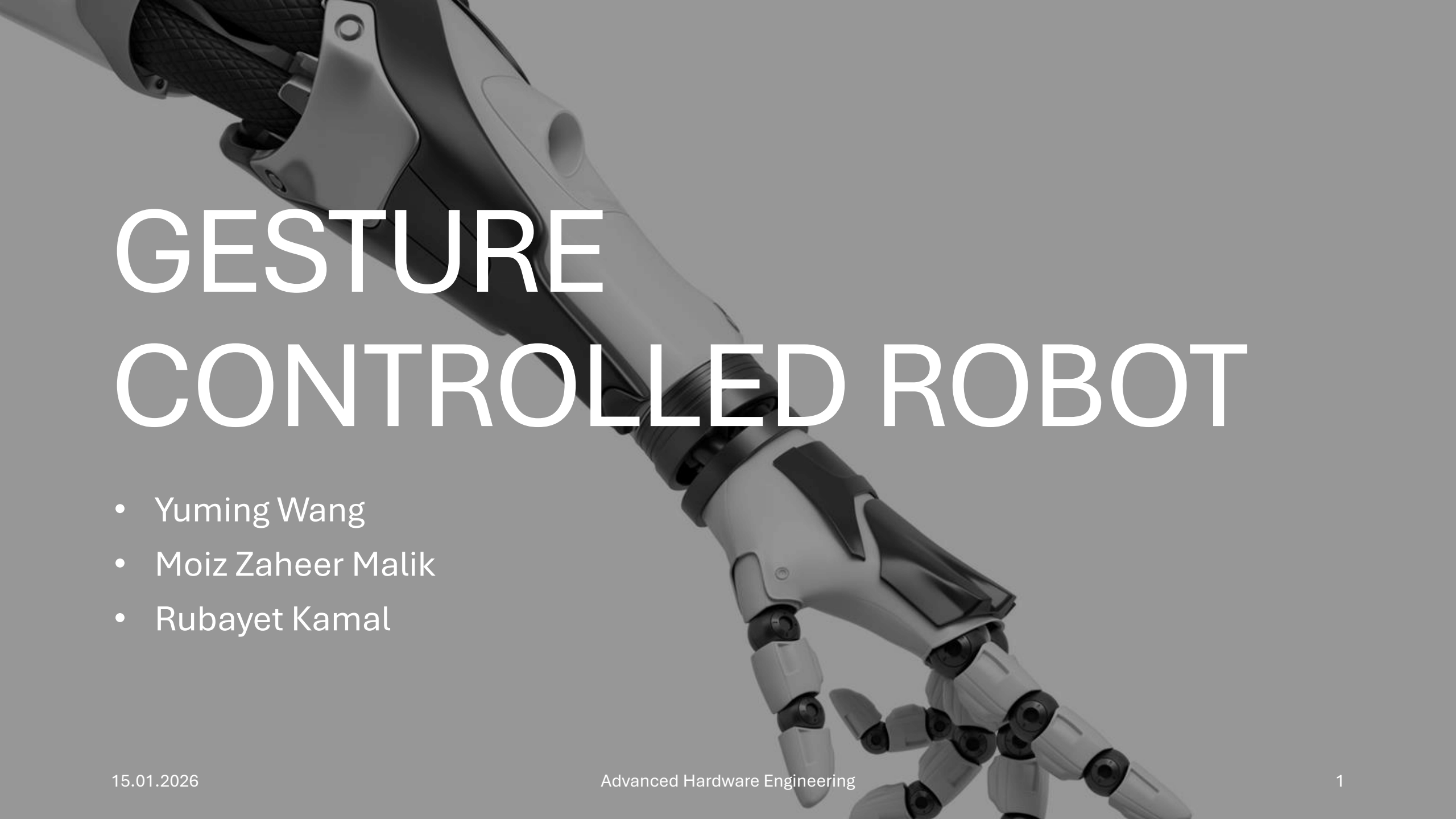
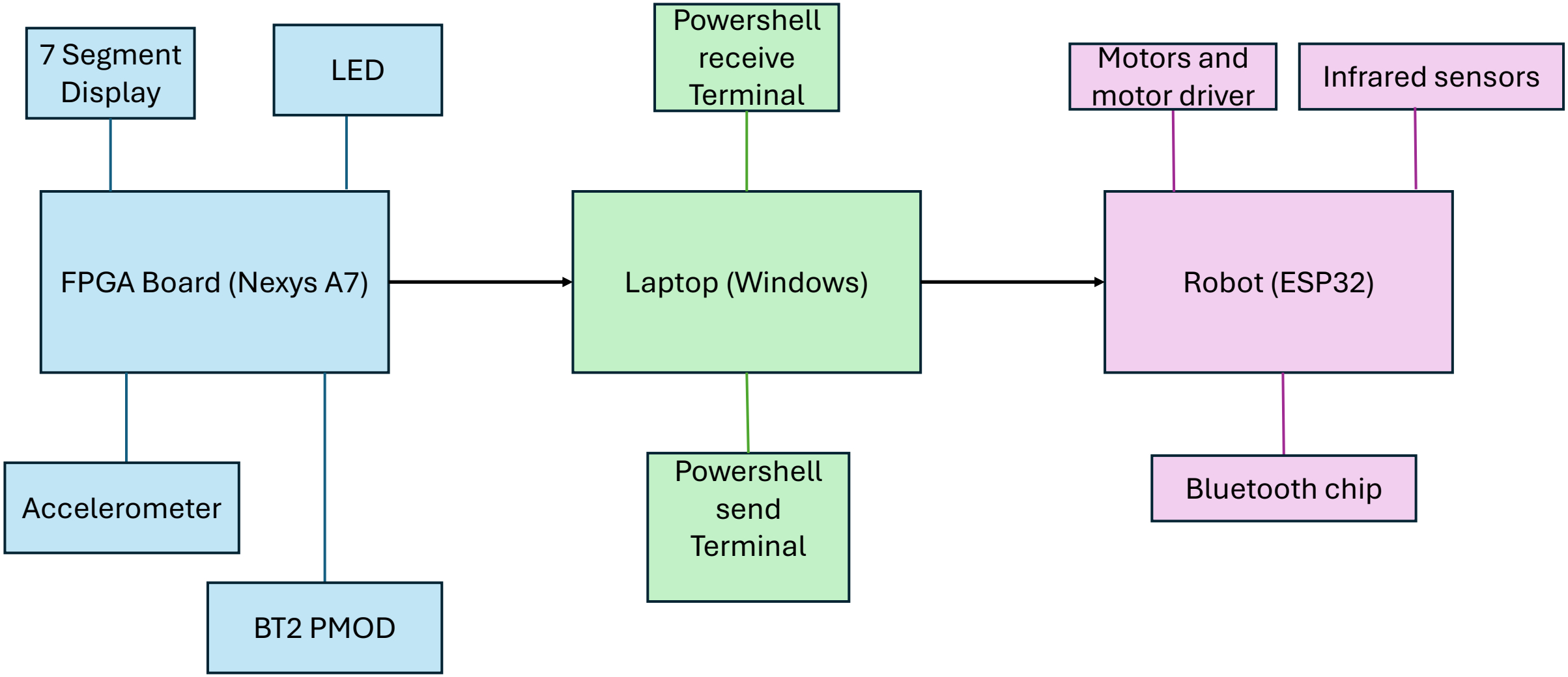


