



science
& technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA



SARAO
South African Radio
Astronomy Observatory

Building a self watering plant using Micropython on a WIFI enabled arduino esp8266

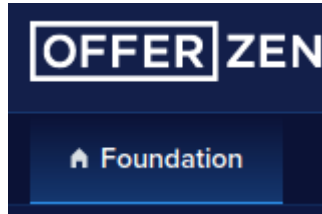
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Junior Software Engineer



www.ska.ac.za

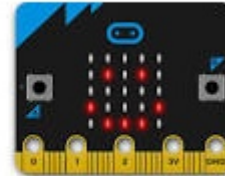
The South African Radio Astronomy Observatory (SARAO) is a National Facility managed by the National Research Foundation and incorporates all national radio astronomy telescopes and programmes. SARAO is responsible for implementing the Square Kilometre Array (SKA) in South Africa.

How it started

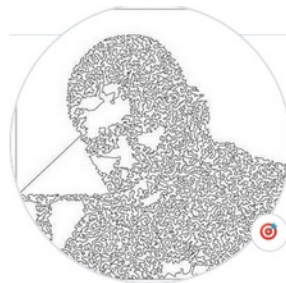
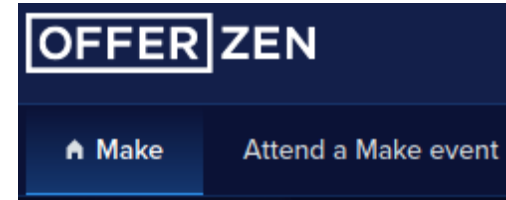


Micro Bit

★★★★★ (169)



Why



Mpho Mphogo
mmphego

Overview repositories 81 Projects 1 Packages

mmphego / README.md

I'm a Maker.

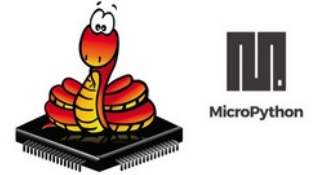
IoT, Raspberry Pi, Arduino, MicroPython, ESP8266/ESP32.

Overview

- ☐ What is Micropython/uPython
- ☐ Micropython vs Circuit Python
- ☐ Arduino vs Micropython
- ☐ Micropython in Microcontrollers
- ☐ Demo (Self Watering Plant)
 - ☐ How
 - ☐ Information Insights.

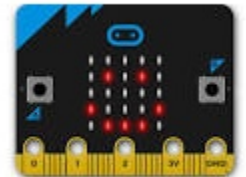
What is Micropython/uPython

- ☐ Tiny open source python programming language interpreter
- ☐ Runs on small embedded development boards like the bbc micro bit
- ☐ Capabilities
 - ☐ Control hardware & connected devices
 - ☐ Read analogue sensors
 - ☐ network & wifi Support (Board dependant)
 - ☐ And many more
- ☐ Features
 - ☐ Interactive REPL(Read Eval Print Loop)
 - ☐ Extensive Software library
 - ☐ Extensibility

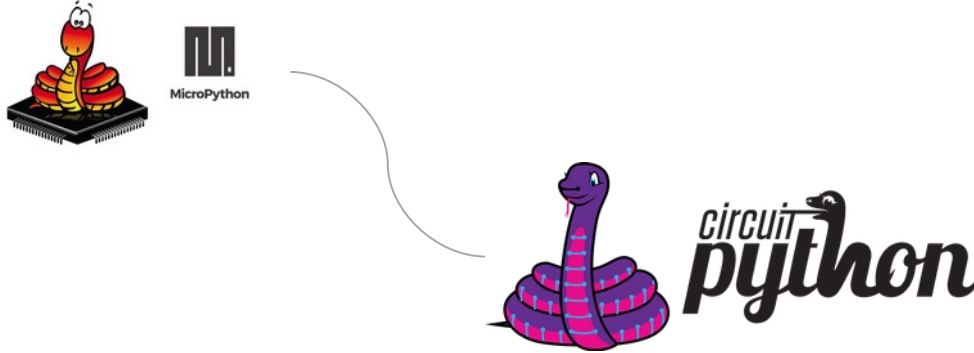


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Micropython and Circuit Python

