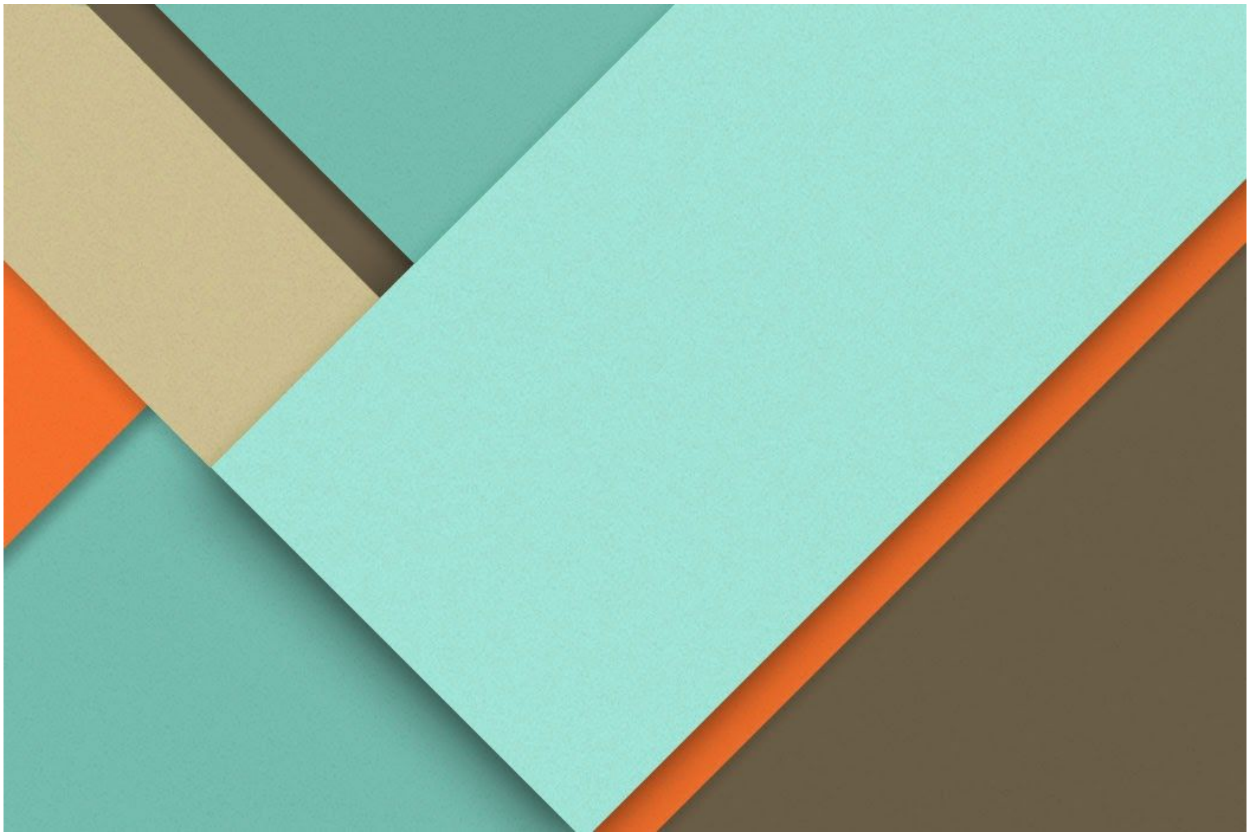

IoT4 Project

Setup Document V1

30.12.2020

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Overview

This report is a walkthrough for setting up the required prerequisites for this project.

Document Parts

1. Components Used
2. Circuit Diagram
3. Firmware and Configurations
4. App
5. Issues

Specifications

The system is divided into 4 different layers which should communicate with each other in real time.

Layers

- Hardware - Sensors' and Actuator Nodes
- Processing Layer - Server {Ubuntu Server 18.04 with Dashboard}
- Transport Layer - Gateway {Controller}

Components Used

- Controller NodeMCU ESP8266
- Entrance NodeMCU ESP8266
- Rider NodeMCU ESP8266
- PayBox NodeMCU ESP8266
- 2x Ultrasonic Sensors HC-SR04
- 2x MFRC522 RFID Readers
- Lithium Charger TP5000
- 2x Arduino Nano
- MPU6050 IMU
- 4x A4988
- 2x DC Driver MX1508
- Stepper Motors and Actuators
- RFID Cards and Stickers
- Micro-Switch
- Battery