GESTURE CONTROLLED ROBOT

- Yuming Wang
- Moiz Zaheer Malik
- Rubayet Kamal

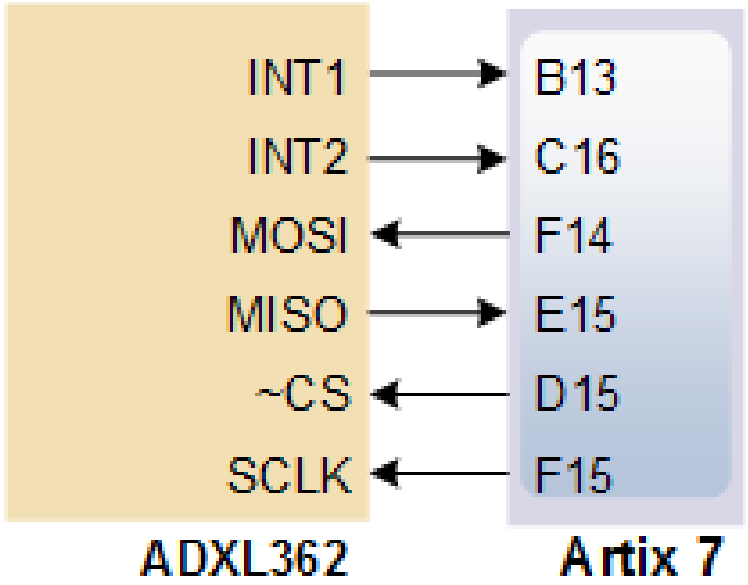
CONCEPT


7 Segment Display
LED
Powershell receive Terminal
Motors and motor driver
Infrared sensors
FPGA Board (Nexys A7)
Laptop (Windows)
Robot (ESP32)
Accelerometer
BT2 PMOD
Powershell send Terminal
Bluetooth chip

FPGA Board Configuration

- ADXL362 Accelerometer.
- 7 Segment Display.
- LEDs.
- BT2 PMOD.

