

BBB Mini Drone

Real-Time Embedded Systems

Members:

Asad Ali Bhatti (23015)

Deep Sureshkumar Bhatt (20975)

Prof. Dr. Rolf Becker

OUTLINE

- ❖ Introduction
- ❖ Components used
- ❖ Approach
- ❖ Implementation
- ❖ Future Enhancements

INTRODUCTION

Problem statement

Flying a mini-drone by giving
All the commands from the
Computer.



MOTIVATION



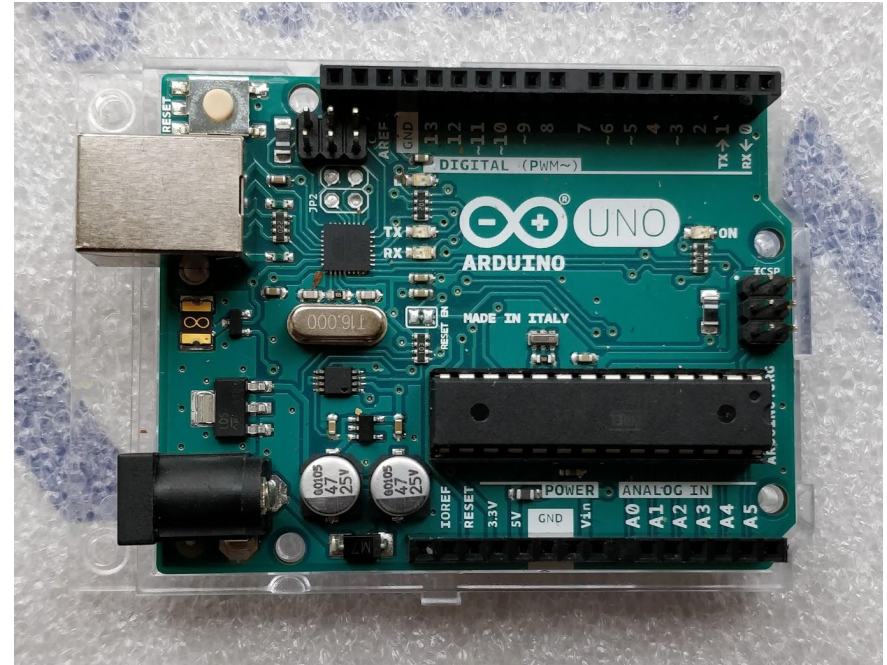
MOTIVATION

- ❖ Chance of working on Drones.
- ❖ Research
- ❖ Extremely difficult challenges
- ❖ Initial step

Components

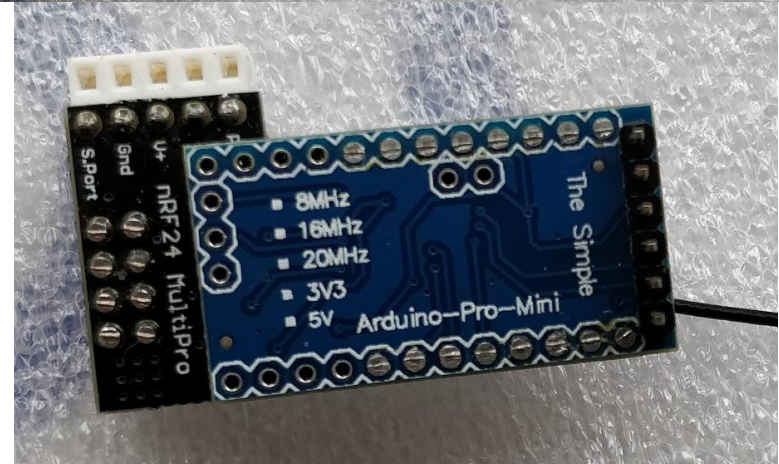
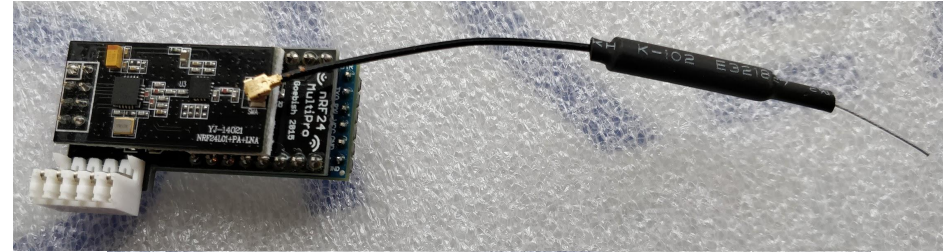
Arduino Uno R3 - (Original Made in Italy)

