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### Embedded System Lab

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Lab 1:

## Introduction to ESP32 and ESP-IDF

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## Mục lục

1 Các bước thực hiện	3
2 Kết quả	4

## 1 Các bước thực hiện

Sau đây là các bước thực hiện để chạy project ví dụ về hello world:

1. Sau khi hoàn tất cài đặt esp-idf, đảm bảo các biến môi trường được hoàn tất set-up và kết quả kiểm tra thẻ hiện ở hình 1.1:

```
get_idf
```

```
Setting IDF_PATH to '/Users/phucdang/esp/esp-idf'
Detecting the Python interpreter
Checking "python3" ...
Python 3.8.5
"python3" has been detected
Checking Python compatibility
Checking other ESP-IDF version.
Adding ESP-IDF tools to PATH...
Checking if Python packages are up to date...
Constraint file: /Users/phucdang/.espressif/espidf.constraints.v5.2.txt
Requirement files:
- /Users/phucdang/esp/esp-idf/tools/requirements/requirements.core.txt
Python being checked: /Users/phucdang/.espressif/python_env/idf5.2_py3.8_env/bin/python
Python requirements are satisfied.
Updated PATH variable:
/Users/phucdang/esp/esp-idf/components/espcoredump:/Users/phucdang/esp/esp-idf/components/partition_table:/Users/phucdang/esp/esp-idf/components/app_update:/Users/phucdang/.espressif/tools/xtensa-esp-elf-gdb/12.1_20221002/xtensa-esp-elf-gdb/bin:/Users/phucdang/.espressif/tools/riscv32-esp-elf-gdb/12.1_20221002/riscv32-esp-elf-gdb/bin:/Users/phucdang/.espressif/tools/xtensa-esp32-elf/esp-12.2.0_20230208/xtensa-esp32-elf/bin:/Users/phucdang/.espressif/tools/xtensa-esp32s2-elf/esp-12.2.0_20230208/xtensa-esp32s2-elf/bin:/Users/phucdang/.espressif/tools/xtensa-esp32s3-elf/esp-12.2.0_20230208/xtensa-esp32s3-elf/bin:/Users/phucdang/.espressif/tools/riscv32-esp-elf/esp-12.2.0_20230208/riscv32-esp-elf/bin:/Users/phucdang/.espressif/tools/esp32ulp-elf/2.35_20220830/esp32ulp-elf/bin:/Users/phucdang/.espressif/tools/openocd-esp32/v0.12.0-esp32-20230419/openocd-esp32/bin:/Users/phucdang/.espressif/python_env/idf5.2_py3.8_env/bin:/Users/phucdang/esp/esp-idf/tools:/Users/phucdang/.local/bin:/Library/Frameworks/Python.framework/Versions/3.8/bin:/usr/local/bin:/System/Cryptexes/App/usr/bin:/usr/bin:/bin:/usr/sbin:/sbin:/usr/local/go/bin:/usr/local/share/dotnet:/opt/X11/bin:~/dotnet/tools:/Library/Apple/usr/bin:/Library/Frameworks/Mono.framework/Versions/Current/Commands:/Users/phucdang/.local/bin:/Library/Frameworks/Python.framework/Versions/3.8/bin:/Applications/Visual Studio Code.app/Contents/Resources/app/bin:/Applications/Visual Studio Code.app/Contents/Resources/app/bin:/Applications/Visual Studio Code.app/Contents/Resources/app/bin
Done! You can now compile ESP-IDF projects.
Go to the project directory and run:

idf.py build
```

