M5 Core ESP32 IoT Controller Architecture. . .

Location of the key electronic components and M5 communication bus



Lab: Setup of UiFlow Software – Hello World Application



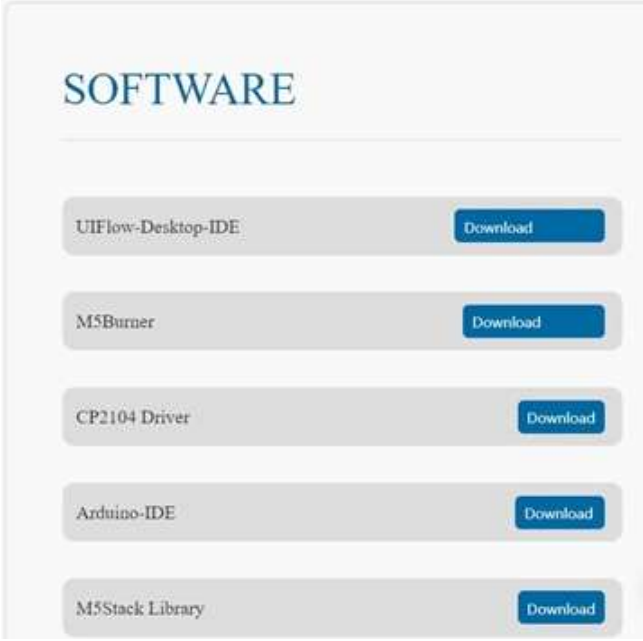
Lab: Setup of UiFlow Software – Hello World Application…

Big IDEAS (Learning Objectives):

1. The participant will be able to install and setup UiFlow Blockly Code software.
2. The participant will be able to setup communication with the M5 Core ESP32 controller.
3. The participant will be able to build a Hello World wearable app.

Lab: Setup of UiFlow Software – Hello World Application…

Download the UiFlow Blockly Code Software



https://shop.m5stack.com/pages/download.

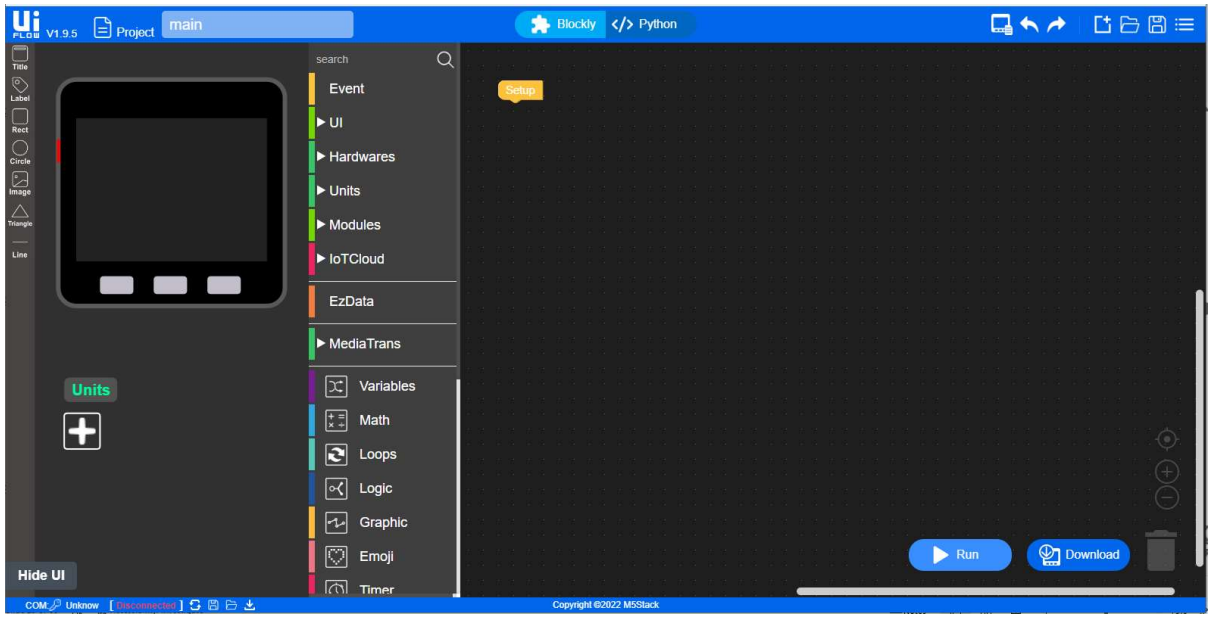
Lab: Setup of UiFlow Software – Hello World Application…

