SPARK Project Challenges I

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Dated: October 1, 2021

Github Project Link: `https://github.com/SPARK-UoM/Raspberry-Pi-Labs`

Contents

1 Introduction

SPARK project challenges allow learning Raspberry Pi as well as Linux systems. In our day-to-day life, we need to control our household electronics even we are not around, and going outside at night may be dangerous. Furthermore, there are some devices we turn on/off at a specific time every day. For example,

- The Garden lights should turn on at 7 p.m, and turn off at 5 a.m.
- We have to control lights in our home when we are on a trip.
- Turn on outside lights before we step outside at night.

So, our first project is an IoT device to manipulate electronic devices.

2 Project Outcomes

By doing this project, you will learn,

- To properly set up the "apache2" server on raspberry pi
- To manipulate GPIO using python
- To control high power electronics using relay module
- To port forward

3 Item List

For our first project, you will need,

- A relay module (with several relays for your need)
- A 5V DC power supply
- A Raspberry PI with python GPIO package installed (in "Raspbian OS" already installed
- 3.3v to 5v logic level shifter
- Connecting Wires
- 2 - Core Wires
- A 3 pin plug

4 The Circuit Connection

In this particular example, we have used a 4-relay module. You can use any module and edit scripts for your needs. The allocated GPIO pins are GPIO 4,17,22 and 27.

1. First, connect the relay module to the 5V power supply and RPi to its power supply.

2. Then connect RPi's ground with Relay module's ground.

3. After that, connect allocated GPIO pins with level shifter module's inputs, and shifted outputs to relay module's input

4. Finally, connect AC load via the relay

5 Project Abstraction

This project consists of three simple subunits.

- Web server and PHP script

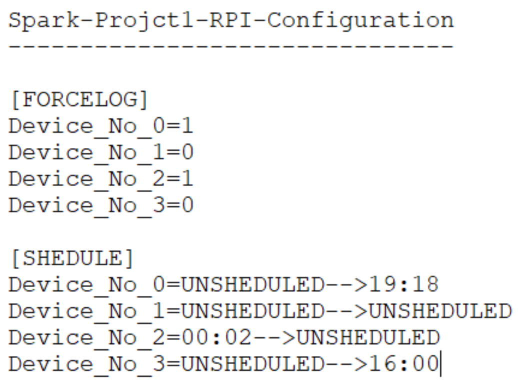
- Configuration File

- Main python scripts

The web server will present a user with an interface via a web browser. The user can control the entire system using only the given interface. When the user submits a specific instruction set, it will be written in the configuration file by the PHP script. Meanwhile, there is a python script (main script) running in the background. It periodically checks the configuration file every 5 seconds. If the script detects a change, it will update the GPIO pin status according to that.

6 Program Explanation

6.1 Configuration File



```
Spark-Projct1-RPI-Configuration
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[FORCELOG]
Device_No_0=1
Device_No_1=0
Device_No_2=1
Device_No_3=0

[SHEDULE]
Device_No_0=UNSHEDULED-->19:18
Device_No_1=UNSHEDULED-->UNSHEDULED
Device_No_2=00:02-->UNSHEDULED
Device_No_3=UNSHEDULED-->16:00
```

The file contains settings for two modes of operation. The ”Force Log” contains the current requirements of the user. And the schedule contains the periodic On/Off states and their times. In the Schedule section, the setting follows the below formatting.

$$[DeviceID] = [StartTime] - - > [EndTime]$$

6.2 PHP Script

6.2.1 index.php

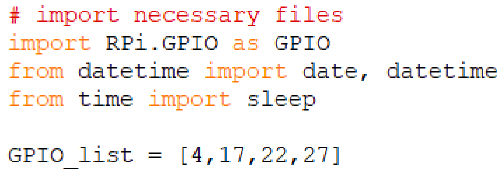
The index file is responsible for the user interface. From line 9 to 37, it reads the configuration file and stores the setting to the ”config” array (line 2). After that, it creates a simple HTML form for input settings. Finally, it fills the input fields with the data fetched from the configuration file. When the user edits and submits a new setting, the form sends those data to submission.php via the POST method.