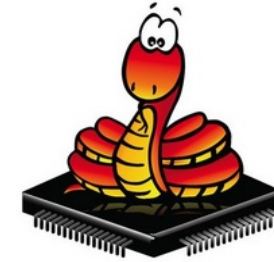


- ☐ Circuit python is adafruit's open source derivative of micropython
- ☐ Adds support for easily getting started with electronics
- ☐ core language is the same for micropython and circuit python
- ☐ Slightly differ in api`s for accessing hardware components

Arduino vs MicroPython



VS



- ☐ Entire Ecosystem
- ☐ Compiled programming language
- ☐ Maximum performance saving memory

- ☐ Just a programming language
- ☐ Interpreted Programming language
- ☐ Less performance and more memory usage

With Micropython you can write clean and simple python code instead of having to use complex low level languages like C(what arduino uses).

Micropython in Microcontrollers

- ☐ Flash firmware
- ☐ Using micropython in REPL(Read Eval Print Loop) prompt
- ☐ Using micropython in WEBREPL - Prompt via WIFI(Microcontrollers with WIFI)
- ☐ Using a text editor extensions - VSCODE
- ☐ Main scripts
- ☐ Manipulating Files & Running micropython code

Micropython in Microcontrollers

Flash firmware

- ☐ Download latest Micropython Firmware
- ☐ Put microcontroller in boot-loader mode(Process is board specific.)
- ☐ boot-loader mode will allow a swift flashing of the new firmware
- ☐ esptool is a utility used to communicate with ROM bootloader in esp8266 & esp32 series chips
 - ☐ Available via “pip” or clone the github repo.
- ☐ Recommended to erase entire flash of microcontroller before new firmware update.
 - ☐ esptool example

```
esptool.py --port <tty port device> erase_flash
```

Micropython in Microcontrollers

Flash firmware Cont...

- ❑ Flash downloaded firmware using the esptool(linux) or similar alternative for other OS.

- ❑ esptool example

```
esptool.py --port <tty port device> --baud <baudrate> write_flash --  
flash_size=detect 0 <new-firmware>.bin
```

Micropython in Microcontrollers

REPL(Read Eval Print Loop) prompt

☐ Using micropython in REPL prompt

use terminal emulator program like Teraterm(windows),
picocom(linux) similar in other operating systems to access REPL
picocom <tty port device> -b<baudrate>

```
picocom /dev/ttyUSB0 -b115200
```

☐ Using micropython in WEBREPL - Prompt via WIFI

- ☐ WebREPL client is hosted <http://micropython.org/webrepl>
- ☐ configure microcontroller as an AP before connecting to WEBREPL
- ☐ To access WEBREPL connect computer to microcontroller`s AP.

Micropython in Microcontrollers

Using a text editor extensions - VSCODE

- ☐ Download Micropython IDE extension
 - ☐ Launch VS Code Quick Open and paste the command
ext install dphans.micropython-ide-vscode
- ☐ Requirements
 - ☐ ampy - utility that allows you to interact with file system created on the chip
 - ☐ rshell - Remote shell for micropython
- ☐ Features
 - ☐ Manage projects
 - ☐ Run and Stop scripts
 - ☐ Flash new firmware

Micropython in Microcontrollers

Main scripts

boot.py

- ☐ Script that runs when board boot up or wake up from sleep
- ☐ Should contain low level code that sets up the board

main.py

- ☐ If exist, it runs *boot.py*
- ☐ Should contain any main script that needs to run when the board is powered up or reset

Micropython in Microcontrollers

Manipulating Files & Running micropython code

- ☐ Ampy is a utility that allows you to interact with file system created on the chip.
- ☐ We`ll use ampy to show how to:
 - ☐ Manipulate Files
 - ☐ Run micropython code
- ☐ Ampy is a simple cross-platform command line tool that offers enough functionality without being too complex
- ☐ There are alternatives like rshell for manipulating files and more on a microcontroller.

MicroPython in Microcontrollers

Usage: ampy [OPTIONS] COMMAND [ARGS]...

ampy - Adafruit MicroPython Tool

Ampy is a tool to control MicroPython boards over a serial connection. Using ampy you can manipulate files on the board's internal filesystem and even run scripts.

Options:

-p, --port PORT	Name of serial port for connected board. Can optionally specify with AMPY_PORT environment variable. [required]
-b, --baud BAUD	Baud rate for the serial connection (default 115200). Can optionally specify with AMPY_BAUD environment variable.
-d, --delay DELAY	Delay in seconds before entering RAW MODE (default 0). Can optionally specify with AMPY_DELAY environment variable.
--version	Show the version and exit.
--help	Show this message and exit.