Hình 1.1: Các biến môi trường đã được set-up

2. Sao chép hello world project:

```
cd ~/esp
cp -r $IDF_PATH/examples/get-started/hello_world .
```



3. Vào folder hello\_world, hình 1.2 biểu diễn những file trong folder hello\_world:

```
cd ~/esp/hello_world  
code .
```

```
hello_world_main.c 7 getPort.py ESP-IDF Setup  
main > C hello_world_main.c > app_main(void)  
5 /*  
6  
7 #include <stdio.h>  
8 #include <inttypes.h>  
9 #include "sdkconfig.h" // include errors detected. Please update your includePath. Squiggles are disabled for this translation.  
10 #include "freertos/FreeRTOS.h"  
11 #include "freertos/task.h" cannot open source file "freertos/task.h"  
12 #include "esp_chip_info.h" cannot open source file "esp_chip_info.h"  
13 #include "esp_flash.h" cannot open source file "esp_flash.h"  
14 #include "esp_system.h" cannot open source file "esp_system.h"  
15  
16 void app_main(void)  
17 {  
18     printf("Hello world!\n");  
19  
20     /* Print chip information */  
21     esp_chip_info_t chip_info;  
22     uint32_t flash_size;  
23     esp_chip_info(&chip_info);  
24     printf("This is %s chip with %d CPU core(s), %s%s%s, ",  
25         CONFIG_IDF_TARGET,  
26         chip_info.cores,  
27         (chip_info.features & CHIP_FEATURE_WIFI_BGN) ? "WiFi/" : "",  
28         (chip_info.features & CHIP_FEATURE_BT) ? "BT" : "",  
29         (chip_info.features & CHIP_FEATURE_BLE) ? "BLE" : "",  
30         (chip_info.features & CHIP_FEATURE_IEEE802154) ? " 802.15.4 (Zigbee/Thread)" : "");  
31  
32     unsigned major_rev = chip_info.revision / 100;  
33     unsigned minor_rev = chip_info.revision % 100;  
34     printf("silicon revision %d.%d, ", major_rev, minor_rev);  
35     if(esp_flash_get_size(NULL, &flash_size) != ESP_OK) {  
36         printf("Get flash size failed");  
37         return;  
38     }  
39  
40     printf("%" PRIu32 " MB %s flash\n", flash_size / (uint32_t)(1024 * 1024),  
41         (chip_info.features & CHIP_FEATURE_EMB_FLASH) ? "embedded" : "external");  
OUTPUT DEBUG CONSOLE 7 PORTS  
TERMINAL
```

Hình 1.2: Project hello\_world trên vscode

4. Build project (kết quả biểu diễn ở hình 1.3):

```
idf.py build
```

5. Hiển thị serial port đang kết nối với ESP32 (kết quả biểu diễn ở hình 1.4):

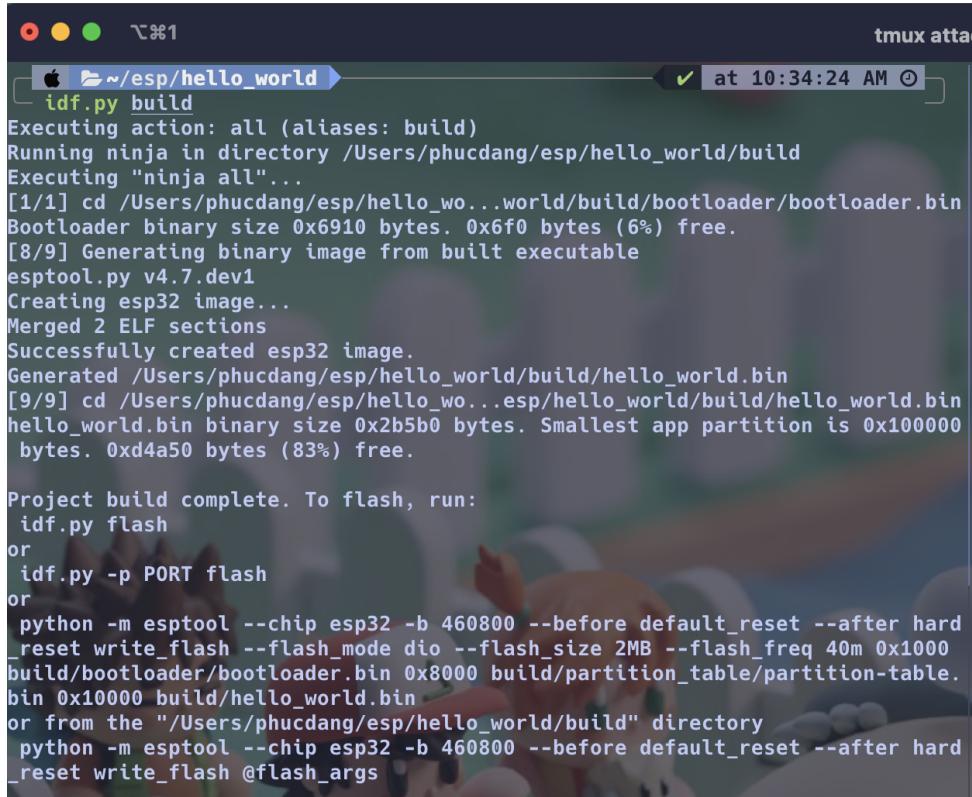
```
import serial.tools.list_ports  
  
for port in list(serial.tools.list_ports.comports()):  
    print(port)
```