ADXL362



INT1: Interrupt One

INT2: Interrupt Two

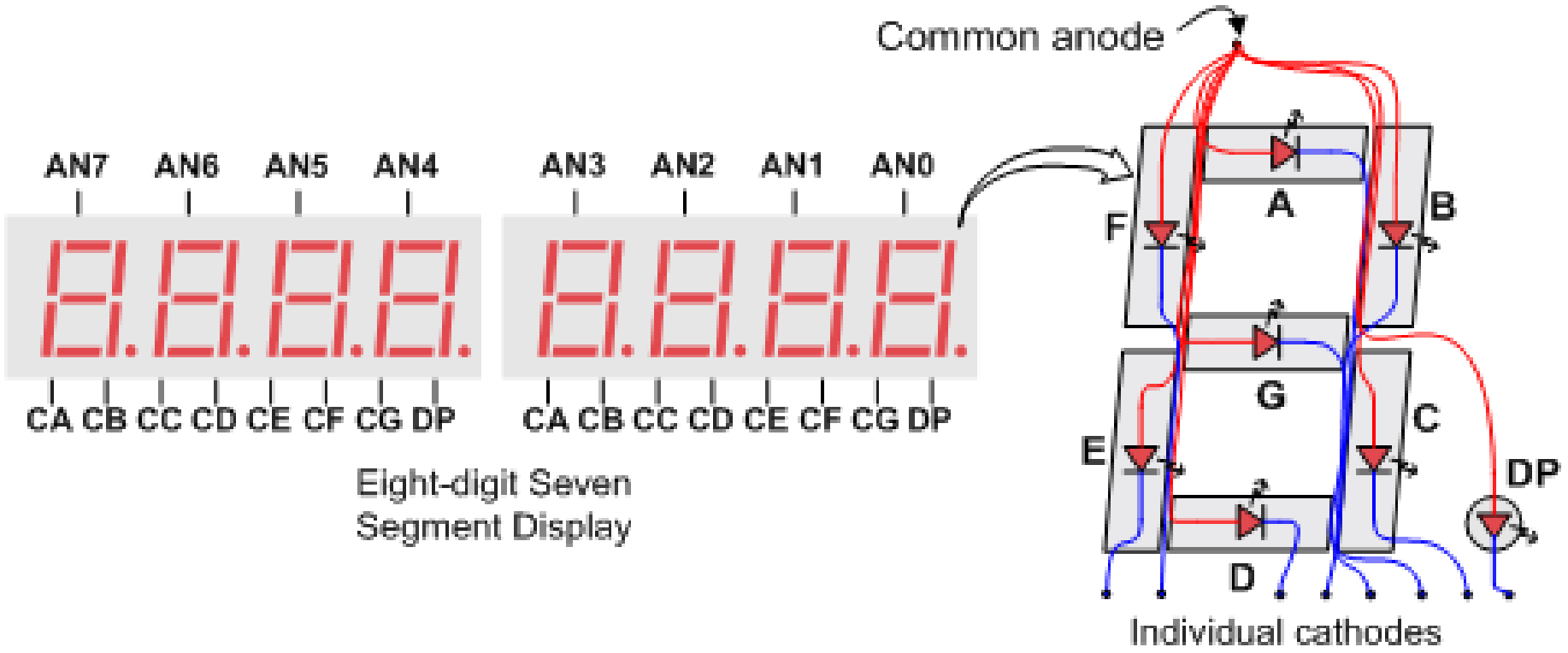
MOSI: Master Out Slave In

MISO: Master In Slave Out

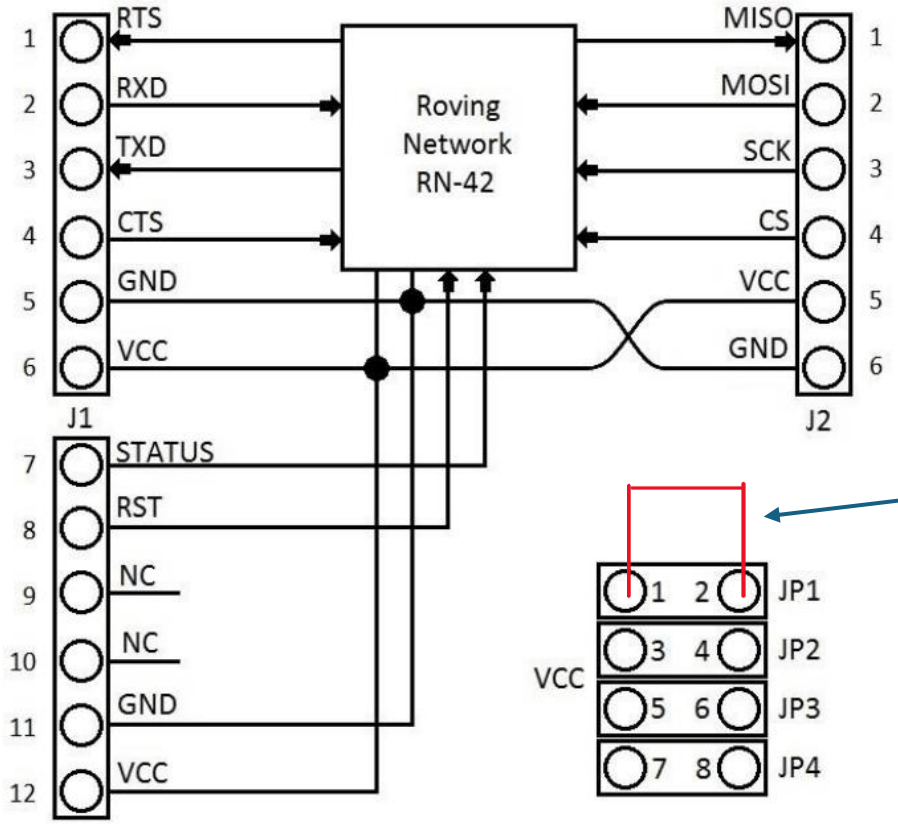
~CS: Slave Select (Active Low)

SCLK: Serial Clock

7 Segment Display



BT2 PMOD



9600 Baud rate setup

Role of VIVADO

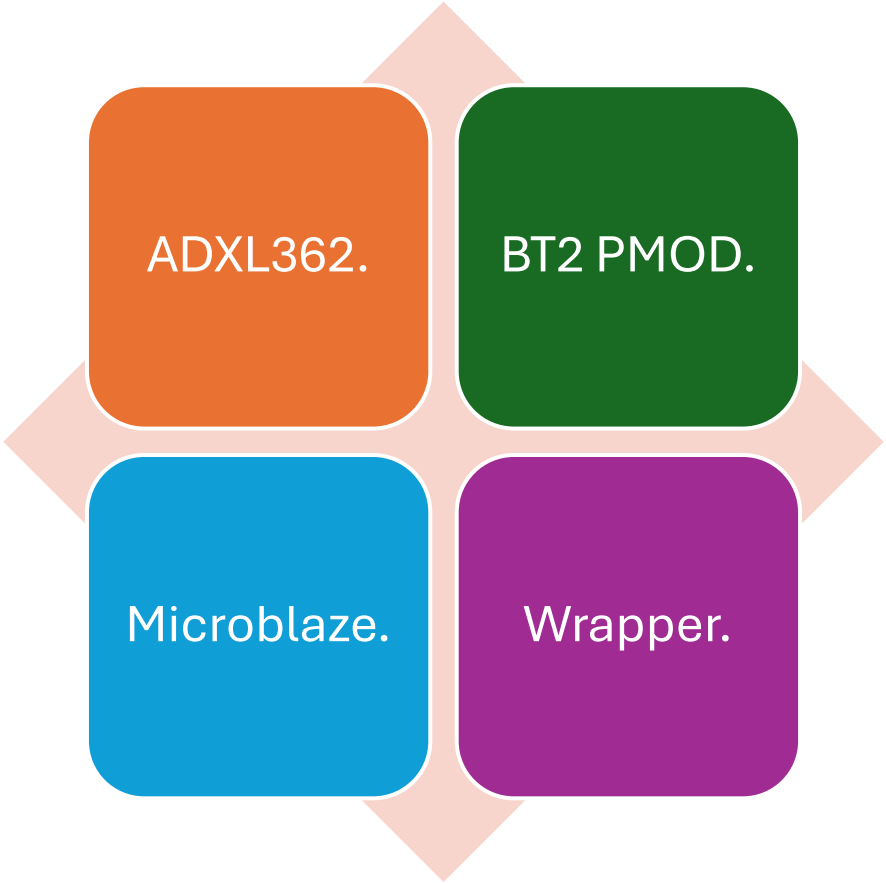
Custom IP creation.

Top IP wrapper.

