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Booklets

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Title: Microcontroller lab with remote connectivity and control of virtual instruments

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INDEX

HOME

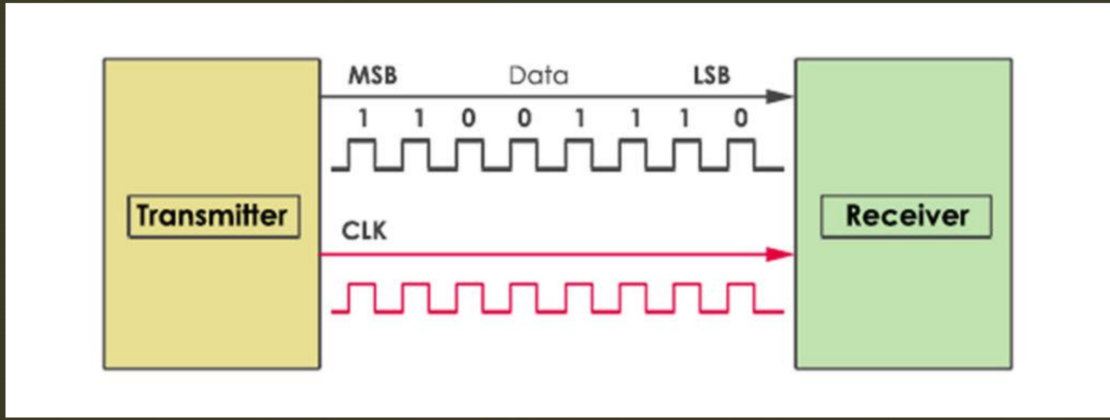
ABSTRACT

- This article shows a learning alternative for undergraduate engineering students, who due to force majeure do not attend their practices or projects in a face-to-face manner in the subject of microcontrollers. This guarantees a hybrid teaching-learning process, where students can interact remotely with control boards located in laboratories and workshops. To achieve this task, the syllabus of this subject was consulted, a series of practices were selected and with them the use of graphical interfaces for visualization and control of virtual instruments was developed, which through a USB-Serial RS232 adapter communicates with the transmission (Tx) and reception of data (Rx) ports of the PIC18f4550 microcontroller, thus allowing control actions on output actuators. Finally, the remote connection is made, through the NodeMCU development board based on the ESP8266 chip and a mobile application developed in Blynk, allowing the student to learn in a more didactic way. The implementation of this type of alternative is intended to ensure quality education at the higher level, in situations where students do not have the availability to attend the facilities of their academic institution.

INDEX

INTRODUCTION

- Teaching-Learning Process
- Microcontrollers
- Virtual Instrumentation
- Serial Protocols
- Internet of things
- Mobile Apps
- Remote Laboratories



INDEX

Virtual Instrumentation

- A virtual instrumentation system is computer software that a user would employ to develop a computerized test and measurement system, for controlling from a computer desktop an external measurement hardware device, and for displaying test or measurement data collected by the external device on instrument-like panels on a computer screen.

