User Interface for the Drone

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Part I

Drone Subsystems

1. Terminology
2. User Controls
3. Drone Subsystems
4. Step wise Development

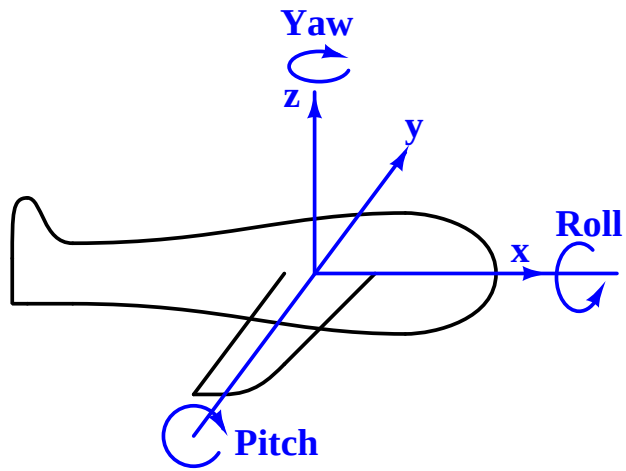
Terminology

It is useful to understand terms which are frequently used for flying and sailing objects. Consider an object flying along the x direction.

Yaw: is rotation around the vertical axis. (Left and right turn from the direction of motion).

Roll: is rotation around the direction of motion (x axis). (Movement of wing tips in opposite up/down direction).

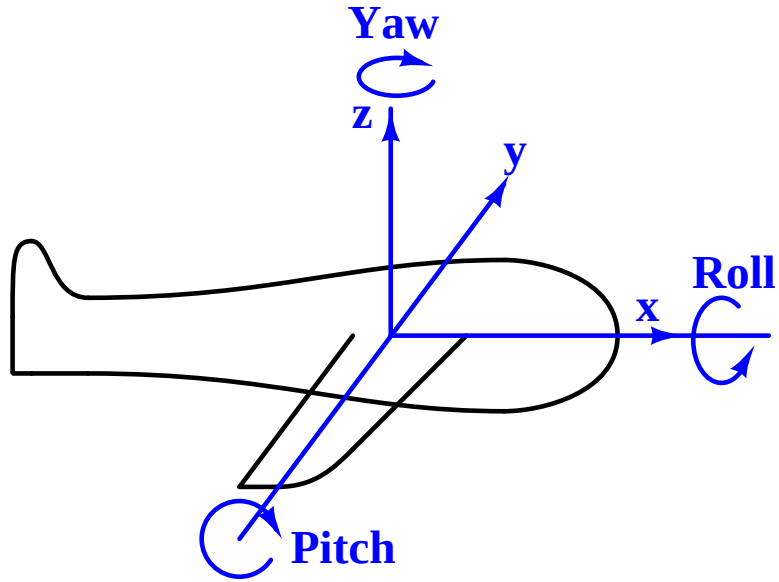
Pitch: is rotation around the y axis. (Up/down movement of the nose of the aircraft with respect to its tail).



Commanding the Drone

To fly the drone, we need to send commands to it to control and adjust:

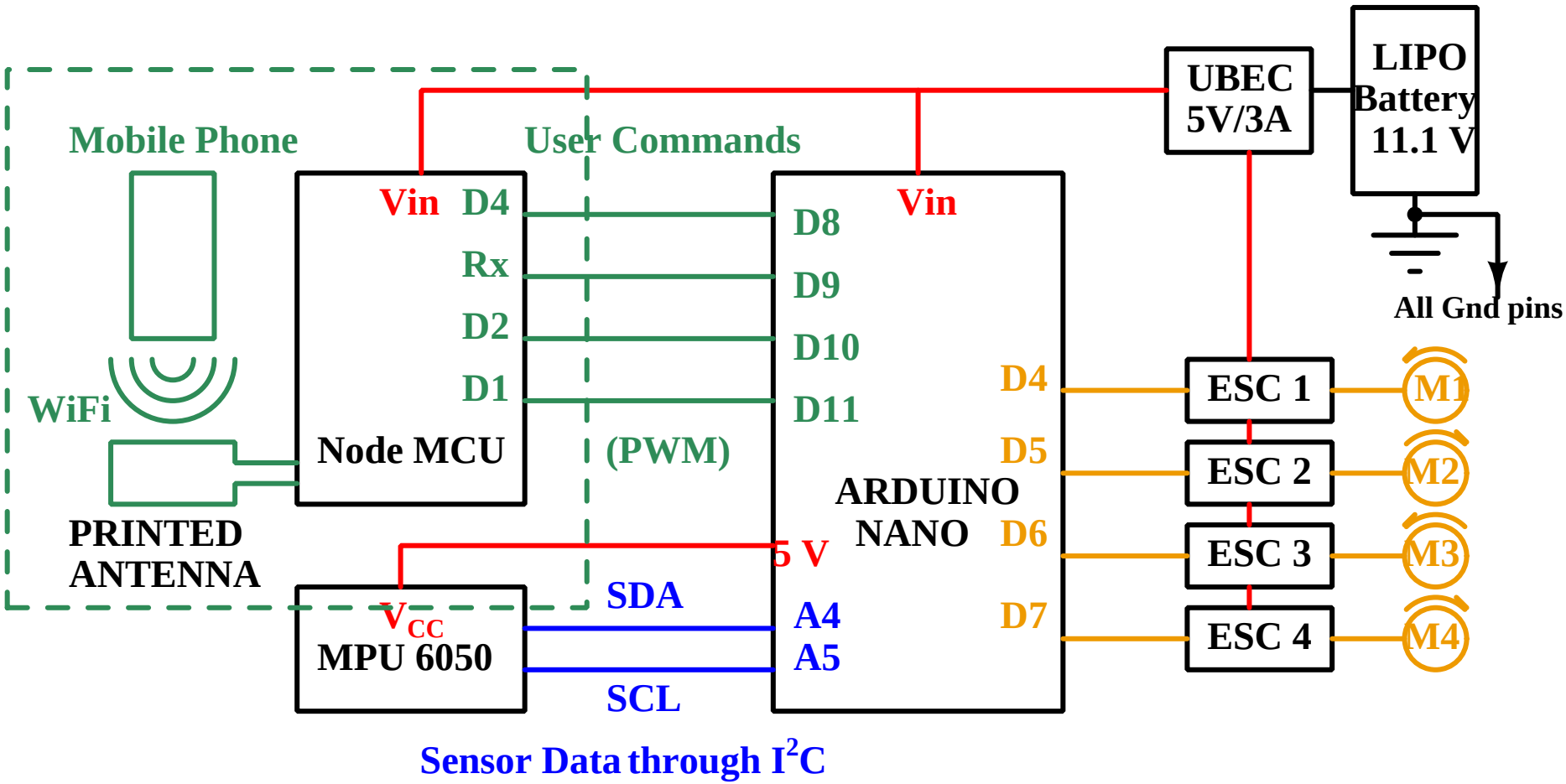
1. Its speed – (throttle),
2. its left-right turn orientation (Yaw),
3. its up/down orientation (Pitch) and
4. its left-right tilt (Roll).



This will be done by a mobile app with two joy-stick like controls and a switch. One joystick will control the pitch and roll, while the other will control throttle and yaw.

The switch will be used to “arm” the human interface. Only when the interface is armed, the user interface will pay attention to commands.