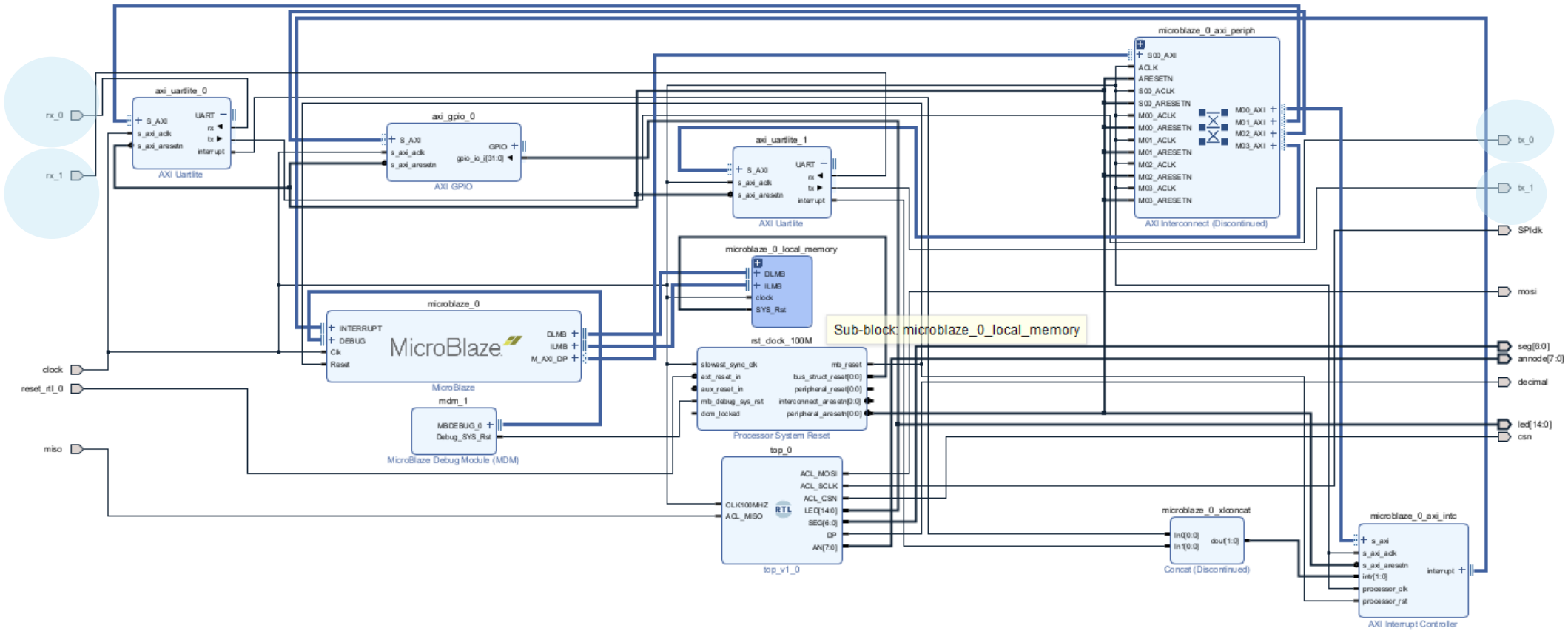
Constrain file mapping.

Bit file generation.

Custom IPs

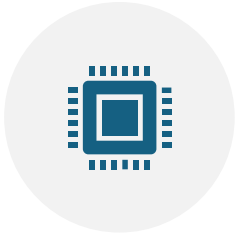


Schematic


axi_uartlite_0
axi_gpio_0
axi_uartlite_1
microblaze_0_axi_periph
microblaze_0_local_memory
microblaze_0
MicroBlaze
rst_clock_100M
Processor System Reset
mdm_1
MicroBlaze Debug Module (MDM)
top_0
top_v1_0
microblaze_0_xlconcat
Concat (Discontinued)
microblaze_0_axi_intc
AXI Interrupt Controller
AXI Interconnect (Discontinued)
Sub-block: microblaze_0_local_memory
rx_0
rx_1
clock
reset_rtl_0
miso
tx_0
tx_1
SPIclk
mosi
seg[6:0]
an:node[7:0]
decimal
led[14:0]
csn

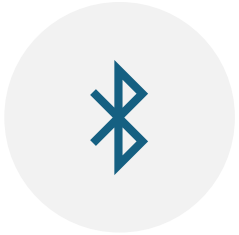
Role of VITIS

UART1: PC <-> FPGA



UART2: FPGA <-> BT2 PMOD

CALIBRATION OF ACCELERATION.

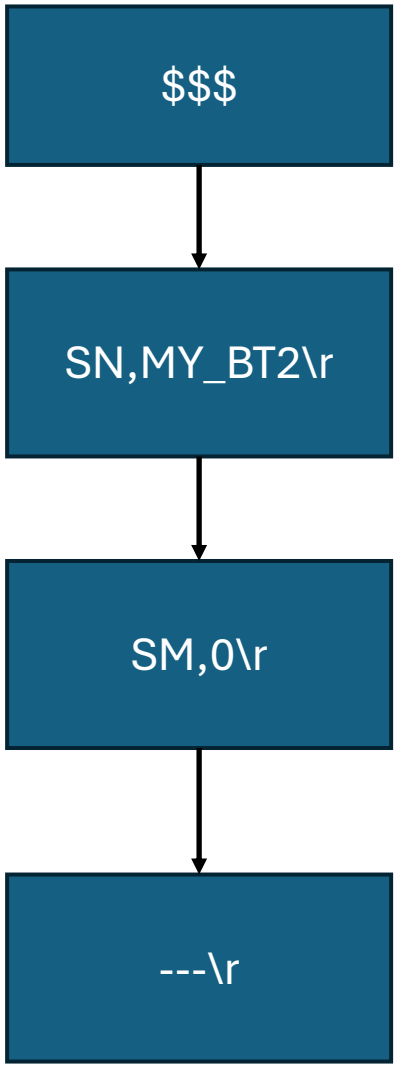


CONFIGURATION OF BLUETOOTH.

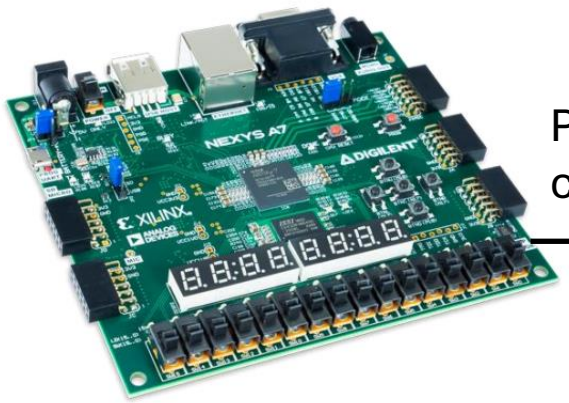
SENDING SPEED TO LAPTOP VIA BLUETOOTH.

Bluetooth configuration in VITIS

Bluetooth commands
XUartLite_Send(&BtUart, (u8 *)"$$$", 3);
XUartLite_Send(&BtUart, (u8 *)"SN,MY_BT2\r", 10);
XUartLite_Send(&BtUart, (u8 *)"SM,0\r", 5);
XUartLite_Send(&BtUart, (u8 *)"---\r", 4);
XUartLite_Send(&BtUart, (u8*)"BT2 READY\r\n", 11);