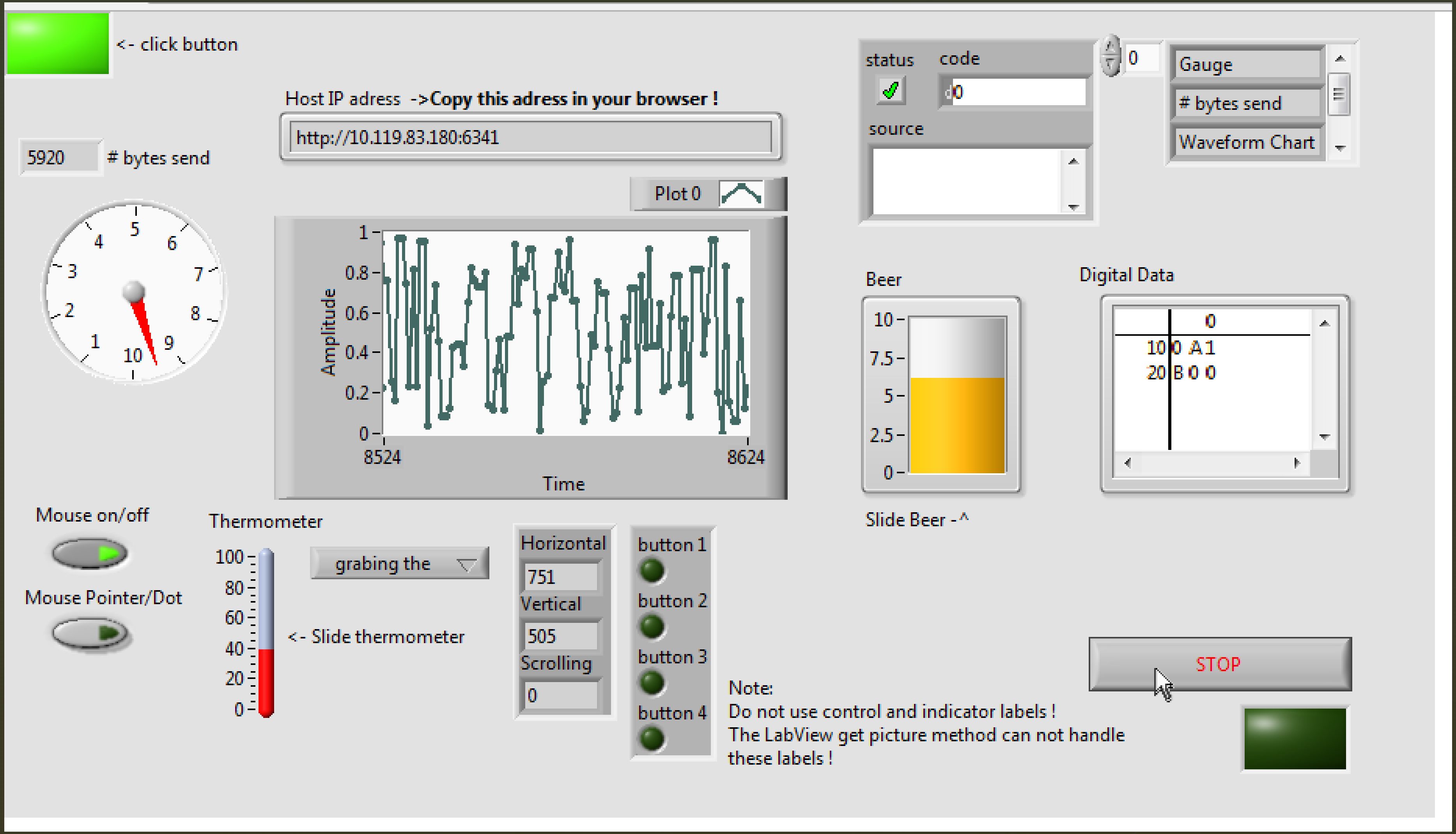
Frontal Panel

Programming Environment

On-Off DC motor

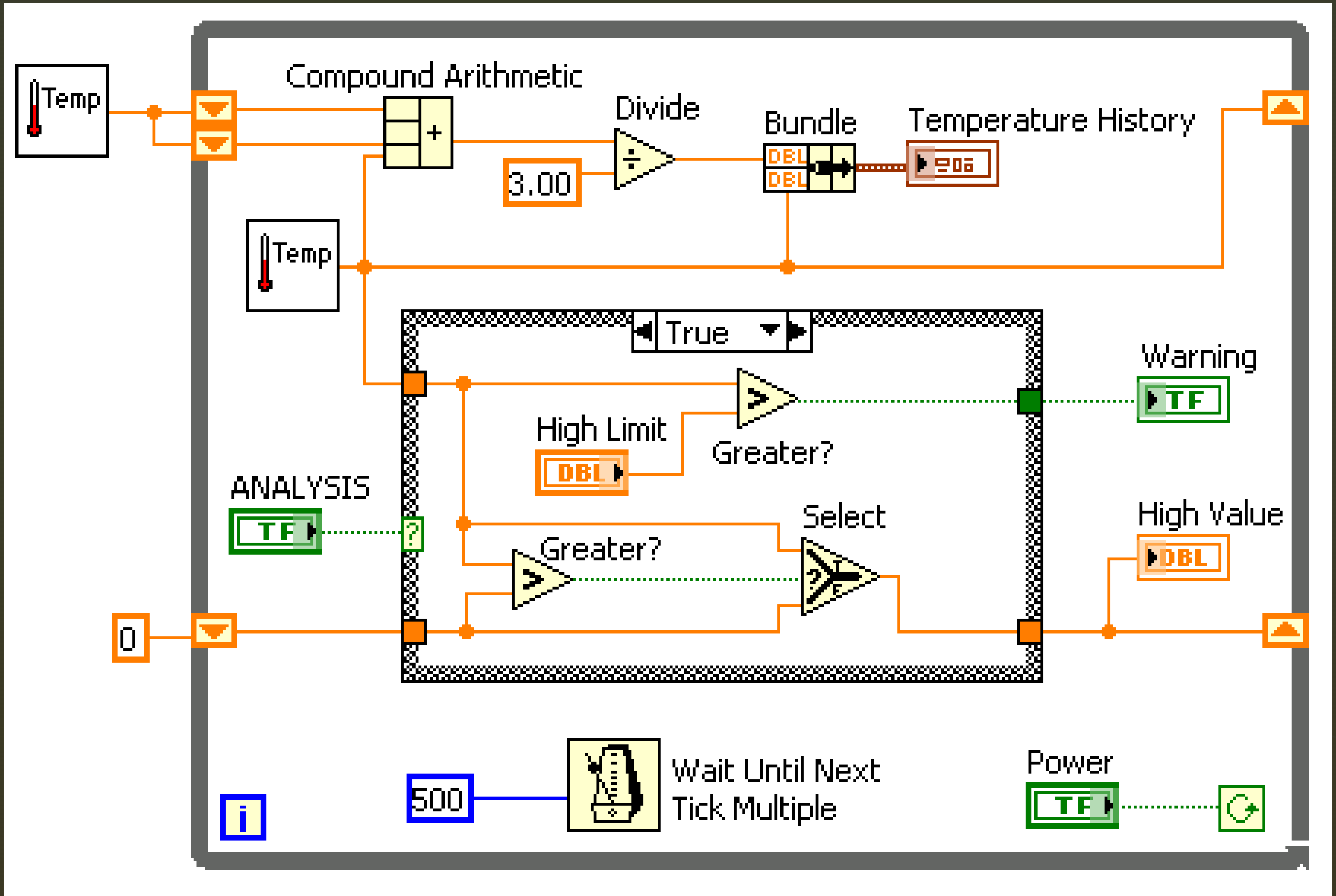
INDEX

Frontal Panel



INDEX

Programming Environment



INDEX

On-Off DC Motor

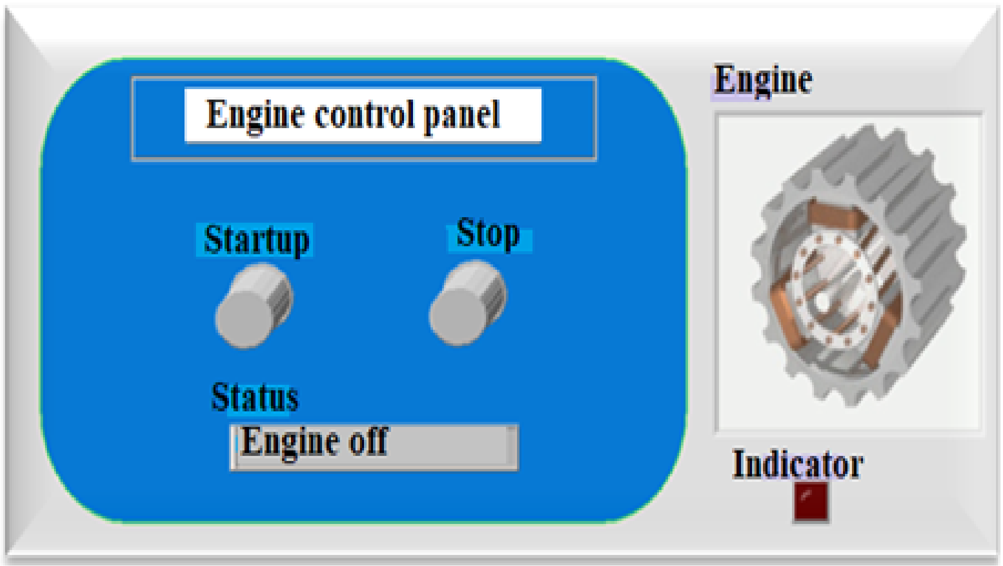


Figure 3. The graphical interface of the on-off control of a direct current motor.