6.2.2 submission.php

The submission file fetches the data via the POST method. After that, it extracts the data and stores it in the ”config” array (line 2). From line 35 to 45, it writes those data to the configuration file for a predefined format.

6.3 Python Script

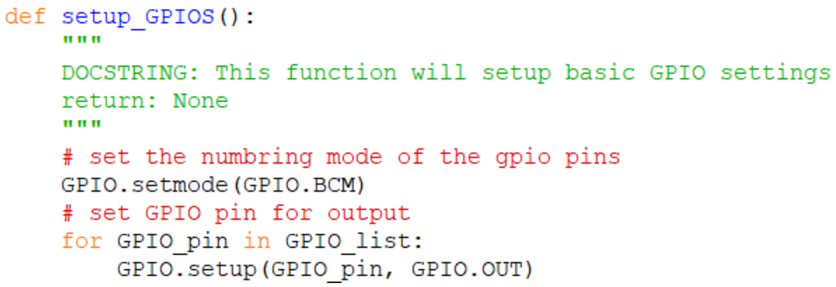
The main script is responsible for detecting the change of the setting and act accordingly.



```python
# import necessary files
import RPi.GPIO as GPIO
from datetime import date, datetime
from time import sleep

GPIO_list = [4,17,22,27]
```

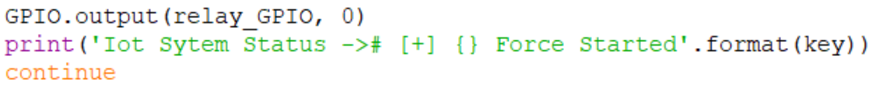
First, we must include the RPi library to handle GPIO pins of the raspberry pi. For some reason, if you don't have the library installed, you can do so using the command **"pip install RPi.GPIO"**. First, we must include the RPi library to handle GPIO pins of the raspberry pi. For some reason, if you don't have the library installed, you can do so using the command. Then datetime and time libraries are used to get the current time and handle delays. You can find `GPIO documentation here`.



```
def setup_GPIOS():
    """
    DOCSTRING: This function will setup basic GPIO settings
    return: None
    """
    # set the numbring mode of the gpio pins
    GPIO.setmode(GPIO.BCM)
    # set GPIO pin for output
    for GPIO_pin in GPIO_list:
        GPIO.setup(GPIO_pin, GPIO.OUT)
```

Next, we must initialize GPIO pins. For that, we should define the numbering system of the pins. After defining the numbering system, we should define the data direction of the pins. The two numbering schemes we can use for Rpi are,

- Broadcom chip-specific pin numbers (This is the numbering system provided by the RPi foundation)
- BOARD - This follows the numbering on board starting with the first pin as 1



```
GPIO.output(relay_GPIO, 0)
print('Iot Sytem Status -># [+] {} Force Started'.format(key))
continue
```

Finally, Using the given settings, we update the GPIO pins.

7 Installing Apache2

Apache2 is a famous web server used worldwide. Furthermore, we are not only focusing on apache2 but on installing PHP, MySQL, PHPMyAdmin, and databases. The installation procedure in Linux systems is very straightforward. So, fire up your terminal and run the commands below. You can find `YouTube Tutorial here`.

1. sudo apt update
2. sudo apt upgrade
3. sudo apt install apache2
4. sudo apt install php7.3
5. sudo apt install mariadb-server

6. sudo apt install mariadb-client

7. sudo apt install php-mysql

8. sudo apt install phpmyadmin

8 Port Forwarding

Note: Port forwarding is not mandatory for this project.
Port forwarding is used to allow remote computers to connect to a specific computer in our Local Area Network (LAN). If you enable port forwarding to your RPi, you can control the system even if you are not connected to the home router.The procedure of port forwarding varies from router to router. Therefore, I will provide you with a very famous website `portforward.com` which has instructions for a wide variety of routers.

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