Architecture

The complete project has multiple components

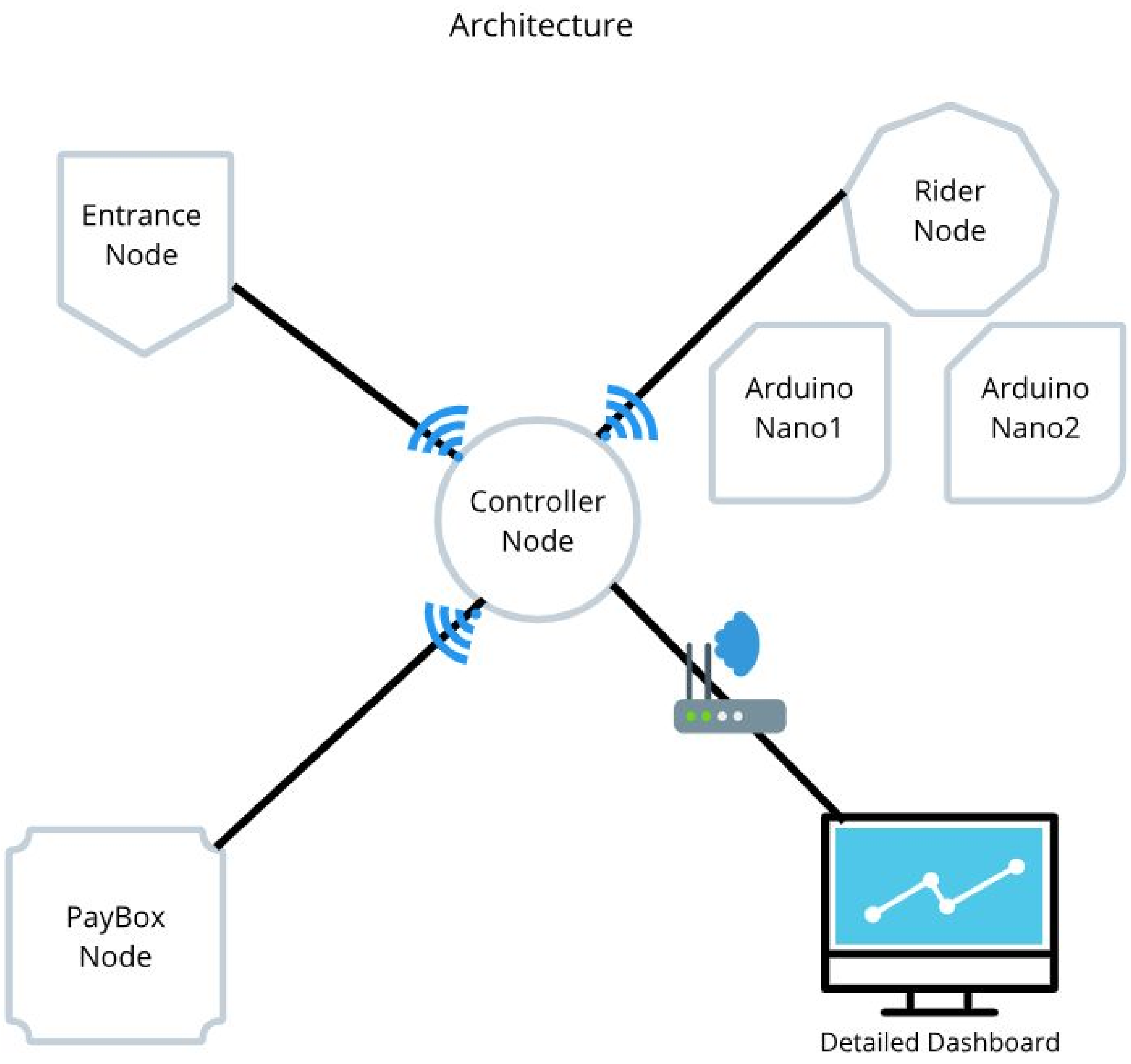
- Entrance Node
- Controller Node

- Rider Node
- PayBox Node

All nodes are connected wirelessly to a Controller Node. The Controller Node is connected to a WebApp based Dashboard running on a Ubuntu Server displaying the data of all nodes and allowing two-way communication within the system. The communication protocol used in this architecture is MQTT.