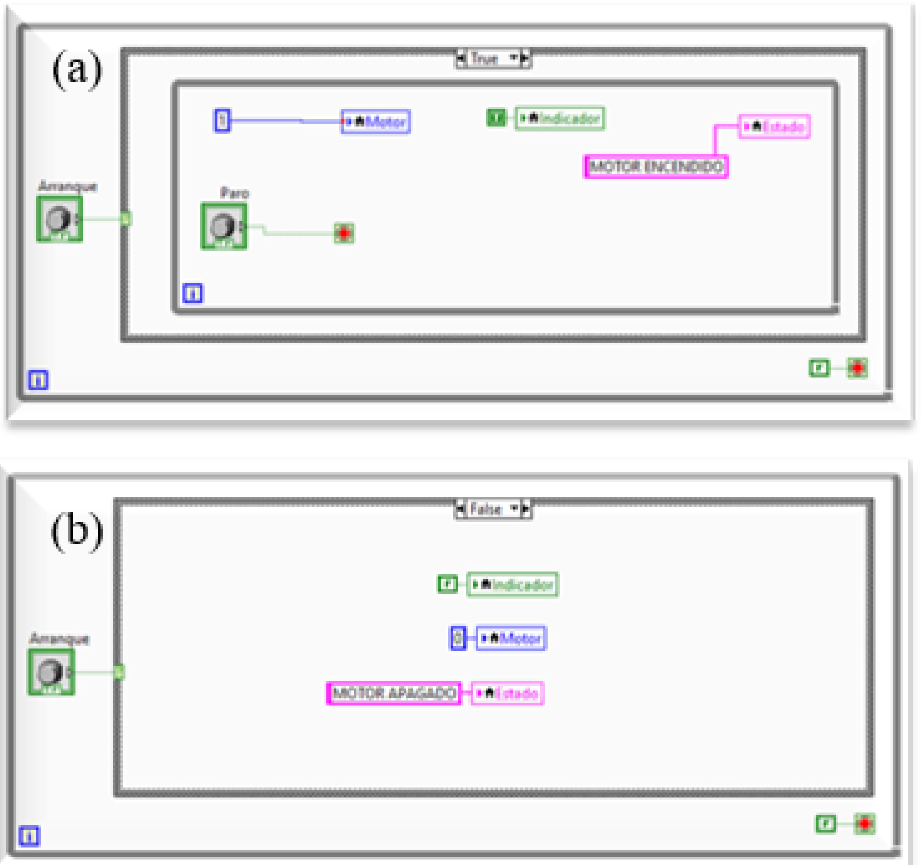


Figure 4. Block diagram of the on-off control of a DC motor (a) first part, b) second part

INDEX

Design & Printed Circuit

- The design of the control board allows us to control various physical actuators.

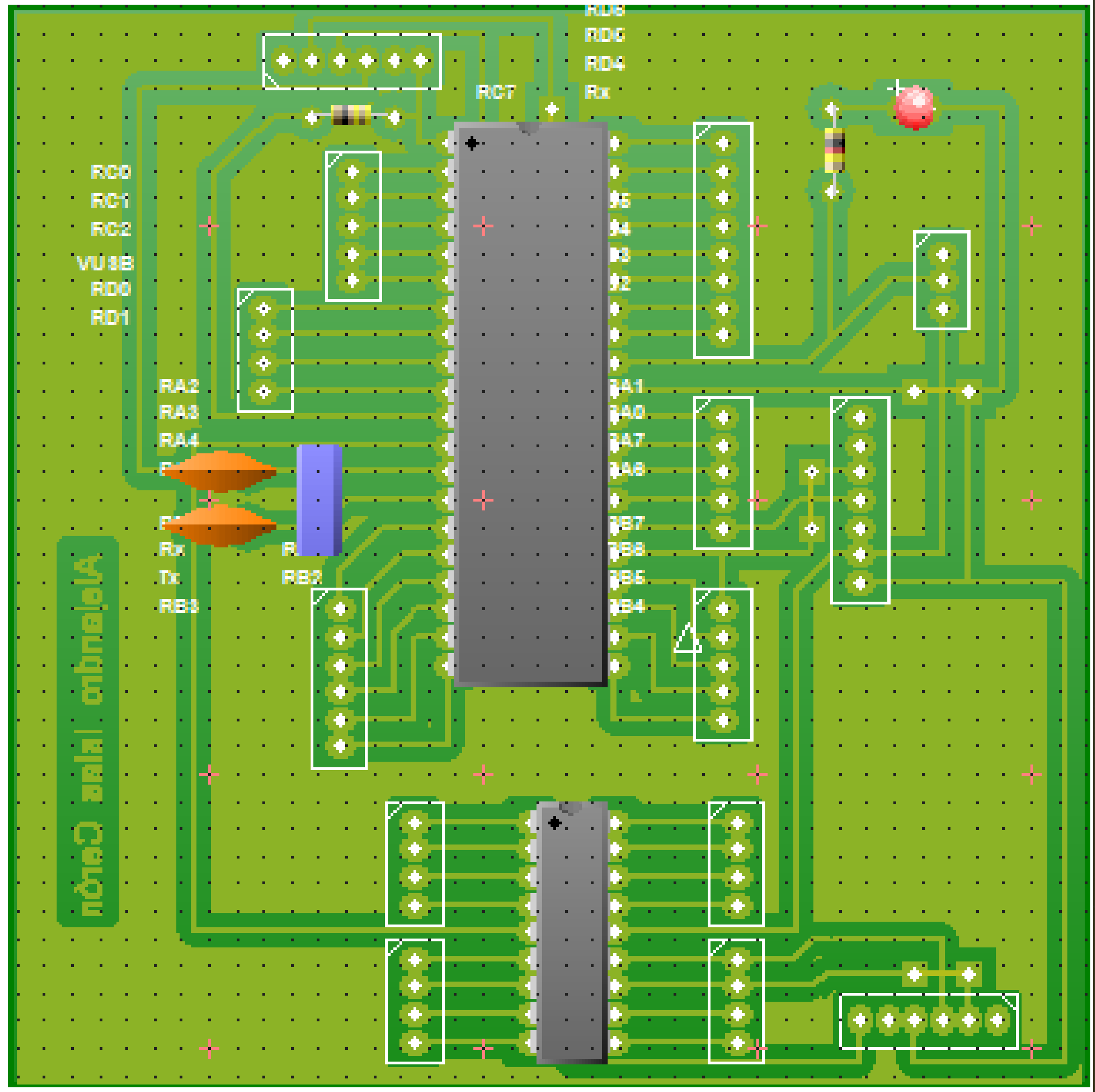
- In this case, the PCB Wizard software was used for this purpose. The control board has 2 microcontrollers (PIC18F4550, and the PIC16F628a). We can also observe that the board already has integrated pins for the connection of its programmer, in this case, the PICKit 2.