Download the UiFlow Blockly Code Software

Once the programming package has been installed, click on the icon with the mouse to open the software, which looks like this:

Lab: Setup of UiFlow Software – Hello World Application…

The UiFlow IDE will allow you to program the M5Stack Core using a variety of blockly code blocks.



UiFlow Integrated Development Environment (IDE)

Lab: Setup of UiFlow Software – Hello World Application…

Select the correct COM port and M5 Core device

Click OK

Lab: Setup of UiFlow Software – Hello World Application…

The initial step to communicating with the M5Stack Core is to turn on the programmable device. Press the power **ON** button. Once the UiFlow splash screen is displayed, you will press the rightmost button on the M5Stack Core. The rightmost button is M5Stack Core's **Setup** function

Lab: Setup of UiFlow Software – Hello World Application…

You will then scroll down to:

- Step 1. Switch Mode.
- Step 2. Scroll down to USB Mode. Use the middle button to select the USB mode.

Lab: Setup of UiFlow Software – Hello World Application…

You will scroll down to **Reboot the M5Stack Core**. Use the middle button to select the **Reboot** mode. After selecting reboot, the USB- API key splash screen will be displayed on the M5Stack Core unit's LCD

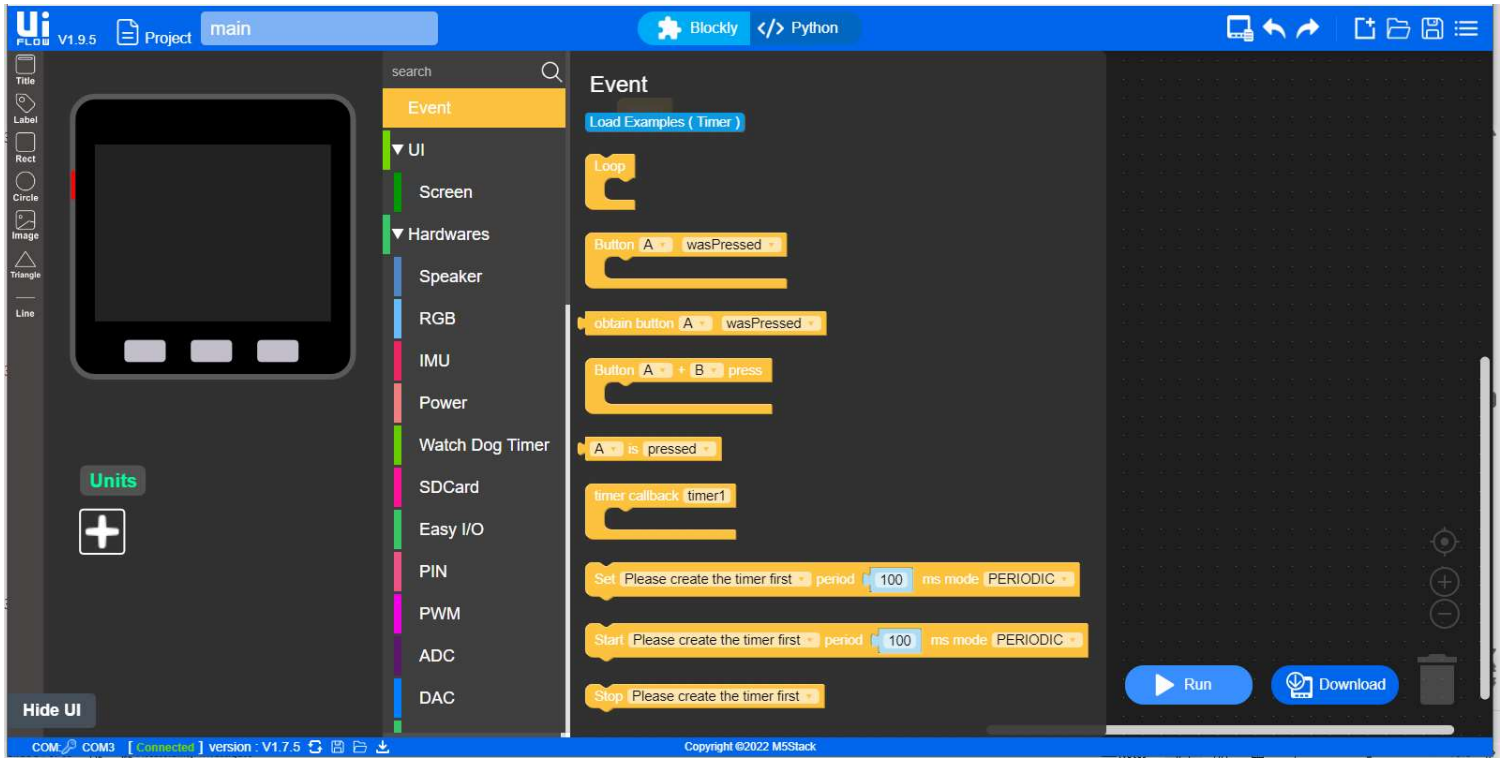
Question 4

To connect with the ESP32,select the correct ____and _____

a) icon, COM port
b) device, COM port
c) COM port, M5 Core device
d) none of the above

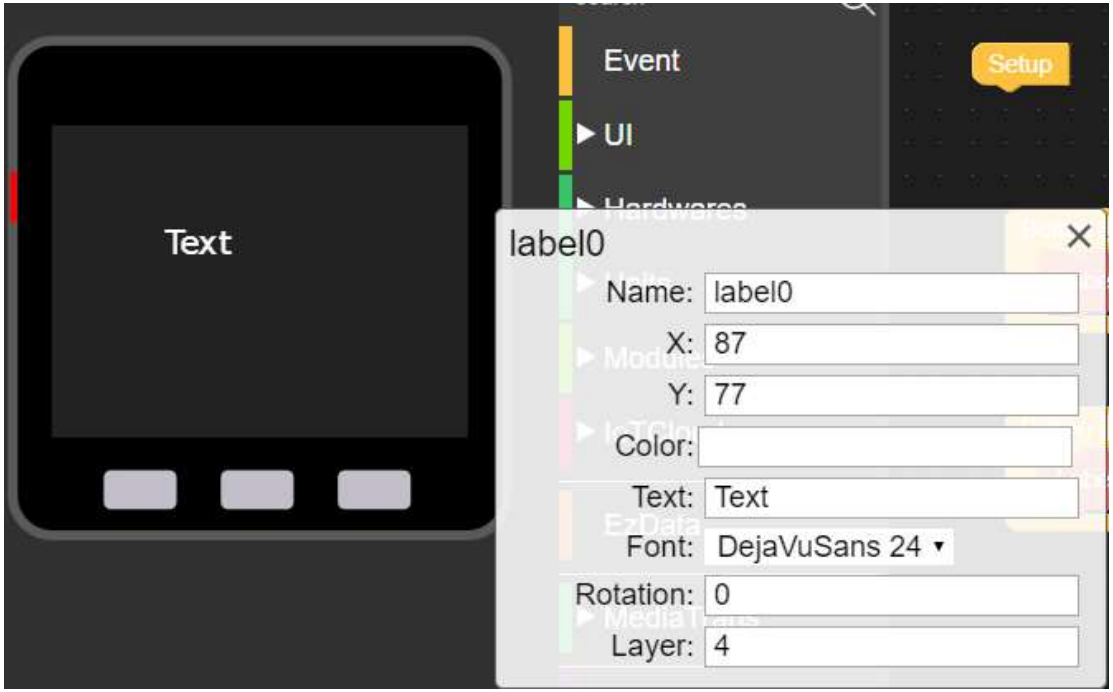
Lab: Setup of UiFlow Software – Hello World Application…