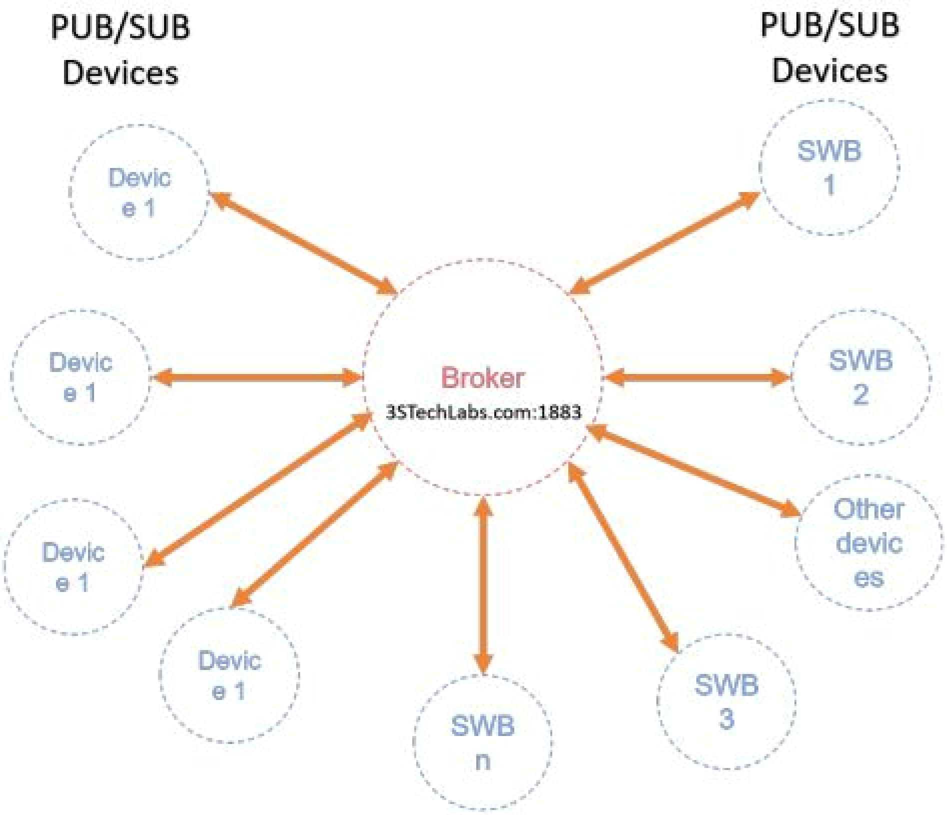
See the architectural diagram below.

Complete Architecture



Above is the Sensor Nodes architecture. Each box contains a single sensor along with Arduino Pro Mini. Each Sensor Node Can be connected to a single Master(ESP8266) on an I2C Bus. The sensor blocks work in a plug and play manner and can be added or removed as required.

What is MQTT?



Take an example of a system in which there are hundreds of people having smart bands that can display information of a person's surroundings. And then there are Android, iOS and Windows devices that can be used to monitor smart bands to define a set of parameters for bands.

So in a scenario where there are mixed types of devices including hardware platforms, the best communication protocol is MQTT.