Commands:

get	Retrieve a file from the board.
ls	List contents of a directory on the board.
mkdir	Create a directory on the board.
put	Put a file or folder and its contents on the board.
reset	Perform soft reset/reboot of the board.
rm	Remove a file from the board.
rmdir	Forcefully remove a folder and all its children from the board.
run	Run a script and print its output.

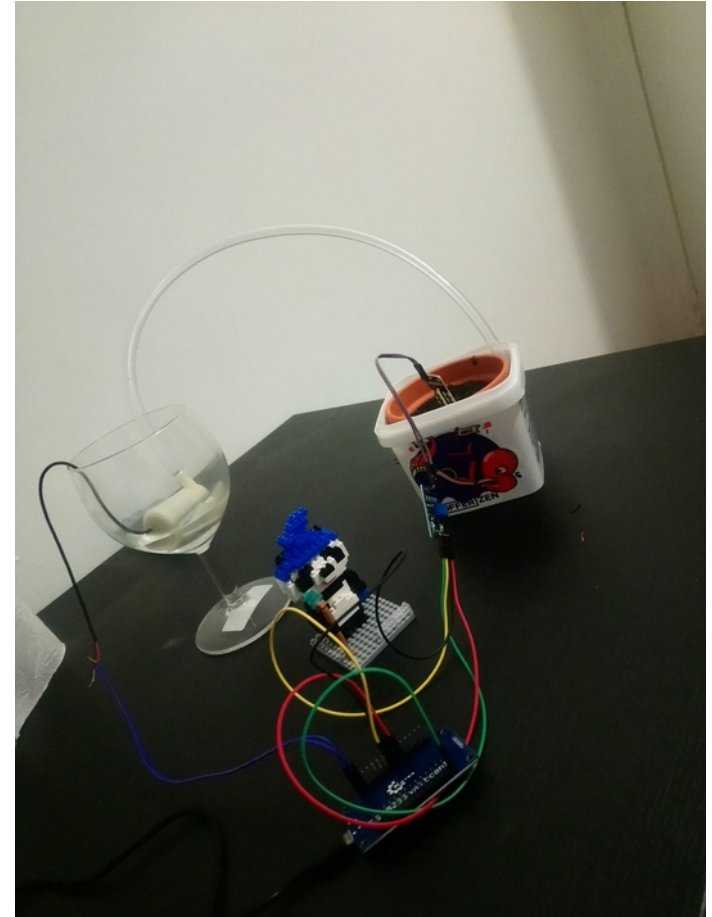
Manipulate Files

Running
micropython
code

Demo(Self Watering Plant)

What you need

- ☐ ESP8266 (NodeMCU) Board
- ☐ Moisture Sensor
- ☐ Micro USB to USB cable
- ☐ Water Pump
- ☐ Dupont F-F(jump) wires
- ☐ Connectors for pump
- ☐ Transistor TIP31C
- ☐ Plant and pot for the plant