PCB (Real World)

PCB (Silk Screen Artwork)

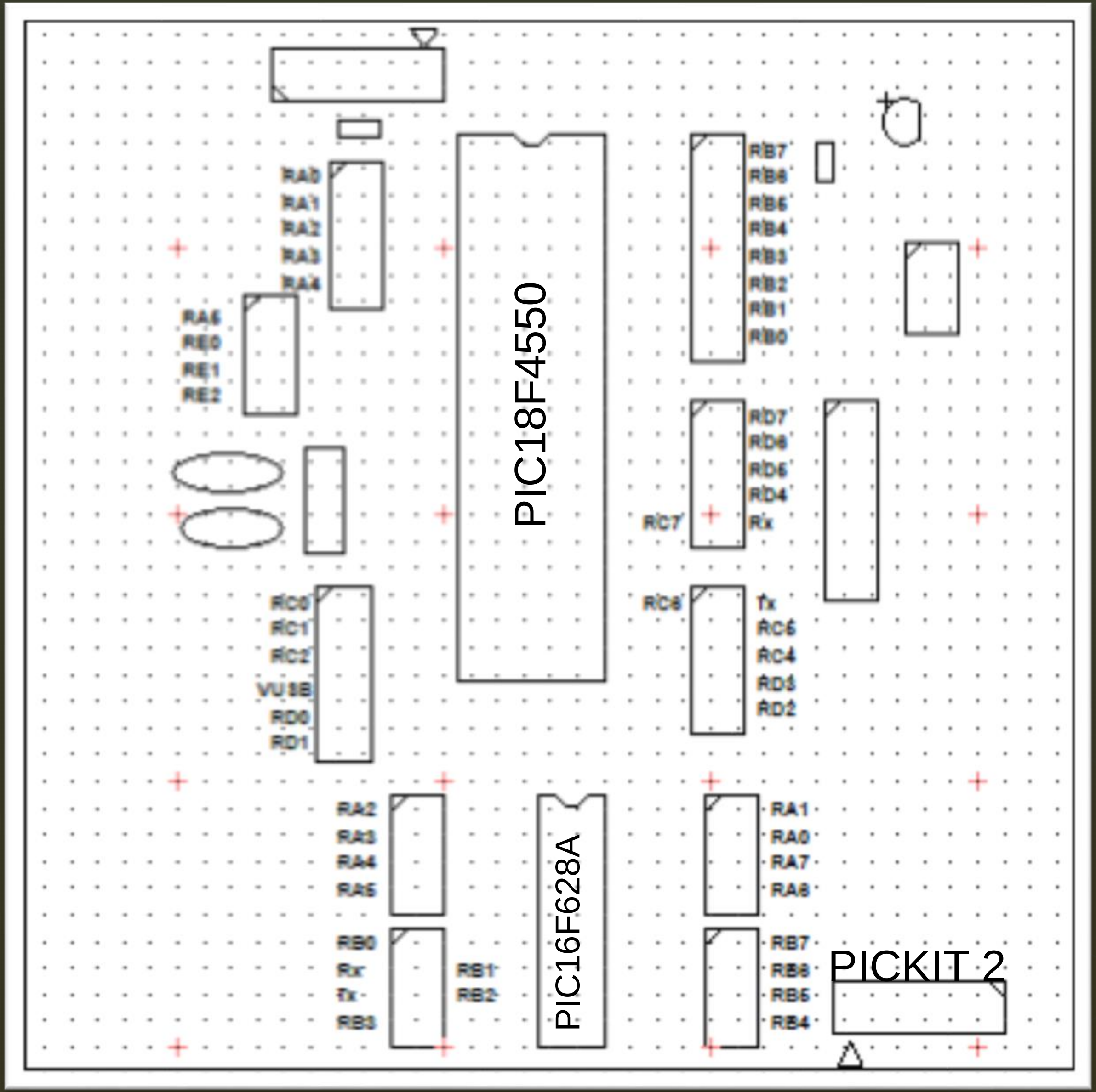
INDEX

PCB (Real World)



INDEX

PCB(Silk Screen Artwork)



INDEX

Communication Protocol

- The communication between virtual instruments and the control board described before is done through the transmission and reception of serial data.

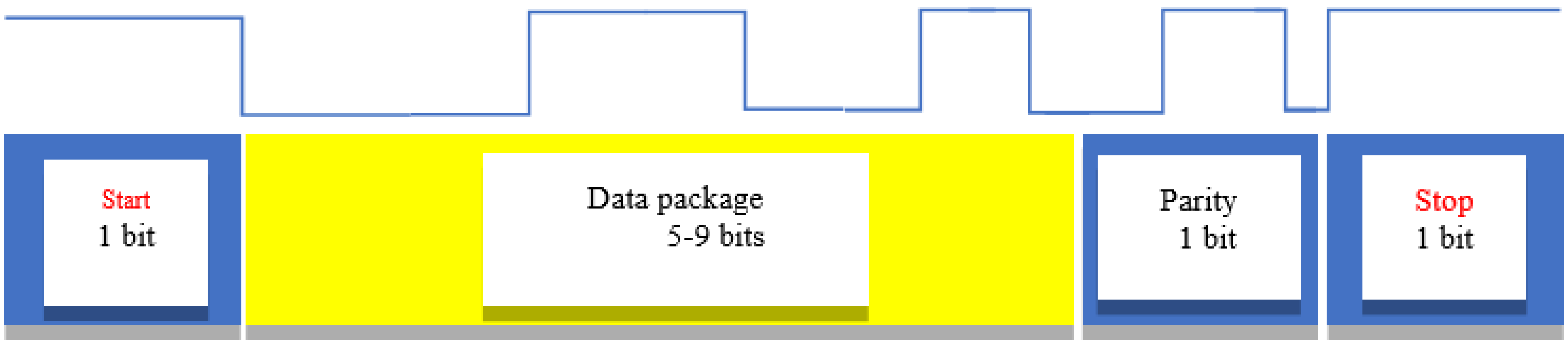


Figure 6. Data sending and receiving protocol

Physical Connection

INDEX

Physical Connection

The physical connection is achieved through a USB – TTL device as shown in Figure 7.