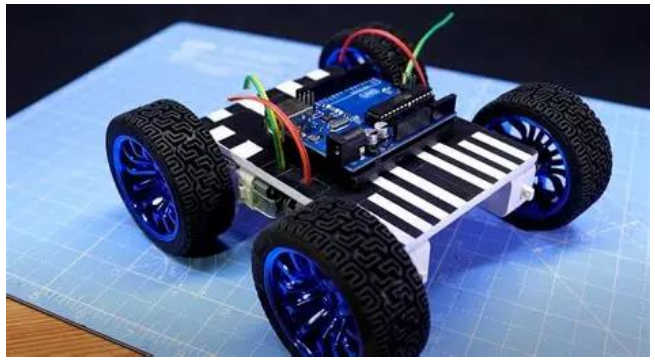


THE BRIDGE



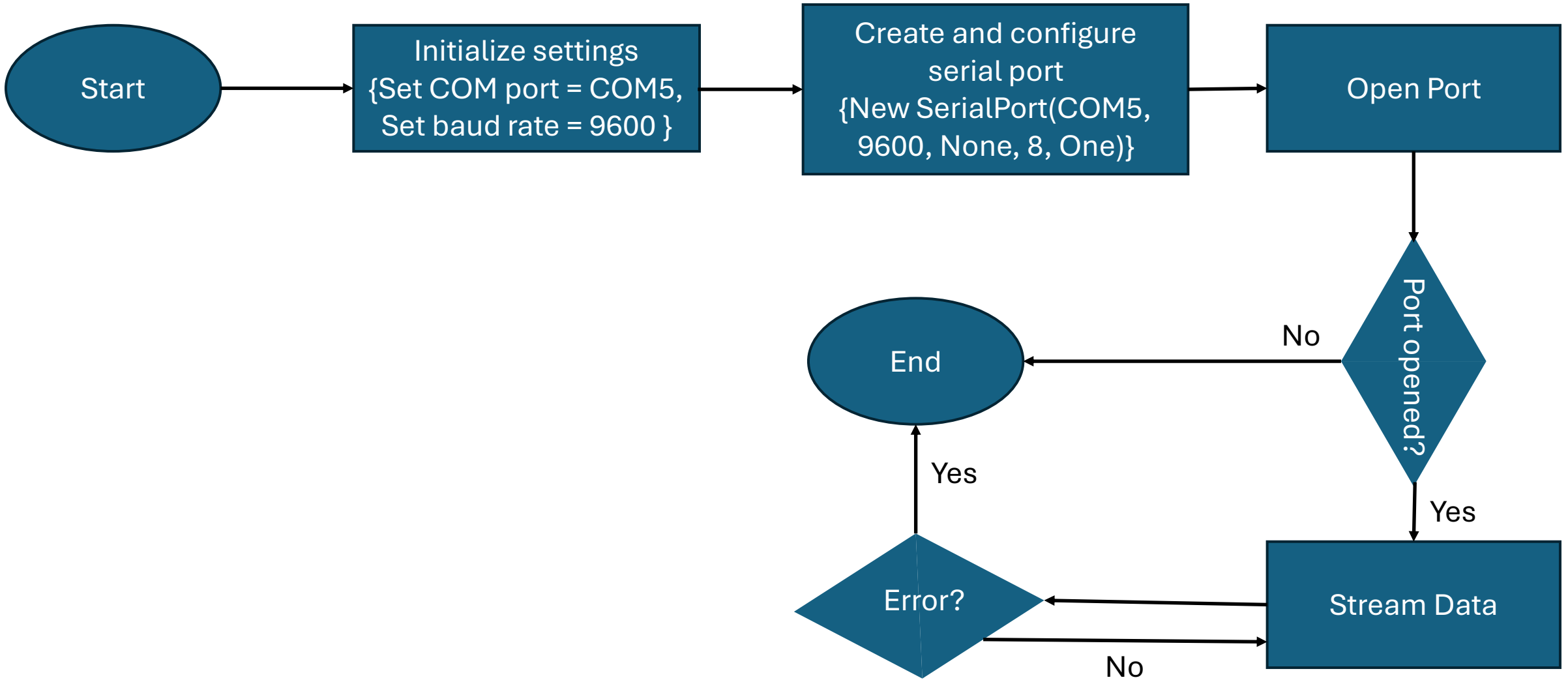
Powershell receive commands

Powershell/ Ubuntu terminal commands

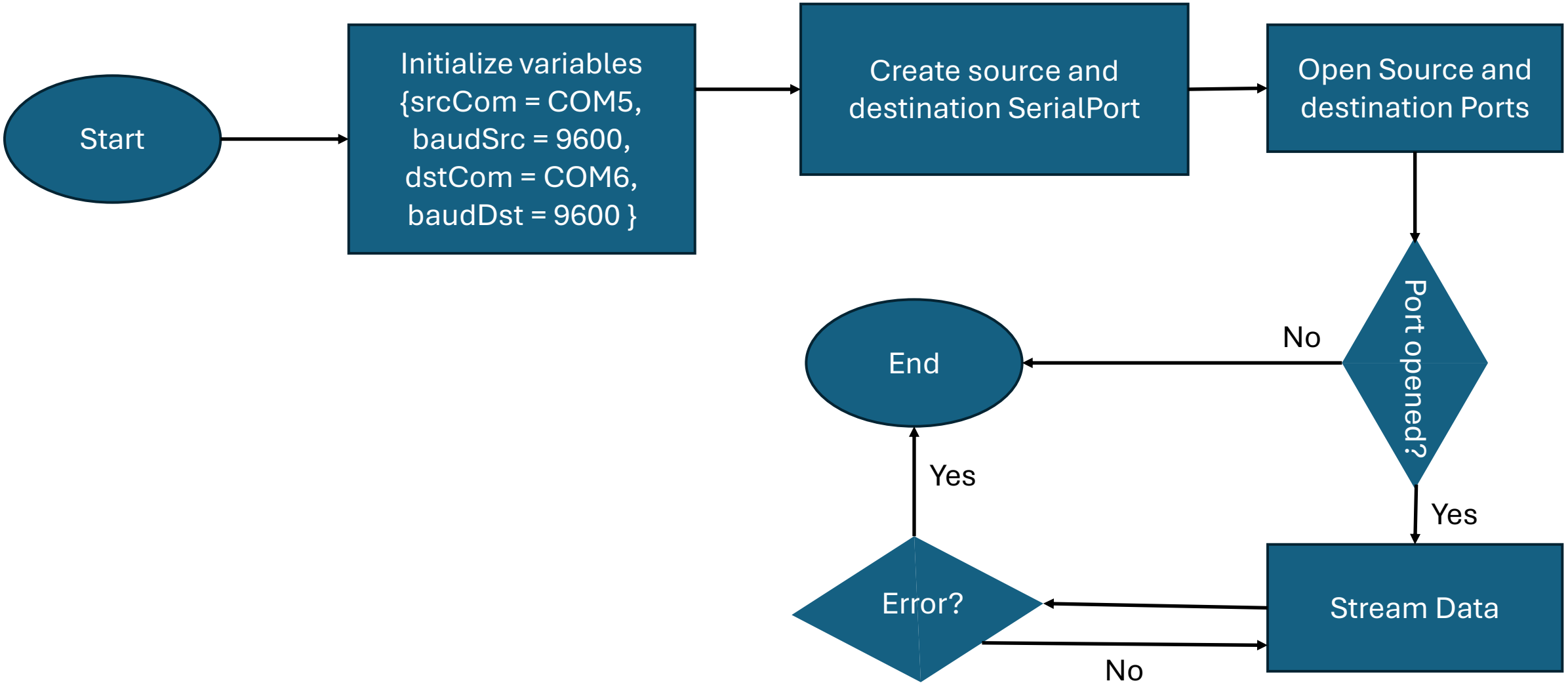


- Powershell terminal implementation.