6. Nạp code vào ESP32 và show kết quả trên terminal:

```
idf.py -p (port) flash  
idf.py -p (port) monitor
```

## 2 Kết quả

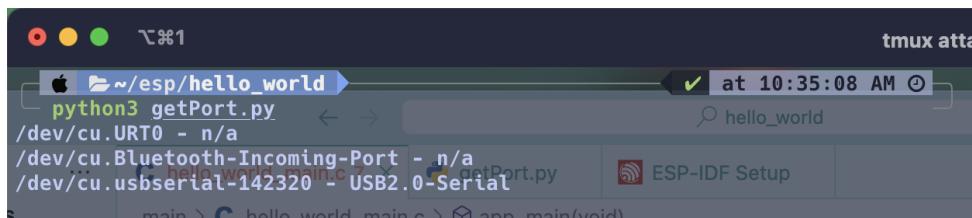
Hình 2.5 và 2.6 biểu diễn kết quả sau khi đã tiến hành chạy với mode **flash** để nạp vào mạch và mode **monitor** để có thể xem kết quả chạy trên ESP32.



```
Executing action: all (aliases: build)
Running ninja in directory /Users/phucdang/esp/hello_world/build
Executing "ninja all"...
[1/1] cd /Users/phucdang/esp/hello_world/build/bootloader
Bootloader binary size 0x6910 bytes. 0x6f0 bytes (6%) free.
[8/9] Generating binary image from built executable
esptool.py v4.7.dev1
Creating esp32 image...
Merged 2 ELF sections
Successfully created esp32 image.
Generated /Users/phucdang/esp/hello_world/build/hello_world.bin
[9/9] cd /Users/phucdang/esp/hello_world/build
hello_world.bin binary size 0x2b5b0 bytes. Smallest app partition is 0x100000
bytes. 0xd4a50 bytes (83%) free.

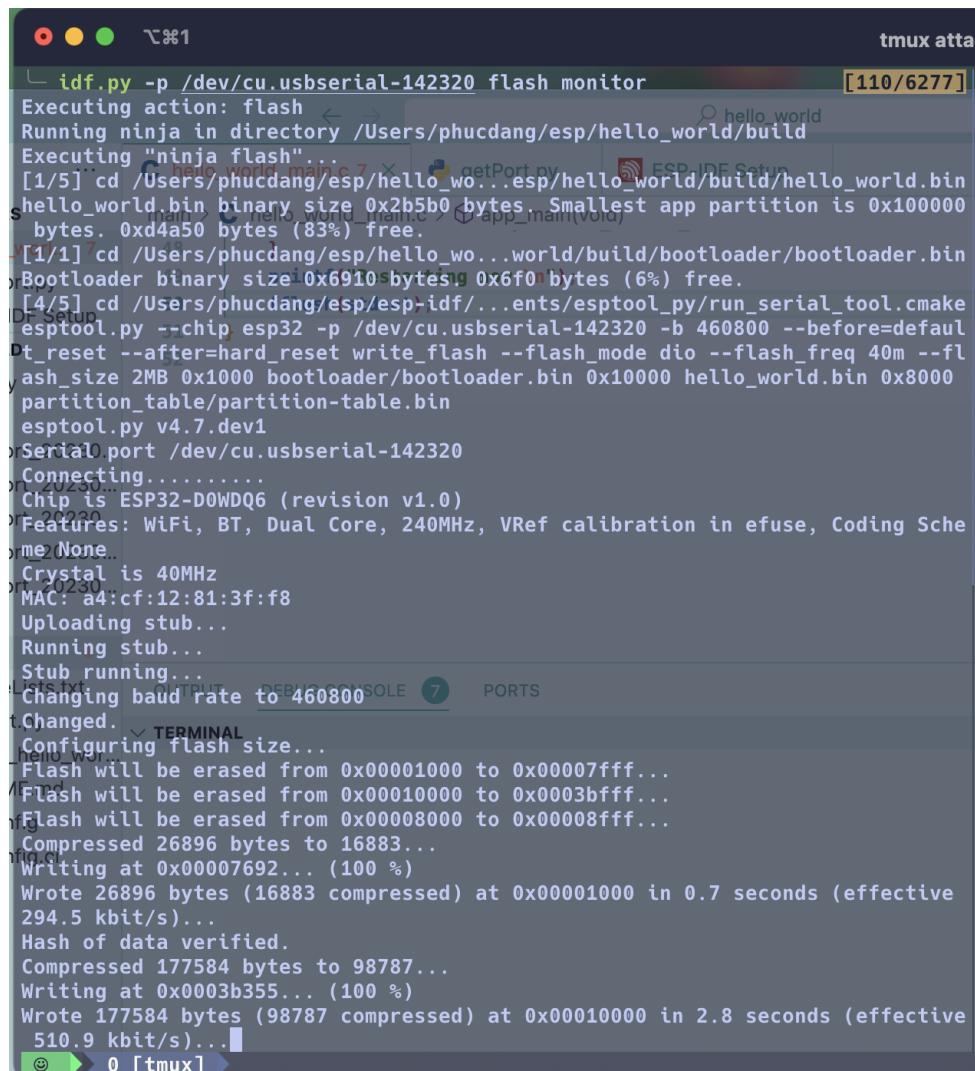
Project build complete. To flash, run:
  idf.py flash
or
  idf.py -p PORT flash
or
  python -m esptool --chip esp32 -b 460800 --before default_reset --after hard
  _reset write_flash --flash_mode dio --flash_size 2MB --flash_freq 40m 0x1000
  build/bootloader/bootloader.bin 0x8000 build/partition_table/partition-table.
  bin 0x10000 build/hello_world.bin
  or from the "/Users/phucdang/esp/hello_world/build" directory
    python -m esptool --chip esp32 -b 460800 --before default_reset --after hard
    _reset write_flash @flash_args
```