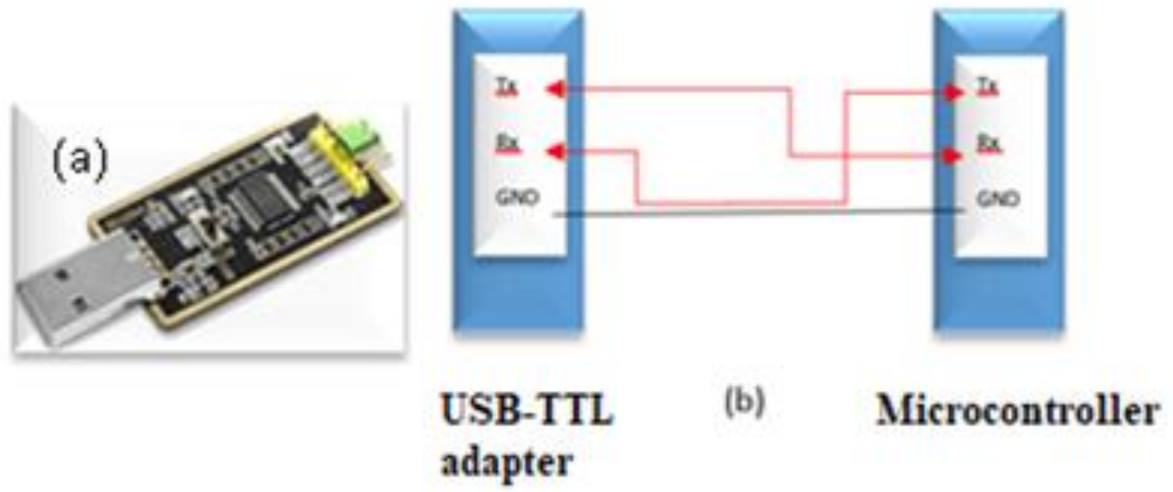
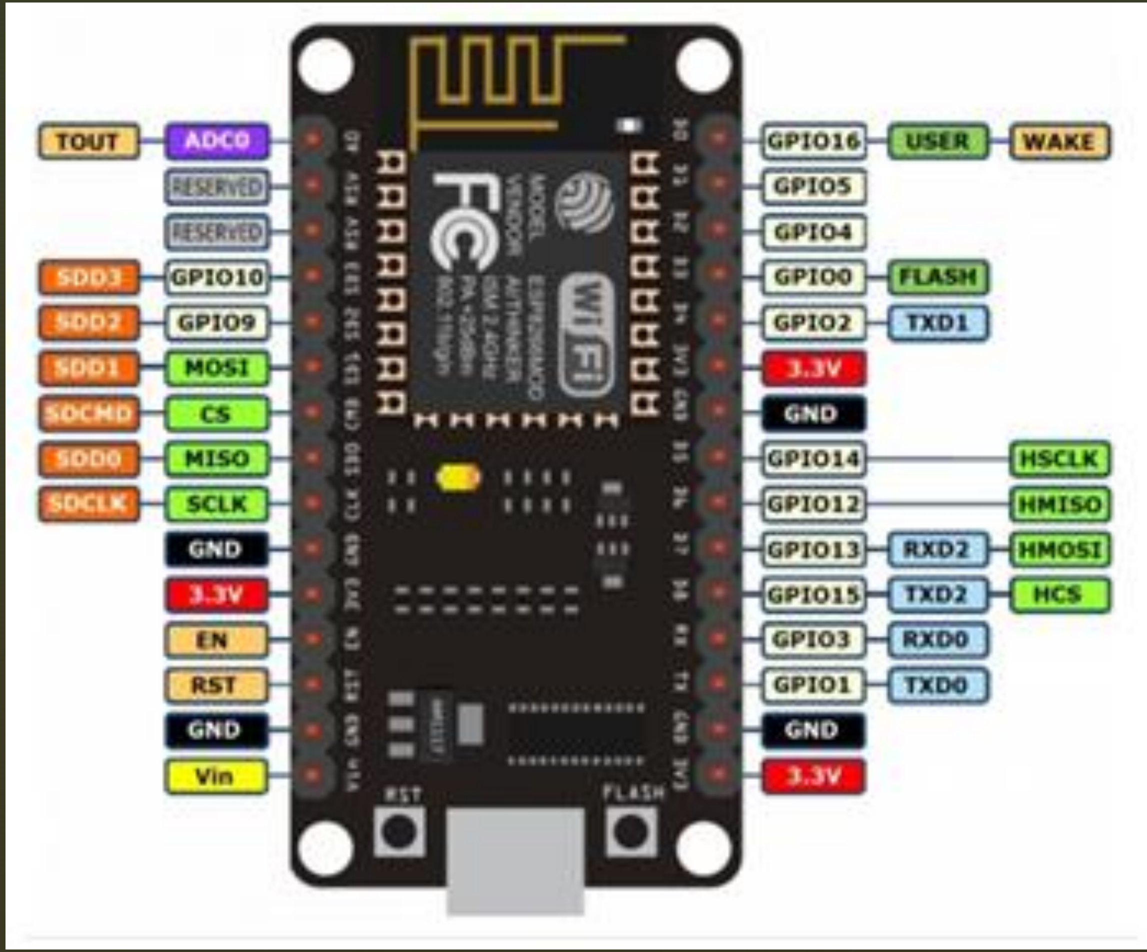


Figure 7. (a) USB to TTL adapter, (b) Physical connection between devices linked by serial communication.

INDEX

Remote Control

- For remote control of the electronic devices, the NodeMCU development board based on the open source ESP8266 SoC and a mobile application developed in Blynk were used.



INDEX

Results & Discussion

- 1.- At the moment of connecting our control card employing the USB-TTL adapter, a COM was automatically generated, which allowed the communication with Labview.

COM Generated

- 2.- By integrating the LabView graphical interfaces with the serial communication protocol, a correct data flow could be observed.