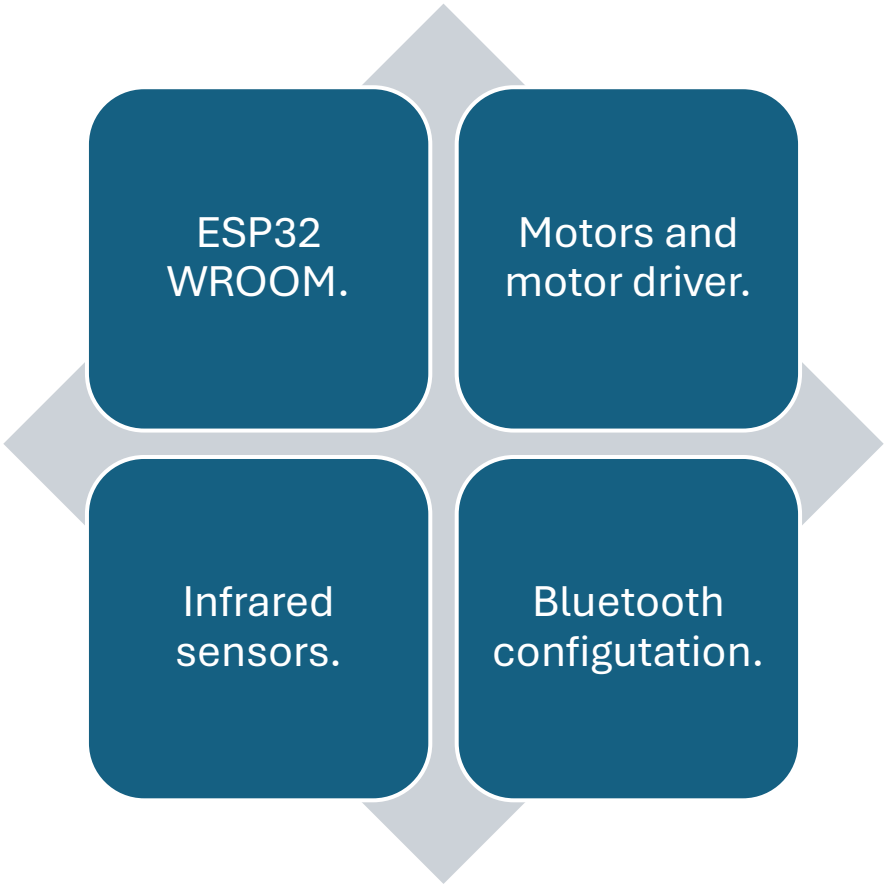
Powershell receive commands



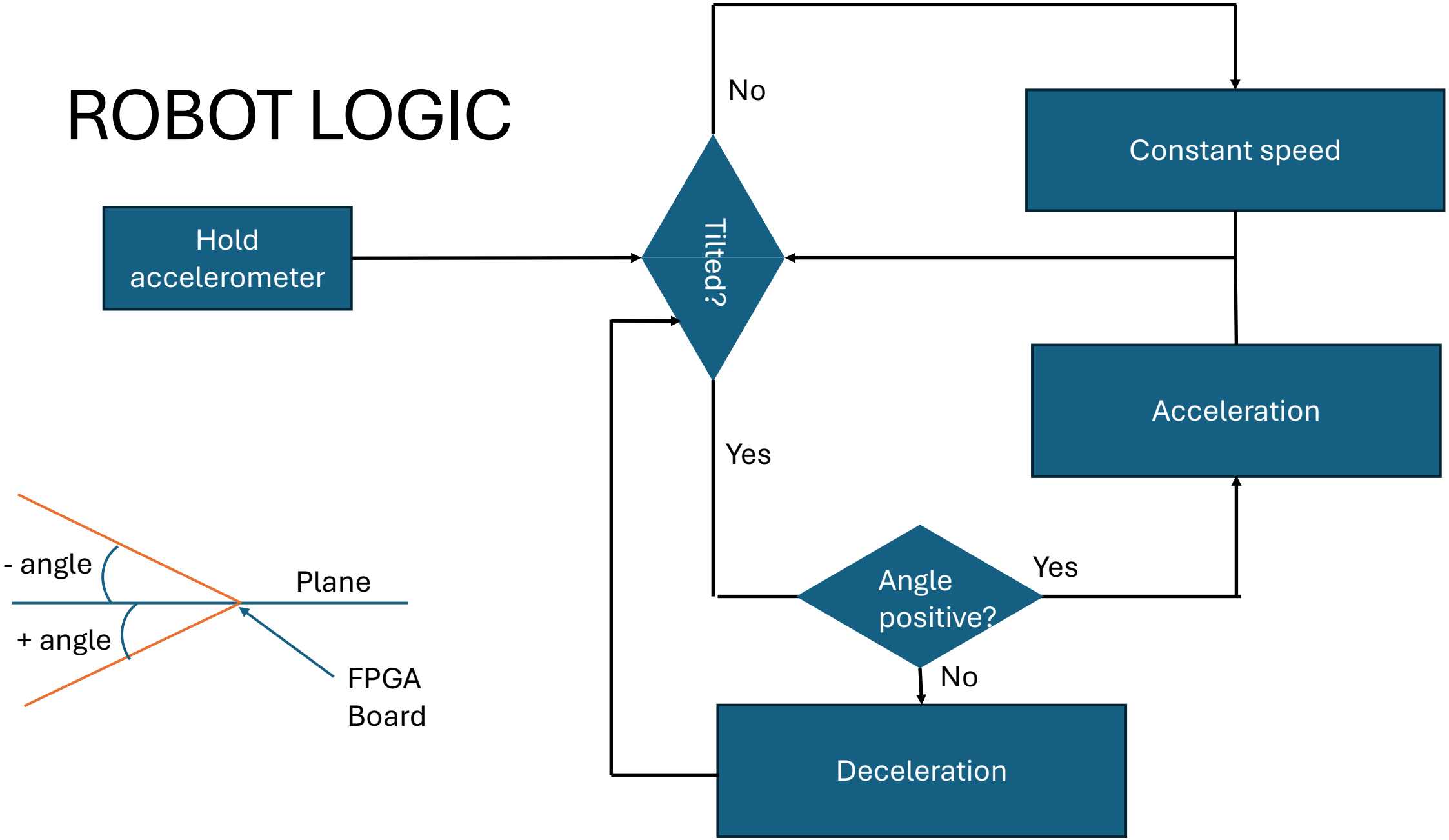
Powershell forward commands



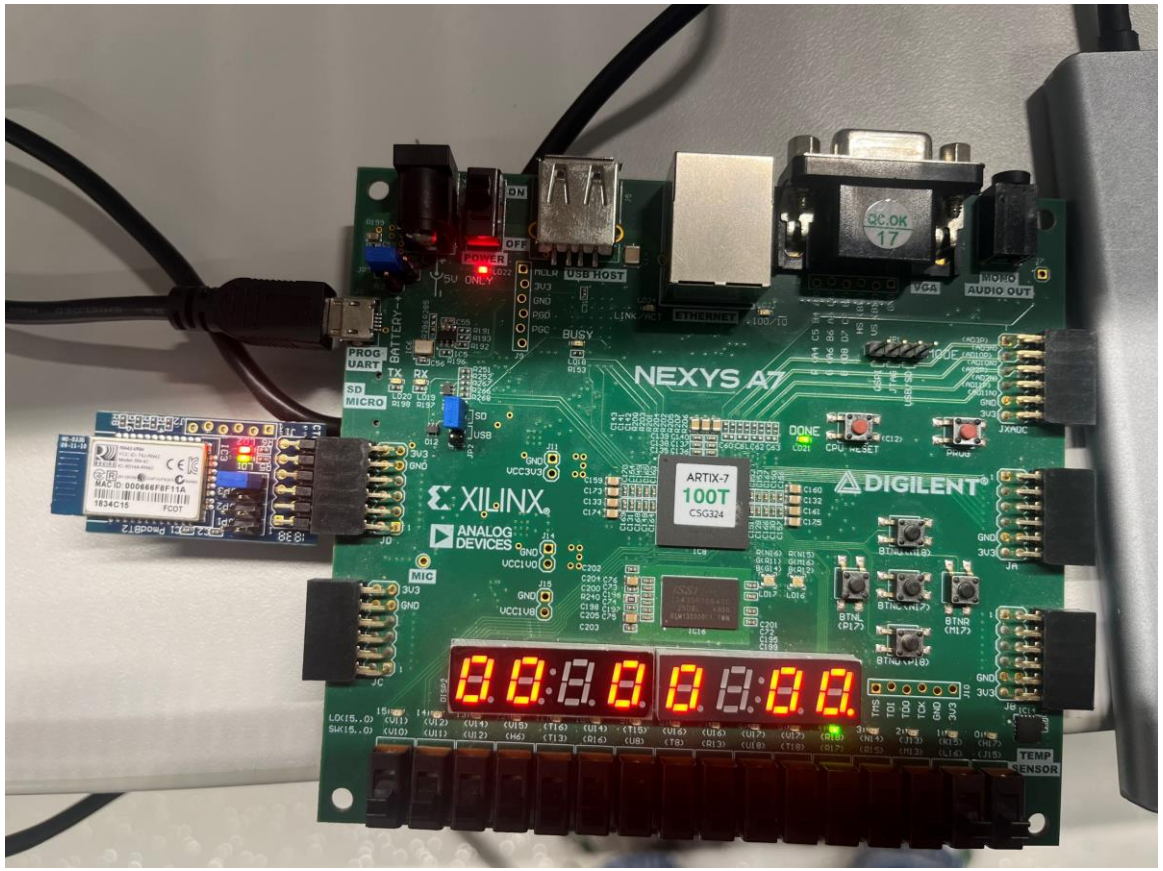
THE ROBOT


ESP32 WROOM.
Motors and motor driver.
Infrared sensors.
Bluetooth configutation.

ROBOT LOGIC


Hold accelerometer
Tilted?
No
Yes
Constant speed
Acceleration
Angle positive?
Yes
No
Deceleration
- angle
+ angle
Plane
FPGA Board

THE BIG PICTURE