Select the Event bin to obtain the blockly code block pallet

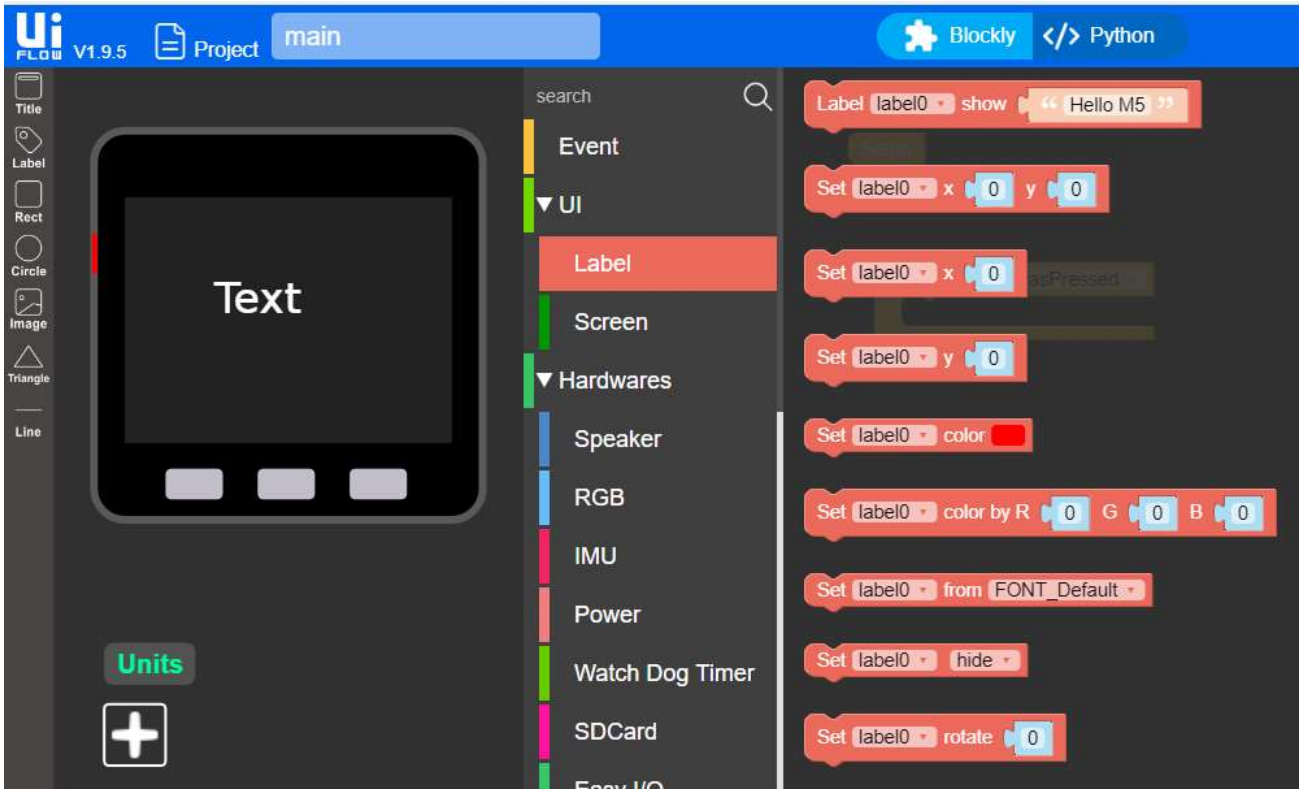


Lab: Setup of UiFlow Software – Hello World Application…

Select **Label** from the UI pallet (located on the left side of the editor)