Hình 1.3: Build project



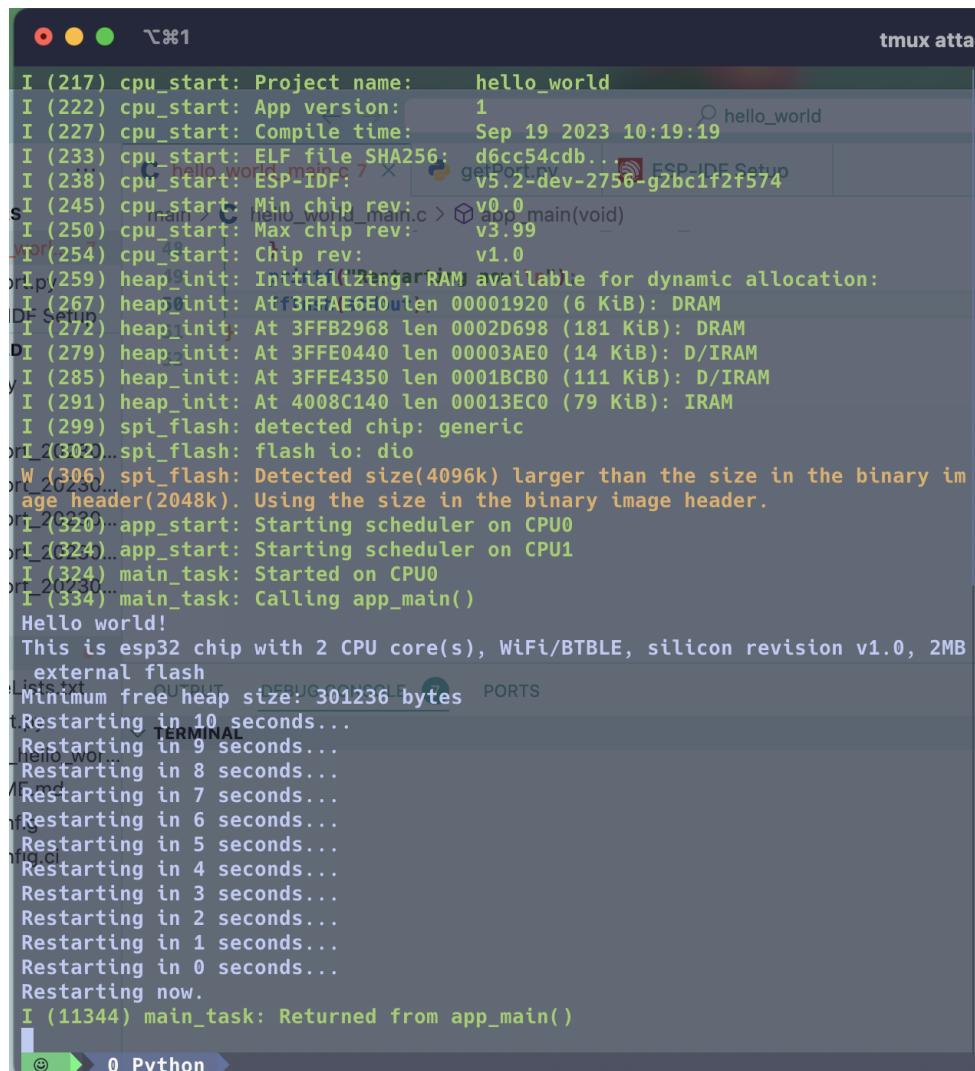
```
python3 getPort.py
/dev/cu.URT0 - n/a
/dev/cu.Bluetooth-Incoming-Port - n/a
/dev/cu.usbserial-142320 - USB2.0-Serial
```