Binary bits from accelerometer

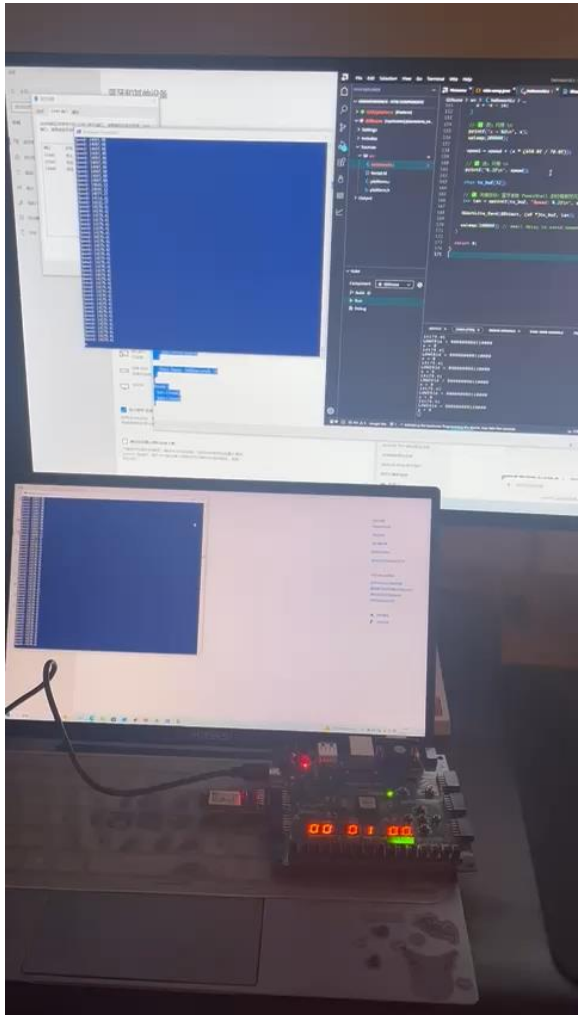
Sign bits

```
OUTPUT X   TASK: XSDB CONSOLE   DEBUG CONSOLE X   COM5 (FT
LOWER16 = 1111100000110000
x = -1
-2925.71
LOWER16 = 1111100000110000
x = -1
-2935.00
LOWER16 = 1111100000110000
x = -1
-2944.28
LOWER16 = 1111100000110000
x = -1
-2953.57
LOWER16 = 1111100000110000
x = -1
-2962.86
LOWER16 = 1111100000110000
x = -1
-2972.14
LOWER16 = 1111100000110000
x = -1
```