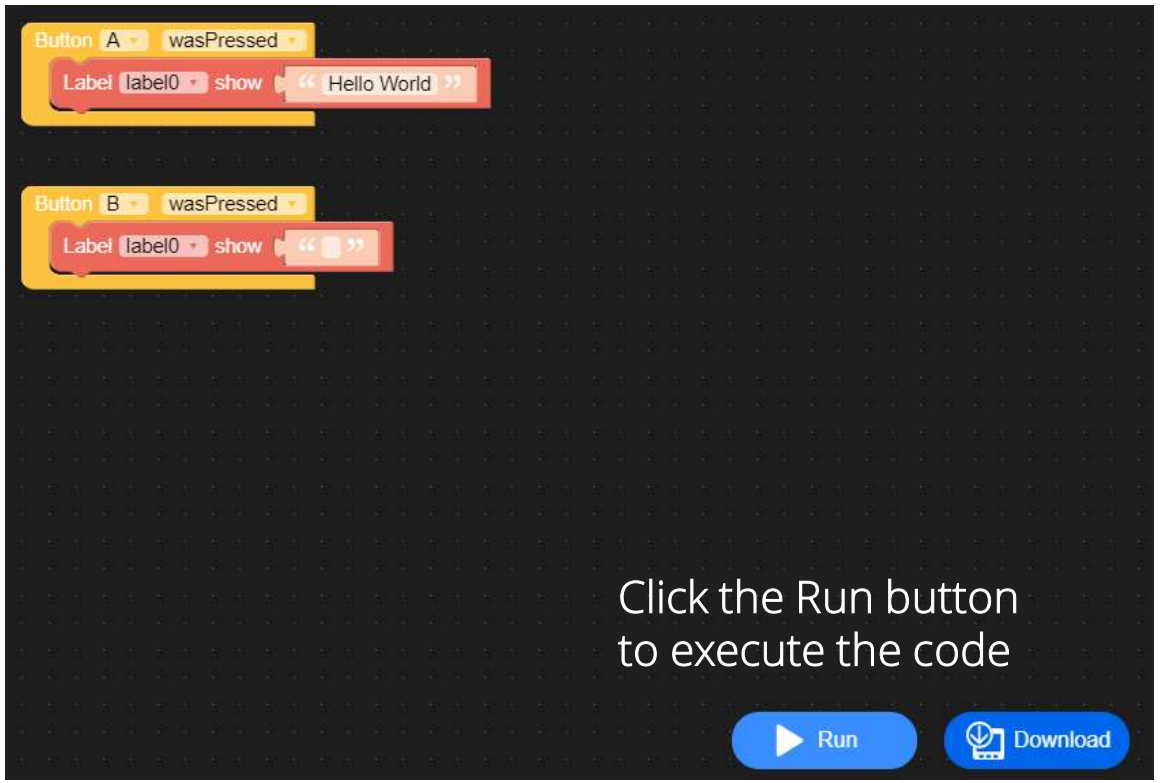
Lab: Setup of UiFlow Software – Hello World Application…



Open the Label blockly code block pallet

Lab: Setup of UiFlow Software – Hello World Application…

Build Hello World blockly code blocks



Lab: Setup of UiFlow Software – Hello World Application…

A-Button = Hello World

B Button = Blank Screen

Question 5

Which Blockly Code Block pallet allows interaction with the M5 Core buttons?

a) Label
b) Event
c) PWM
d) none of the above

Thank you for attending
Please consider the resources below:

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

Grand View Research. (2022, October 30). *Wearable technology, market size, share & trends analysis reports by product*. https://www.grandviewresearch.com/industry-analysis/wearable-technology-market

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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.

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

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