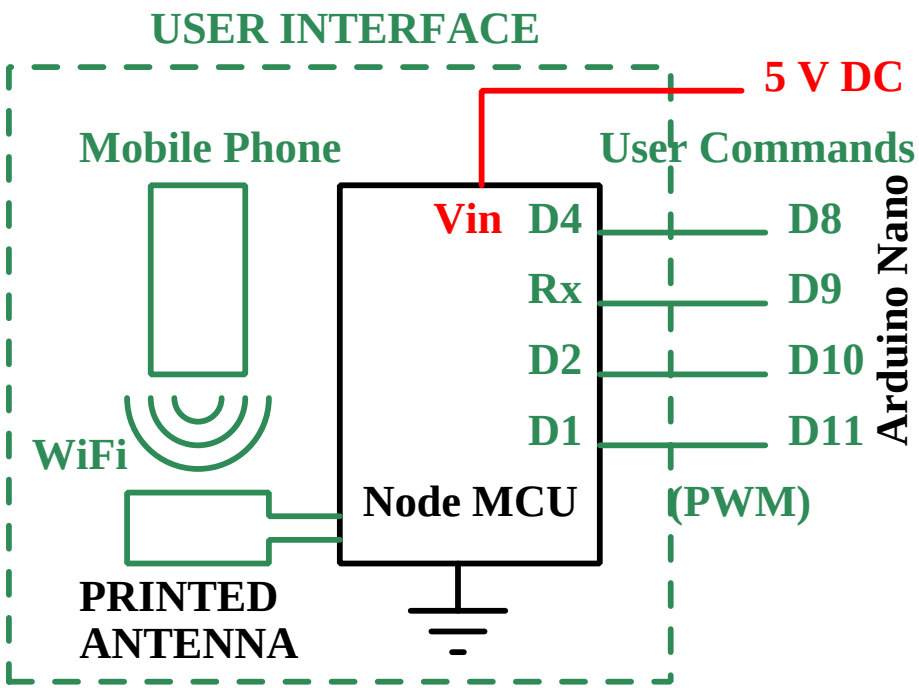
Block Diagram



User Interface

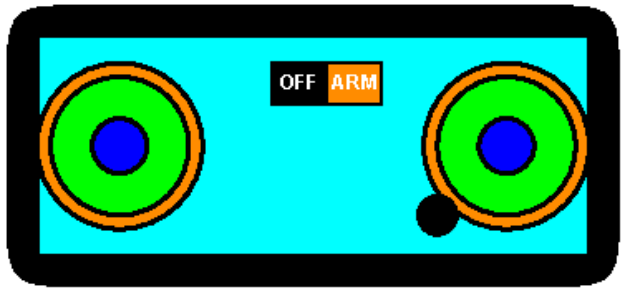
Components of the user interface in the drone are:

- A mobile phone with an app (RemoteXY) loaded on it. The mobile pone connects to the drone using WiFi.
- The WiFi signal from the mobile phone is received using a printed antenna. This is amplified and decoded by the Node MCU 8266 unit.
- The node MCU unit has a WiFi module (WiFi 8266) and a 32 bit processor from Tensilica.



Mobile App

- We'll use a mobile application called RemoteXY to make the user interface on the mobile.
- The graphical pattern can be designed using an on-line graphical editor at: https://remotexy.com



- The graphical editor at RemoteXY.com requires one to choose the combination of hardware/software over which the app is going to operate.
- It outputs a sketch appropriate for the chosen hardware/software combination, containing a data structure which will be exported through WiFi (in our case) by the node MCU card to the mobile, to form the pattern on the mobile screen.
- The sketch will run on the node MCU 8266 – **not** on the Nano!

Task list for Installing User Interface

1. Install RemoteXY app from the link placed on moodle. (Apple users from App store).
2. Connect the NodeMcu card to your laptop using the cable supplied in your took kit.
3. Open the IDE. Now go to:
   File→Preferences and in the box at the bottom of the form, fill in the following url's (one by one)
   http://arduino.esp8266.com/stable/package_esp8266com_index.json
   https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json
   (These can be cut and pasted from the file url.txt available on moodle). **Click on OK**.

   This adds the Node MCU WiFi 8266 card to the boards index.

Task list for Installing User Interface . . .

4. Now go to Tools→Board→Boards Manager.
   Type esp32 and click on “Install” for all esp32 boards.
5. In your IDE, go to sketch→Include Library→ Library Manager.
   Fill in RemoteXY in the box and click on “INSTALL”.