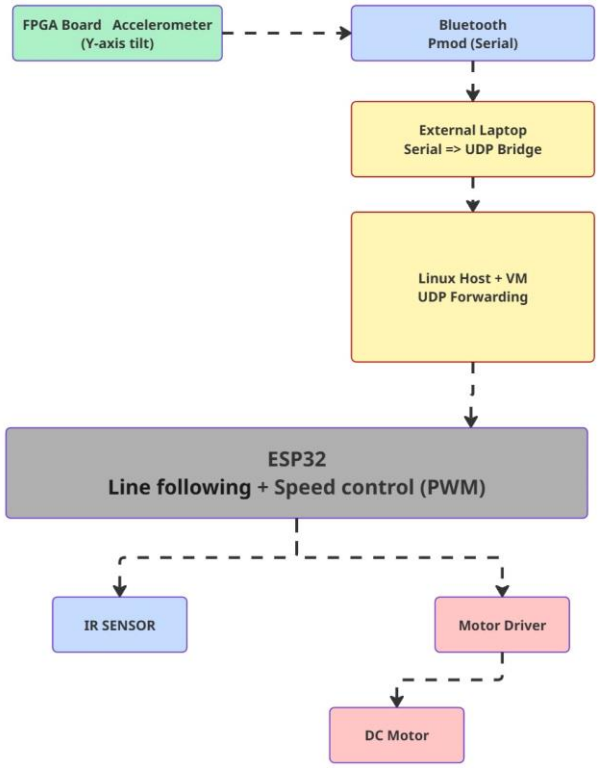
The working coordinate

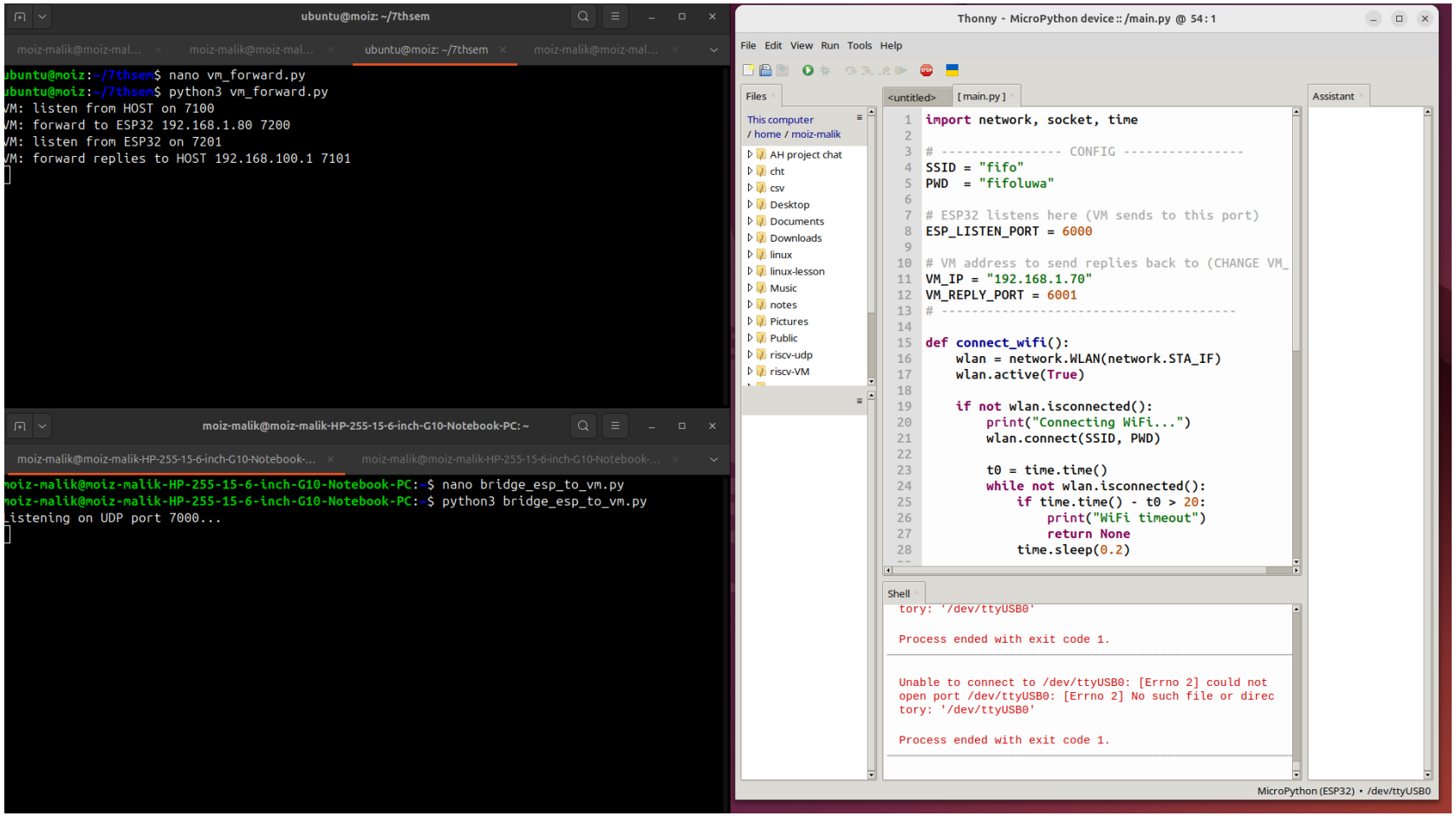
Speed

Working Example



Alternative Approach





Conclusion

- What worked:
  - FPGA Accelerometer reading.
  - BT2 PMOD data transfer.
  - ESP32 data received.
- Future Work:
  - BT2 data reading by ESP32 over WiFi.
  - Car to use the data as velocity.
  - Integration of other dimensions.
  - Different robot ideas such as drones, arms, etc.

References

- VIVADO (multiple versions).
- VITIS (multiple versions).
- Arduino IDE.
- Thonny.
- ChatGPT.
- Github.