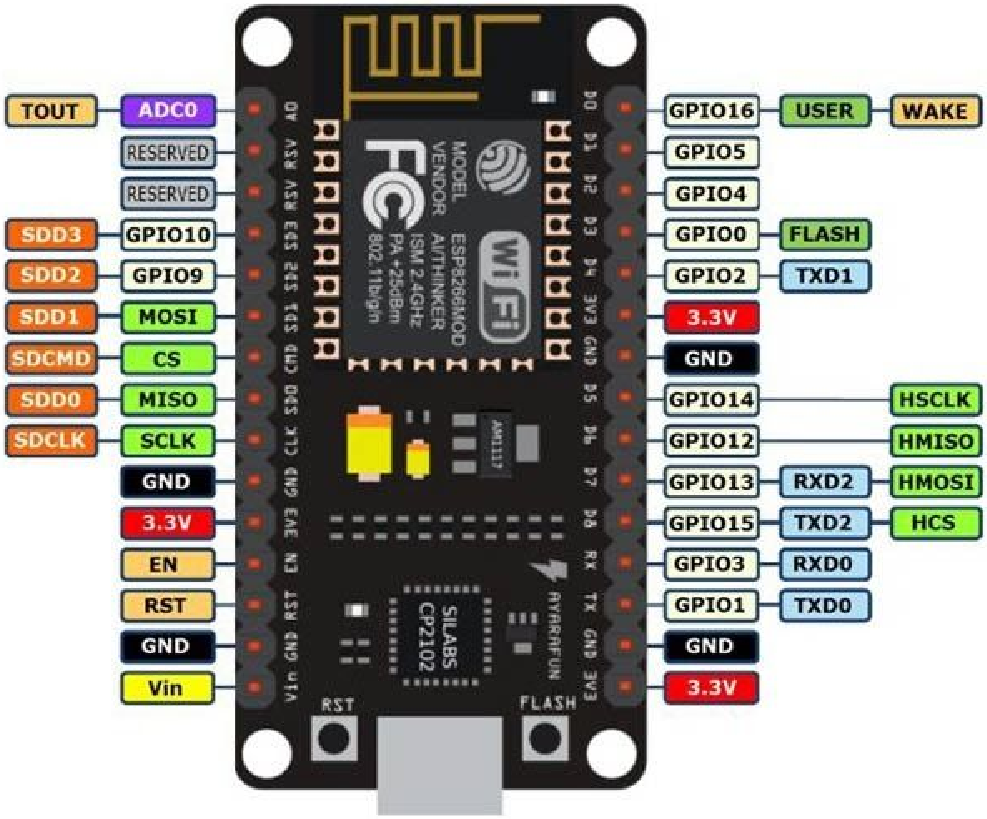
It can handle two-way and parallel communication and the number of devices that can be connected and communicate via MQTT are limitless, the only limit is server resources. MQTT is also known as pub/sub protocol.

Hence the protocol of choice here is MQTT.