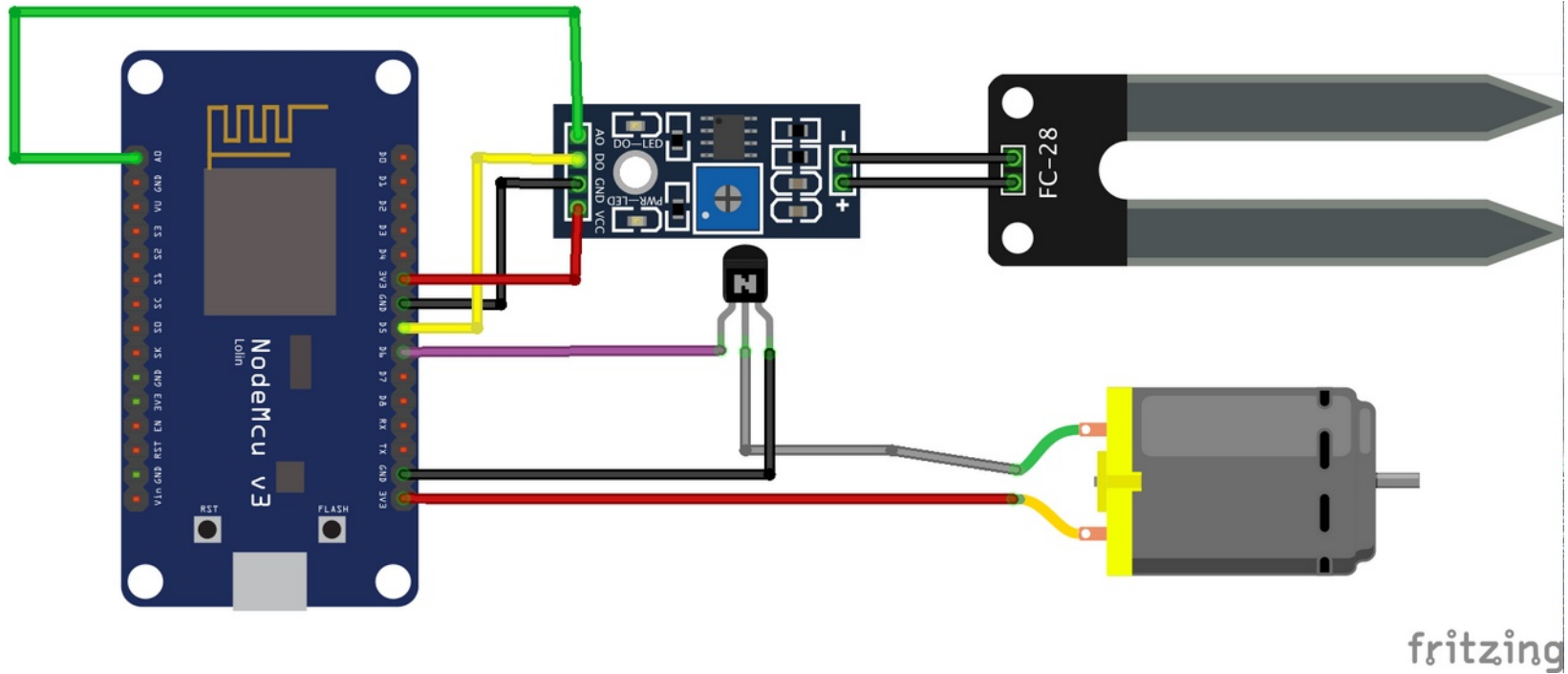


How

- ☐ Setup esp8266 board(Flash firmware)
- ☐ Watering system diagram
- ☐ Calibrate moisture sensor
- ☐ Setup water pump
- ☐ Group everything together.