- ❖ Atmega328p on board chip
- ❖ 14 Digital I/O pins from which 6 PWM pins and 6 analog pins
- ❖ SRAM = 2KB
- ❖ EEPROM = 1KB
- ❖ Flash memory = 32KB
- ❖ Clock Speed = 16Mhz



nRF24L01 multiprotocol RC Transceiver

- ❖ Combination of 3 modules
 - Arduino Pro mini
 - nRF24L01 + PA + LNA wireless module
 - nRF24L01 adapter
- ❖ ~120 feet along with obstacles
- ❖ Can operate on 3 modes, 2 mbps, 1 mbps and 250 kbps



https://github.com/goebish/nrf24_multipro

<https://www.robotshop.com/media/files/pdf/datasheet-wir020.pdf>

Eachine E010 Drone

- ❖ 2.4 GHZ 6-axis drone
- ❖ Small and speedy with nice range
- ❖ 5 minutes of Playtime



<http://www.firstquadcopter.com/reviews/eachine-e010-mini-quadcopter-review/>

RC Turnigy 9x 9ch transmitter module

- ❖ 2.408-2.475 GHZ range
- ❖ 9 channel module
- ❖ 500 Khz bandwidth



[Turnigy reference link](#)

Approach

Approaching steps

Step 1

**Understand and update
the reference code
Geobish-nRF24L01**

Step 2

**Experimented code with
Arduino-nRF24L01
module**

Step 3

**started experiments with
Newly ordered module**

Step 4

**Connection test Multipro
module - Turnigy9x**

Step 5

**Turnigy9x firmware
upgrade**

Step 6

**Turnigy9x - Multipro
module**

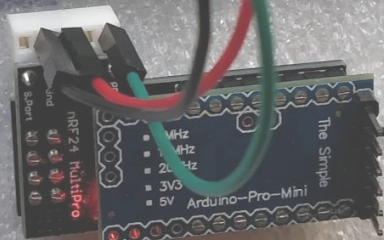
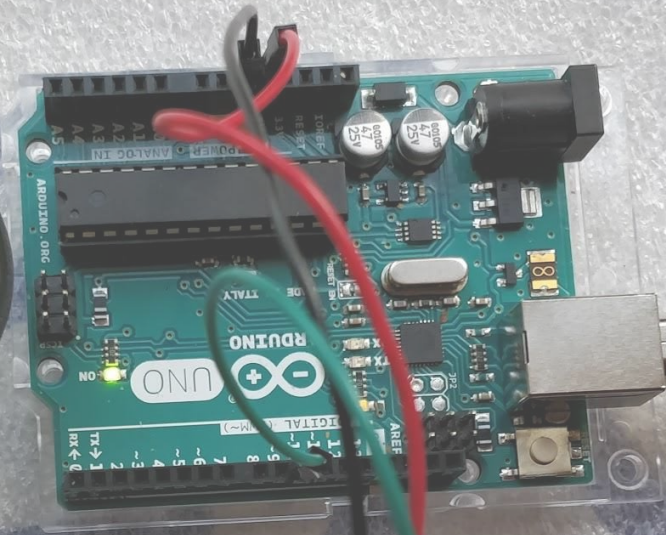
Approaching steps