Data Flow

- 3.- From the mobile application created in Blynk, it was possible to send and received voltage signals in the Node MCU board successfully.

Code and App

INDEX

- 4.- Once the mobile application was linked to the NodeMCU board, the data was sent to the PIC18F4550 (transformation of voltage logic levels was considered).

DC-DC converter

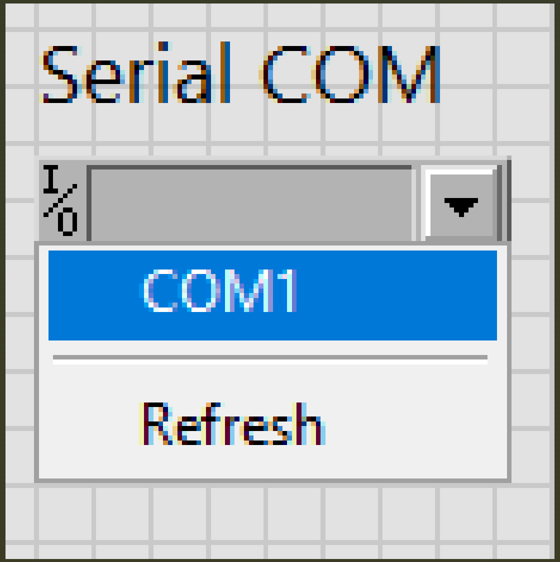
- 5.- The programs in Necto Studio and the Arduino IDE were compiled without errors and allowed reading and writing of the data sent to Labview and received from the mobile application.

Necto Studio Code

- 6.- The electrical connection diagram was made in Fritzing.

Electrical Connection Diagram

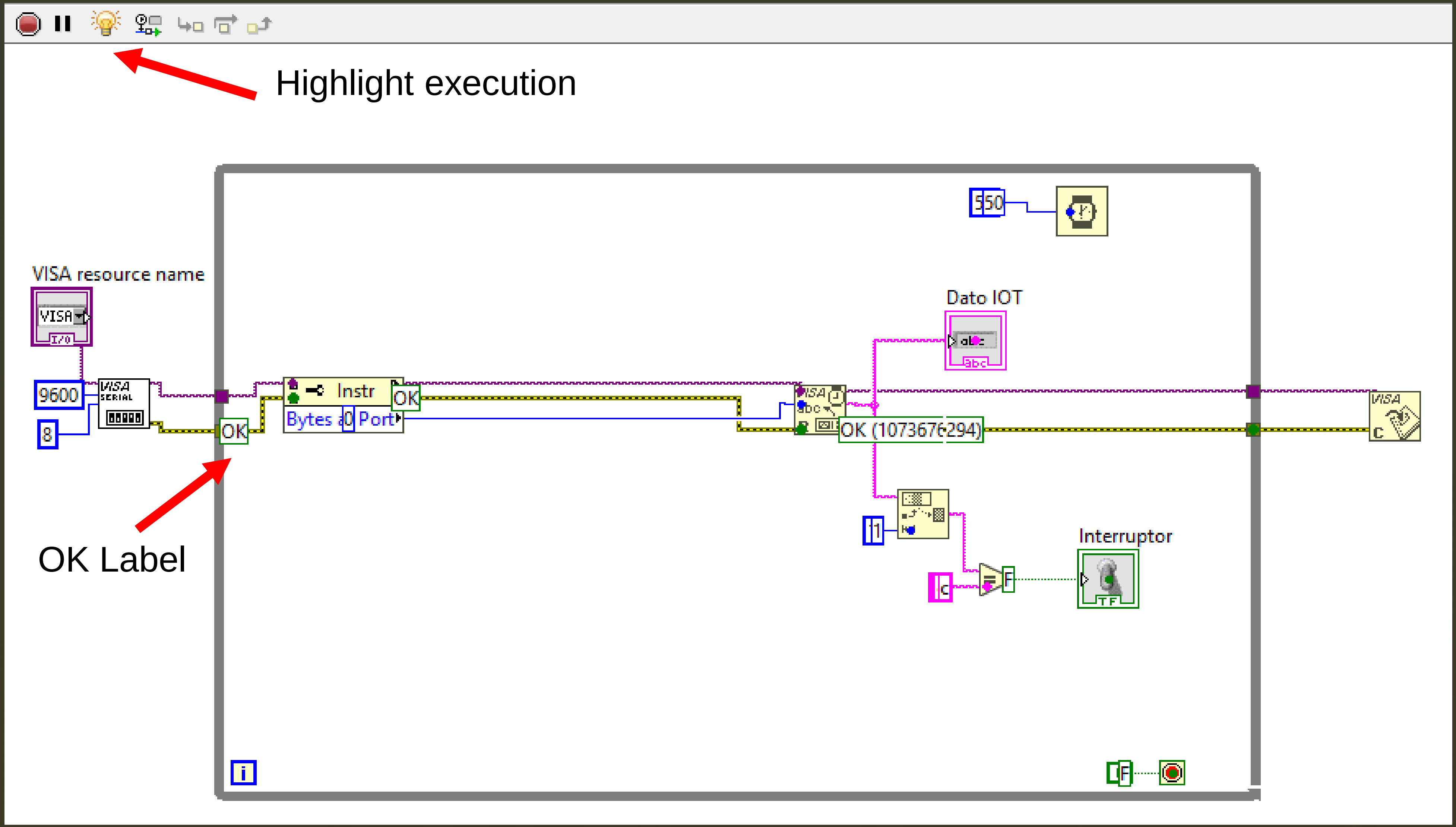
COM Generated Successfully



- On some devices, it was observed that the control board did not show any response, but this problem was solved by installing the CP2102 driver.
- It is also important to add that to avoid any error in Labview, the NI-VISA and NI Serial libraries must be downloaded, otherwise, the proper connection will not be achieved.