How

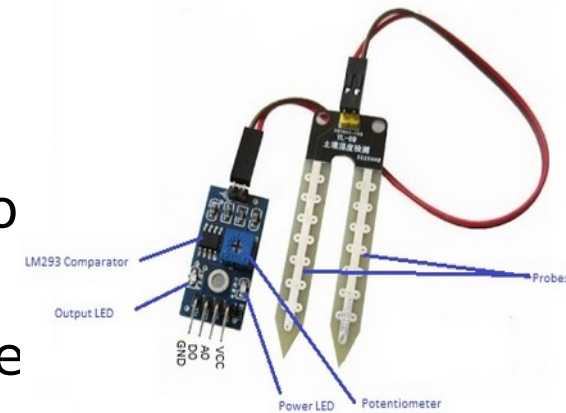
Watering system diagram



How

Calibrate moisture sensor

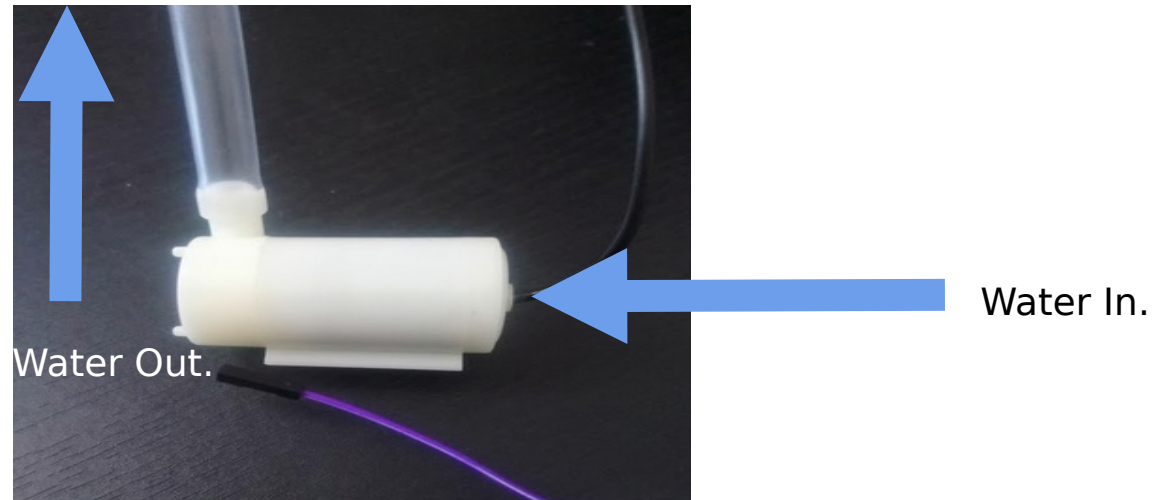
- ☐ Connect the sensor to the board.
 - ☐ Check the above diagram see where it wo connect to the board
 - ☐ Dip the sensor in a bowl of water and take the reading.
 - ☐ Wipe the sensor completely dry and take the reading.
- ☐ The sensor has both an analogue (0 for wet and 1024 for completely dry) and a digital (LOW / 0 for wet and HIGH / 1 for dry) output



How

Setup water pump

- ☐ The water pump is submersible, sucks in water from the whole and pumps it out from the little outlet.
- ☐ It needs to be connected to the board with the TIP31C transistor in order to switch it on and off



How

Group everything together.

- ☐ System run 24/7. Every 15 minutes it checks the sensors in the following order and acts accordingly.
 - ☐ Average last 10 readings from moisture sensor and get a percentage
 - ☐ if soil humidity is less than 70% in pot plant, activate(turn on) water pump for 3 seconds the turn off.

Information insights.



soil sensor APP 9:17 AM

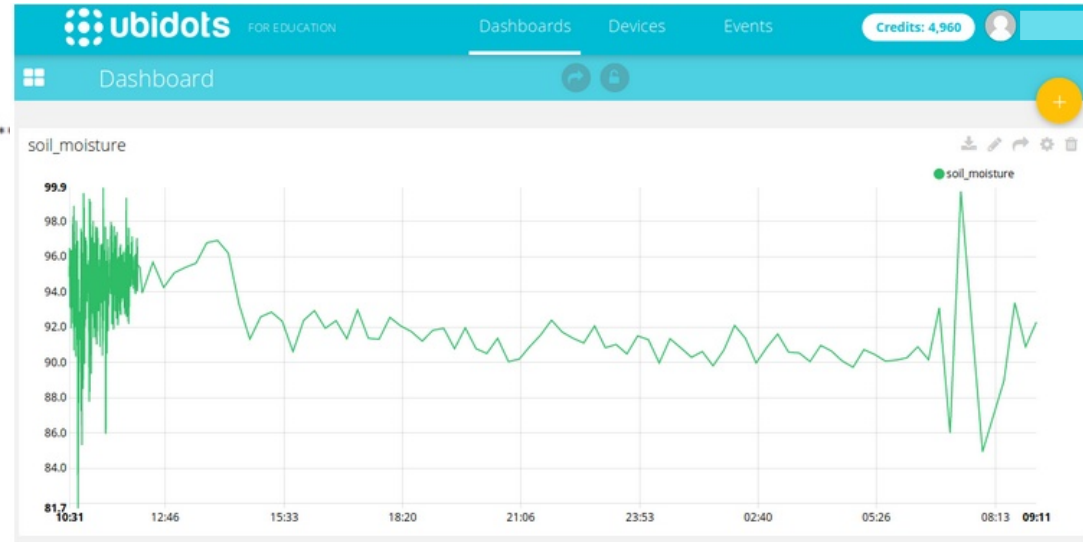
[INFO] Soil Moisture Sensor: 75.53% 2019-8-25 09:27:27

[INFO] Note: Automatically watering the plant(s): 2019-8-25 09:29:29

Turning Pump On: 2019-8-25 09:30:30

Turning Pump Off: 2019-8-25 09:34:34

[INFO] Soil Moisture Sensor: 73.13% 2019-8-25 09:18:18



source: [I built an automated irrigation system, because i'm lazy](#)

Information insights.



python
telegram
bot



Using Python 3



End.

Special Thanks to

Mpho Mphego



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End

Questions