Step 7

**Binding between
multipro module -
Arduino PPM encoder -
PC**

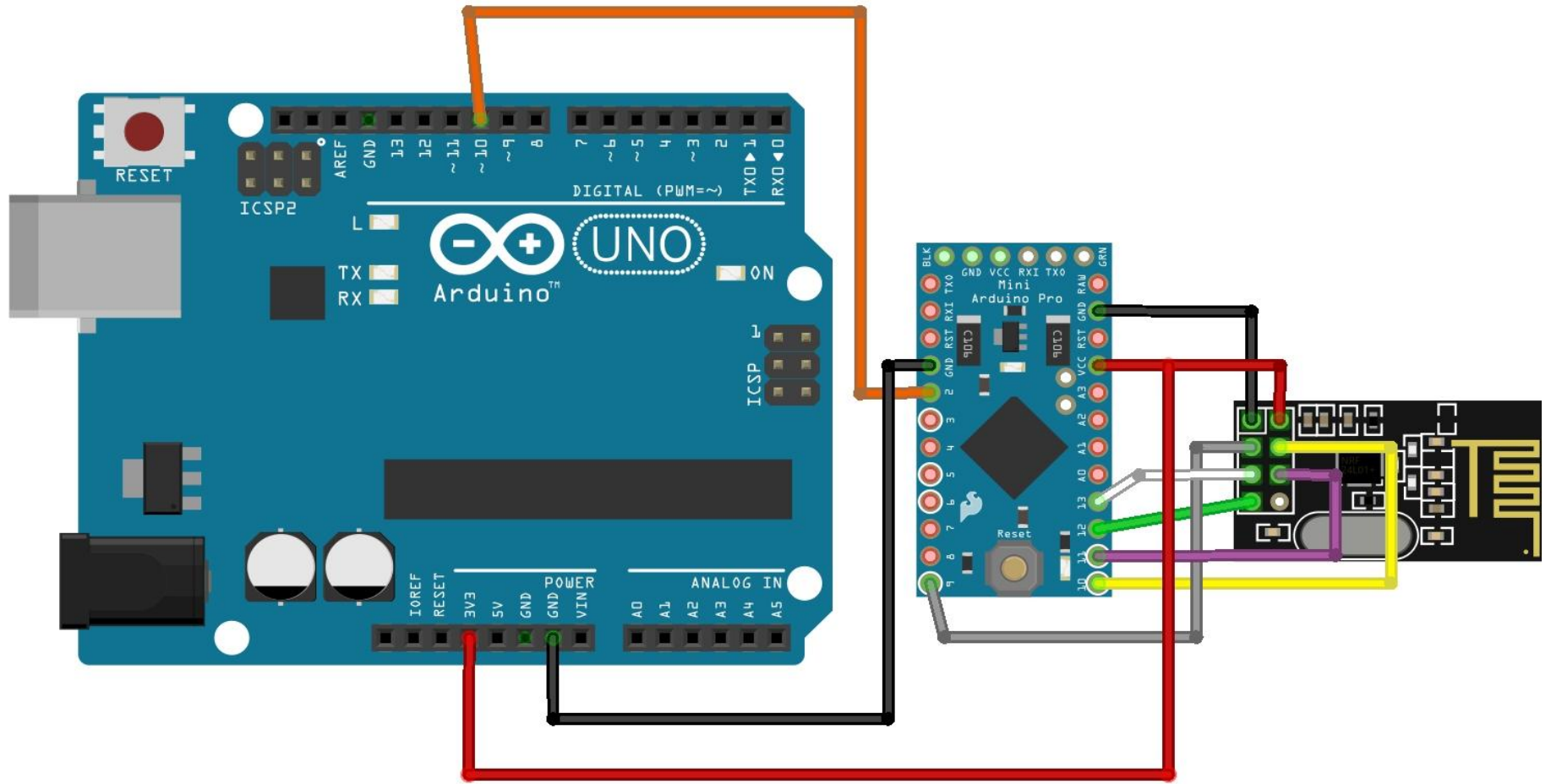
Step 8

**Driver Ruby script to fly
the Drone**



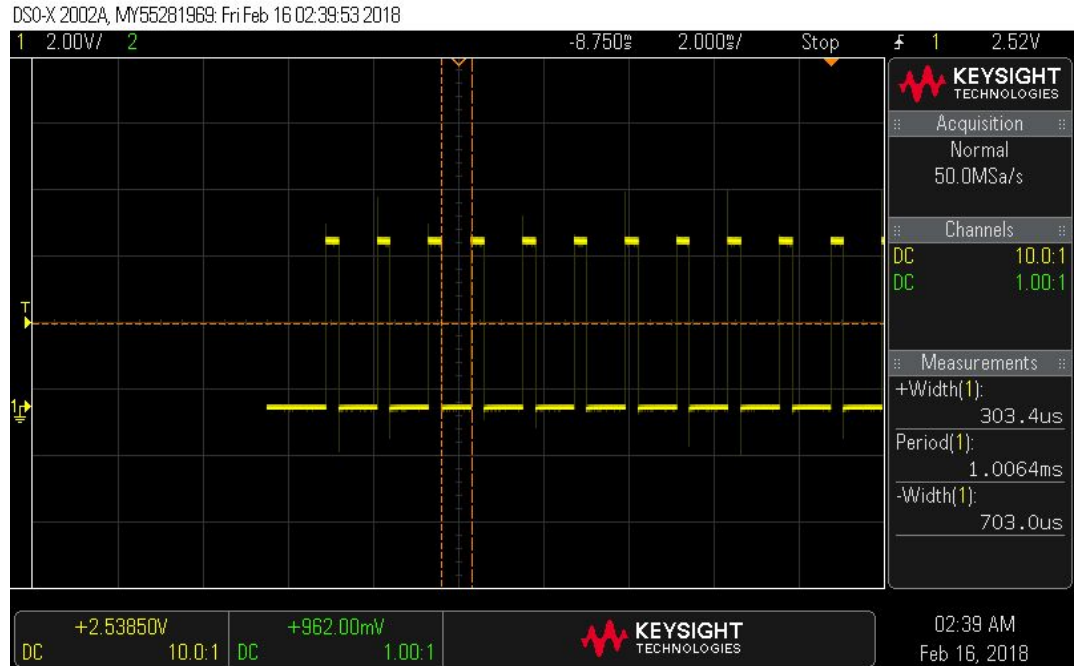
DEMO

Implementation



Pulse Position Modulation

- ❖ Pulse width = 300.4 μ s
- ❖ frame length = 22500 μ s
- ❖ Each channel represents a period.