INDEX

Successful data flow from beginning to end



INDEX

BLYNK & NODE MCU Board

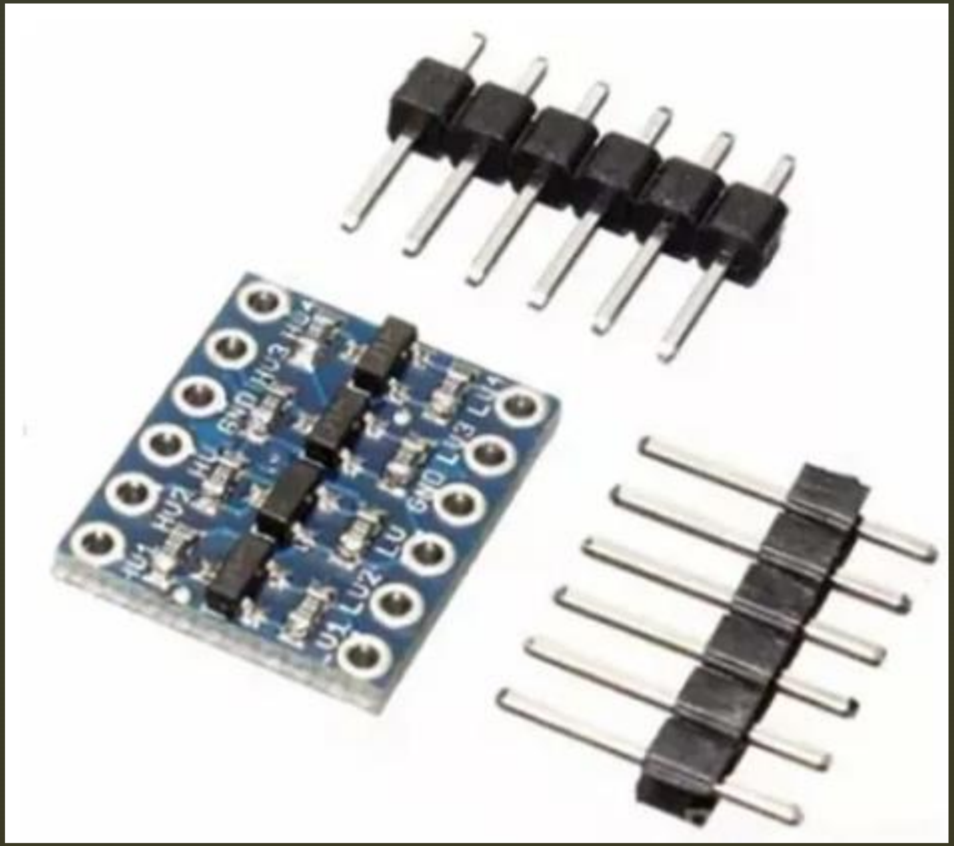
Figure 12. Control interface developed in Blynk.

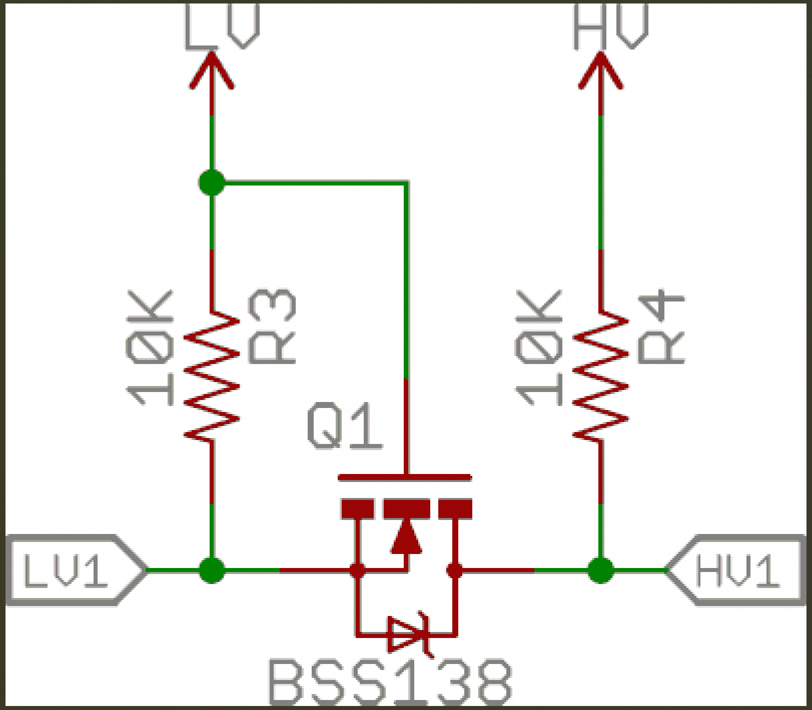
```
#define BLYNK_PRINT Serial


#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "1ZbR0pMD1jdmiQA17xFord9bcA7cq42m";

// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "INFINITUM639D_2.4";
char pass[] = "k65R59eD3s";

void setup()
{
  // Debug console
  Serial.begin(9600);
  pinMode(16,OUTPUT);
  Blynk.begin(auth, ssid, pass);
}

void loop()
{
  Blynk.run();
}
```

Figure 13. Shows the resulting code, which allowed the control of the widget labeled "BUTTON" created in Blynk.