Hình 1.4: Hiển thị các serial port



```
Executing action: flash
Running ninja in directory /Users/phucdang/esp/hello_world/build
Executing "ninja flash"...
[1/5] cd /Users/phucdang/esp/hello_world/build/hello_world.bin
hello_world.bin binary size 0x2b5b0 bytes. Smallest app partition is 0x100000
bytes. 0xd4a50 bytes (83%) free.
[1/1] cd /Users/phucdang/esp/hello_world/build/bootloader/bootloader.bin
Bootloader binary size 0x6910 bytes. 0x6f0 bytes (6%) free.
[4/5] cd /Users/phucdang/esp/esp-idf/.../ports/esptool_py/run_serial_tool.cmake
esptool.py --chip esp32 -p /dev/cu.usbserial-142320 -b 460800 --before=default
--reset --after=hard_reset write_flash --flash_mode dio --flash_freq 40m --flash_size 2MB 0x1000 bootloader/bootloader.bin 0x10000 hello_world.bin 0x8000
partition_table/partition-table.bin
esptool.py v4.7.dev1
Serial port /dev/cu.usbserial-142320
Connecting.....
Chip is ESP32-D0WDQ6 (revision v1.0)
Features: WiFi, BT, Dual Core, 240MHz, VRef calibration in efuse, Coding Scheme None.
Crystal is 40MHz
MAC: a4:cfc:12:81:3f:f8
Uploading stub...
Running stub...
Stub running...
Changing baud rate to 460800
Changed.
Configuring flash size...
Flash will be erased from 0x00001000 to 0x00007fff...
Flash will be erased from 0x00010000 to 0x0003bfff...
Flash will be erased from 0x00008000 to 0x00008fff...
Compressed 26896 bytes to 16883...
Writing at 0x00007692... (100 %)
Wrote 26896 bytes (16883 compressed) at 0x00001000 in 0.7 seconds (effective 294.5 kbit/s)...
Hash of data verified.
Compressed 177584 bytes to 98787...
Writing at 0x0003b355... (100 %)
Wrote 177584 bytes (98787 compressed) at 0x00010000 in 2.8 seconds (effective 510.9 kbit/s)...
0 [tmux]
```

Hình 2.5: Kết quả chạy - 1



```
I (217) cpu_start: Project name:      hello_world
I (222) cpu_start: App version:       1
I (227) cpu_start: Compile time:     Sep 19 2023 10:19:19
I (233) cpu_start: ELF file SHA256:   d6cc54cdb...
I (238) cpu_start: ESP-IDF:          v5.2-dev-2756-g2bc1f2f574
I (245) cpu_start: Min chip rev:    v0.0
I (250) cpu_start: Max chip rev:    v3.99
I (254) cpu_start: Chip rev:        v1.0
I (259) heap_init: Initializing RAM available for dynamic allocation:
I (267) heap_init: At 3FFAE6E0 len 00001920 (6 KiB): DRAM
I (272) heap_init: At 3FFB2968 len 0002D698 (181 KiB): DRAM
I (279) heap_init: At 3FFE0440 len 00003AE0 (14 KiB): D/IRAM
I (285) heap_init: At 3FFE4350 len 0001BCB0 (111 KiB): D/IRAM
I (291) heap_init: At 4008C140 len 00013EC0 (79 KiB): IRAM
I (299) spi_flash: detected chip: generic
I (302) spi_flash: flash io: dio
W (306) spi_flash: Detected size(4096k) larger than the size in the binary image header(2048k). Using the size in the binary image header.
I (320) app_start: Starting scheduler on CPU0
I (324) app_start: Starting scheduler on CPU1
I (324) main_task: Started on CPU0
I (334) main_task: Calling app_main()
Hello world!
This is esp32 chip with 2 CPU core(s), WiFi/BTBLE, silicon revision v1.0, 2MB external flash
Minimum free heap size: 301236 bytes
PORTS
t Restarting in 10 seconds...
Restarting TERMINAL
Restarting in 9 seconds...
Restarting in 8 seconds...
Restarting in 7 seconds...
Restarting in 6 seconds...
Restarting in 5 seconds...
Restarting in 4 seconds...
Restarting in 3 seconds...
Restarting in 2 seconds...
Restarting in 1 seconds...
Restarting in 0 seconds...
Restarting now.
I (11344) main_task: Returned from app_main()
```

Hình 2.6: Kết quả chạy - 2