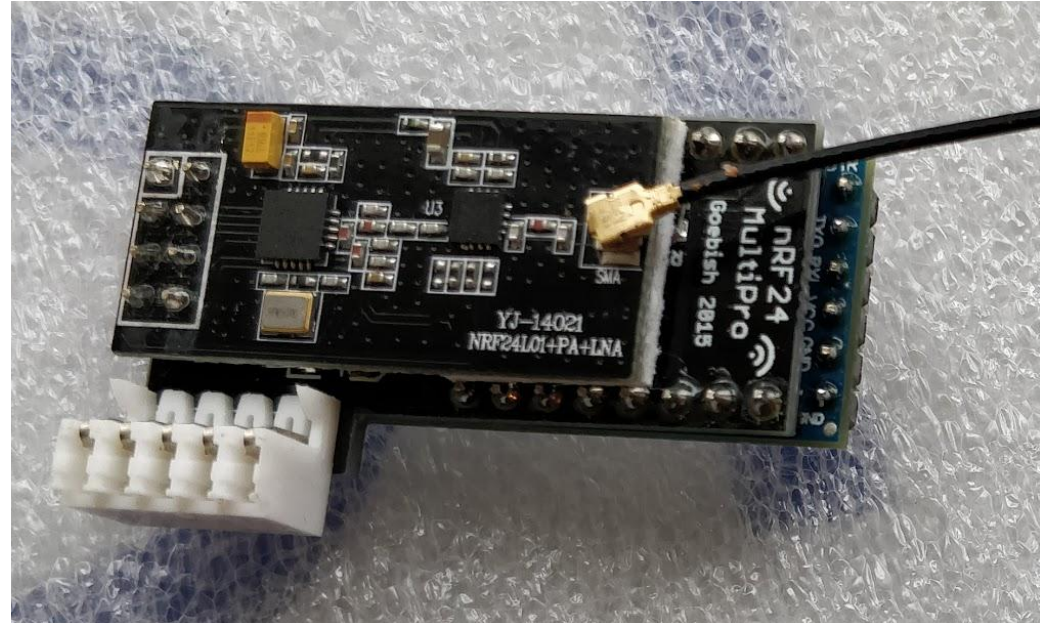
PPM encoder

- ❖ Defined in code:
 - A Servo value array
 - Timer 1 and Timer interrupts
- ❖ Get commands via serial communication with PC.
- ❖ Update servo values array
- ❖ Time interrupts will continuously generate ppm values from the array.

```
#define CHANNEL_NUMBER 12 //set the number of chanels
#define CHANNEL_DEFAULT_VALUE 1500 //set the default servo value
#define FRAME_LENGTH 22500 //set the PPM frame length in microseconds (1ms = 1000µs)
#define PULSE_LENGTH 300 //set the pulse length
#define onState 1 //set polarity of the pulses: 1 is positive, 0 is negative
#define sigPin 10 //set PPM signal output pin on the arduino
////////////////////////////////////
#define SWITCH_PIN 16
#define CHANNEL_TO_MODIFY 11
#define SWITCH_STEP 100
```

Multiprotocol module

- ❖ Receive PPM signals from PPM encoder
- ❖ Selects protocol as per the receiver
- ❖ Selects frequency for communicating with receiver
- ❖ Initiate binding sequence.
- ❖ Start sending commands to drone receiver.



Future Enhancements

- ❖ Generate PPM signals from the same Arduino Pro Mini board
- ❖ Include camera on the drone
- ❖ Design a control loop to fly drone
- ❖ Minimize the whole system to a USB device

References

- ❖ <https://quadmeup.com/generate-ppm-signal-with-arduino/>
- ❖ https://github.com/goebish/nrf24_multipro
- ❖ https://www.ebay.de/itm/RC-Turnigy-9X-9Ch-Transmitter-w-Module-iA8-Receiver-Mode-1-AFHDS-2A-system-/222722657743?_trksid=p2385738.m4383.l4275.c10
- ❖ https://github.com/goebish/nrf24_multipro
- ❖ <http://www.firstquadcopter.com/reviews/eachine-e010-mini-quadcopter-review/>
- ❖ <https://www.robotshop.com/media/files/pdf/datasheet-wir020.pdf>
- ❖ <http://www.hobbytronics.co.uk/arduino-uno-r3>

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THANK YOU
DANKESCHÖN