   Now we are ready to compile and upload programs written for the processor on the NodeMcu card.
6. Download from moodle, the zipped file “Drone wifi v1.zip”. Unzip it in the folder where you keep your sketches.
   This will create a sub-folder called “Drone wifi”, which in turn contains the folder “step(0)-remote xy” (among others).
   “step(0)-remote xy” folder contains the folder containing the sketch dual_joystick, which we are going to compile.

Task list for Installing User Interface . . .

7. Compile and upload the sketch “dual_joystick.ino. For this:
   - Click on File→open in the IDE, and choose the sketch dual_joystick.
   - This sketch adds project specific code to the skeleton software generated by the RemoteXY web site. The wifi name and password are hard coded in it. **Change the passwords to something specific to your group.**
   - Now choose the board NodeMcu 0.9 and the COM port appropriate for your IDE.
   - compile and download the sketch to the node MCU card.

Now we are ready to communicate with the user interface.

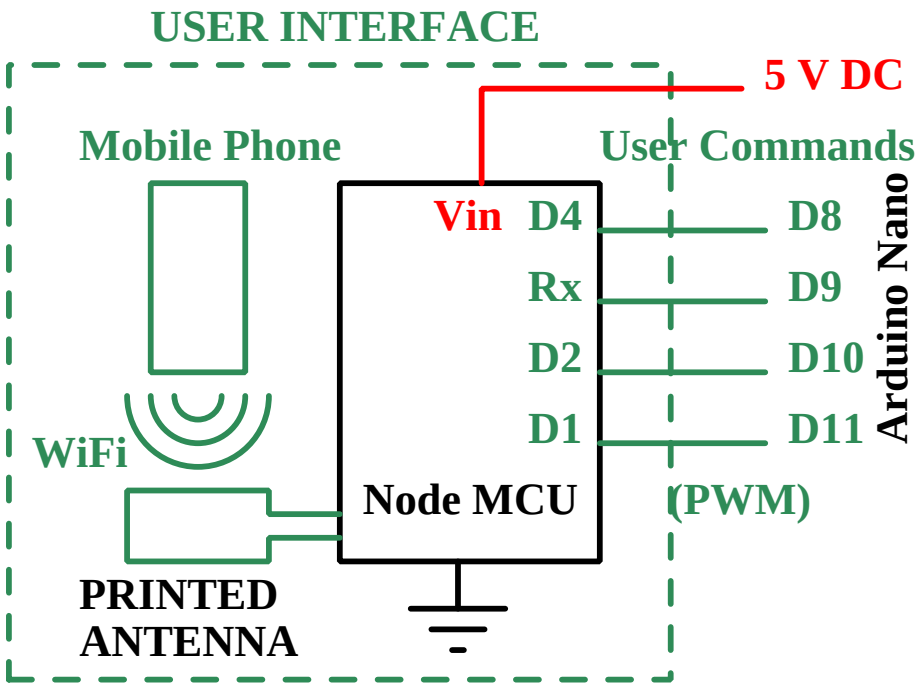
Communicating with the Drone using a mobile phone

8. Start the RemoteXY app and using the ”+” tab, look for the WiFi named RemoteXY.
   - Provide the passwords for connecting to the wifi and then the password to connect to the card.
   - Your mobile app will connect to the card through WiFi and the graphical pattern for the two joysticks and a switch will show up on your mobile.
   - In the IDE on your laptop, turn on the monitor to view the output.
   - Turn on the “arm” switch on your app and you will see the output as a series of lines, each containing 4 values.
     These represent roll/pitch/yaw/throttle values as set by the joystick positions.
   - Check the range of values over which the four parameters change at the extreme x and y positions of the joysticks.

Task list for Installing User Interface . . .

9. Now we can see the effect of manipulating the joysticks on the output pins of the node MCU card on an Oscilloscope.

- Connect the oscilloscope to each of the outputs D1, D2, Rx and D4.
- Observe the wave form as you manipulate the four controls.
- You will find that the pulse width changes in response to manipulation of a specific parameter for a given output pin.



This establishes that the user interface is working.