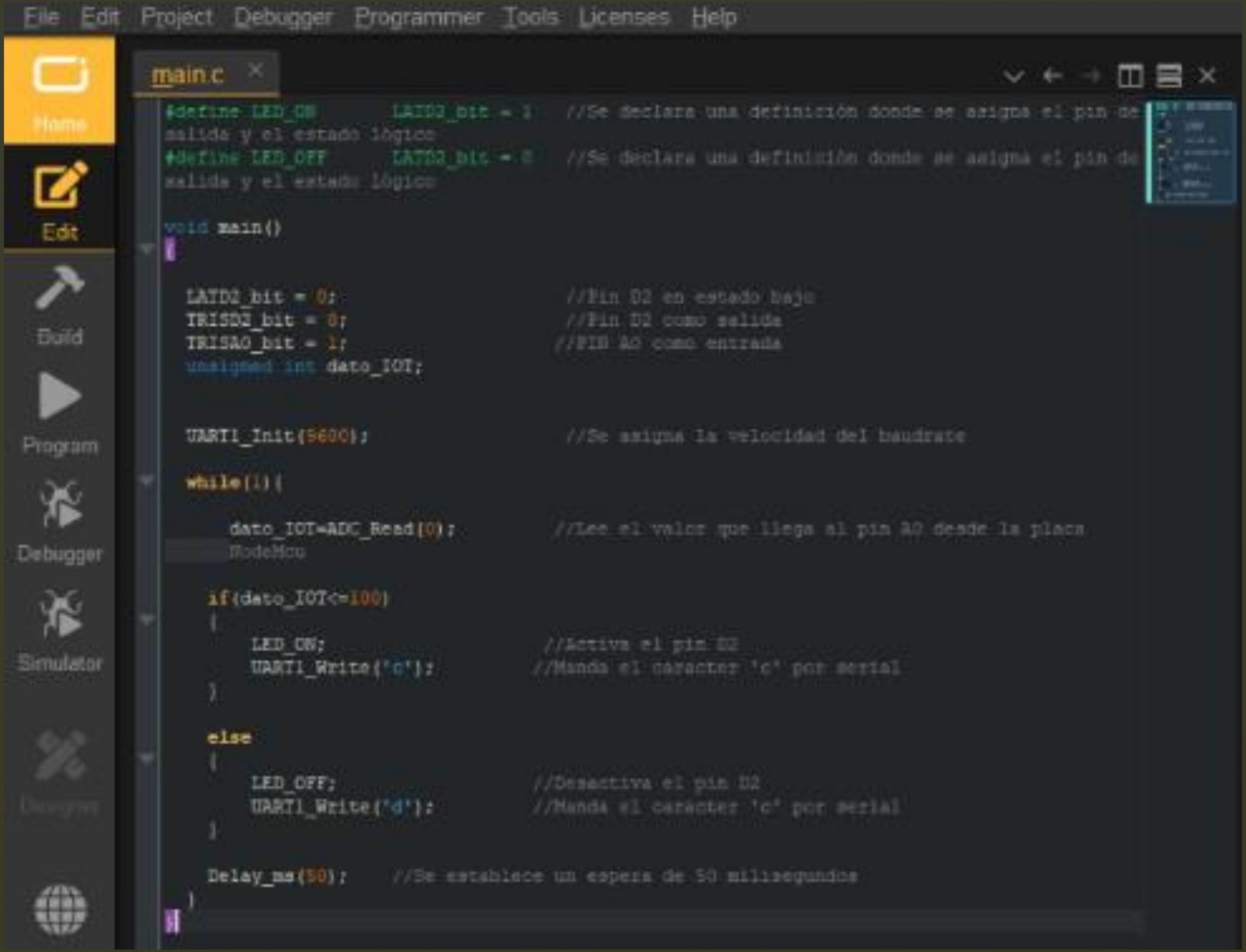
INDEX

Bi-directional 5v To 3.3v Logic Level Converter



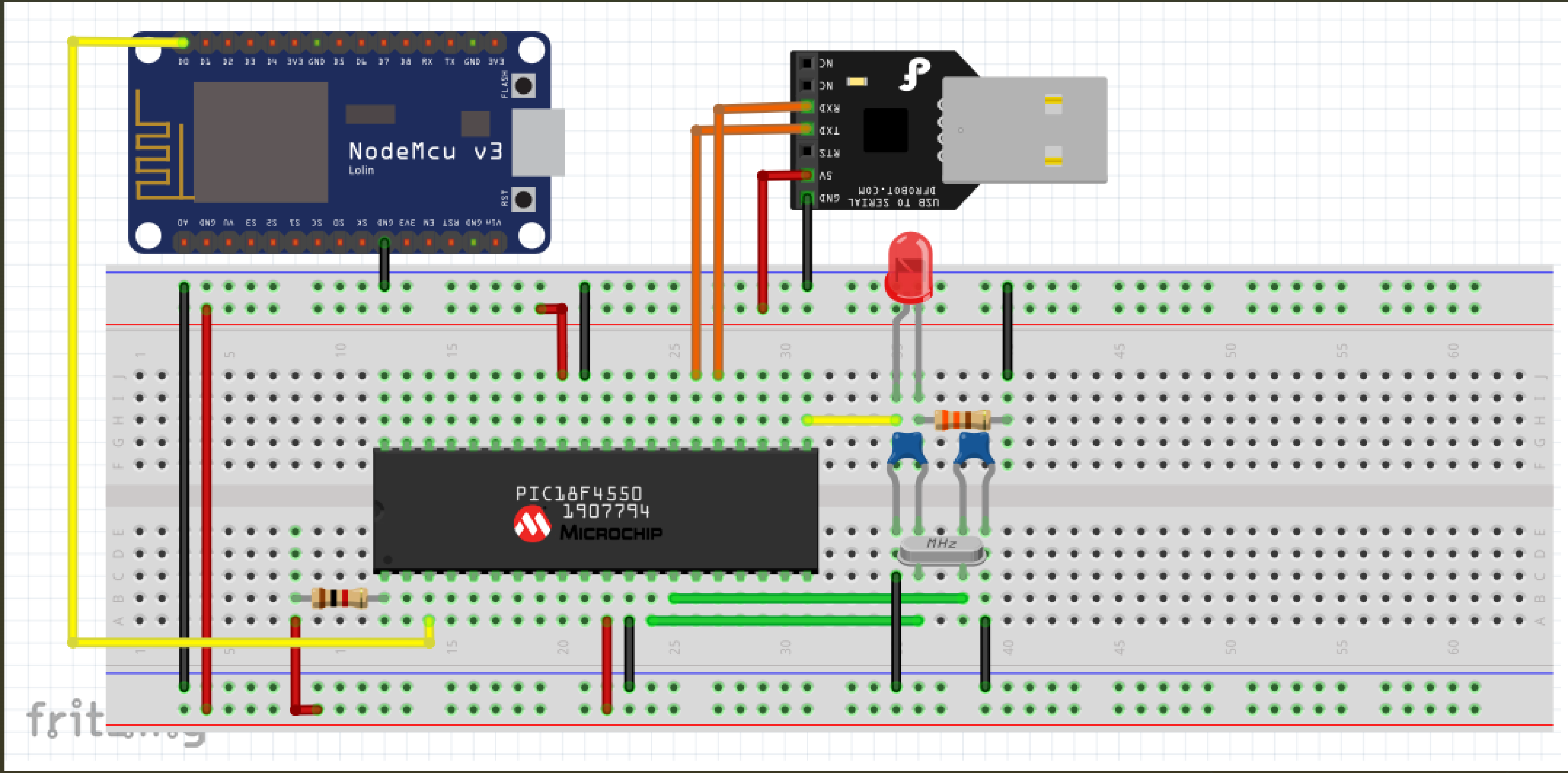


Necto Studio Code



INDEX

Electrical Connection Diagram in Fritzing



INDEX

Conclusion

The implementation of applications focused on the Internet of Things (IoT), allows students to perform practices and projects remotely, strengthening the teaching-learning process.

INDEX

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INDEX

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