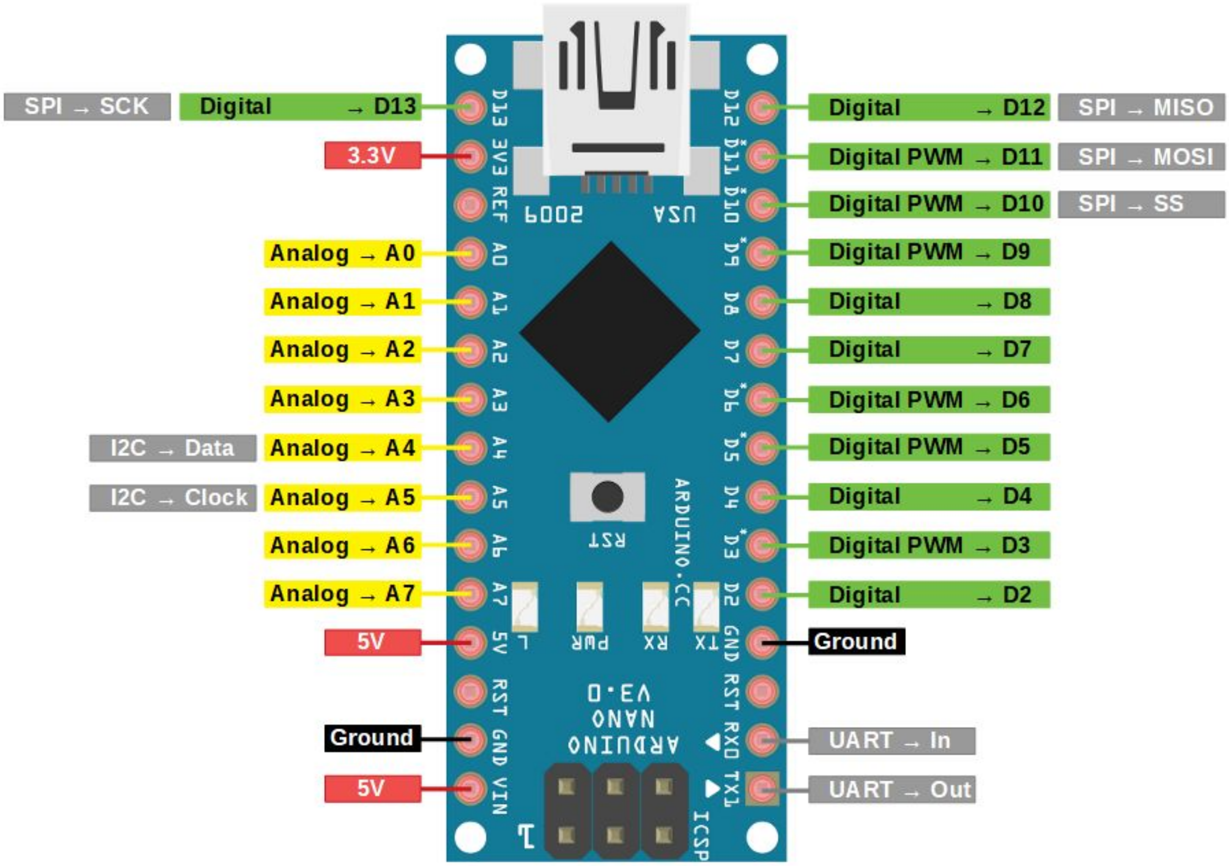
Circuit Diagram

For reference, the pinouts used for the boards are given below.

NodeMCU Pinout

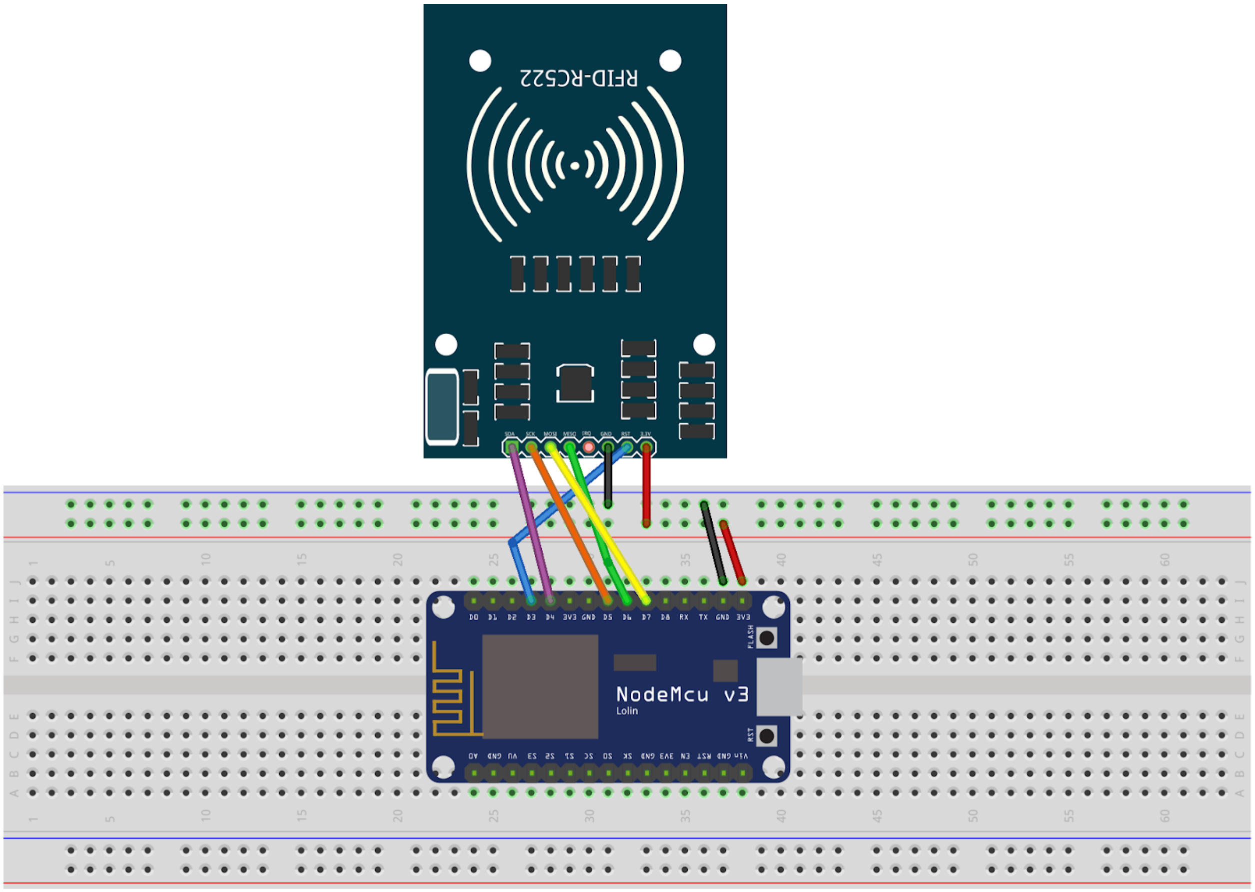


Arduino Nano Pinout



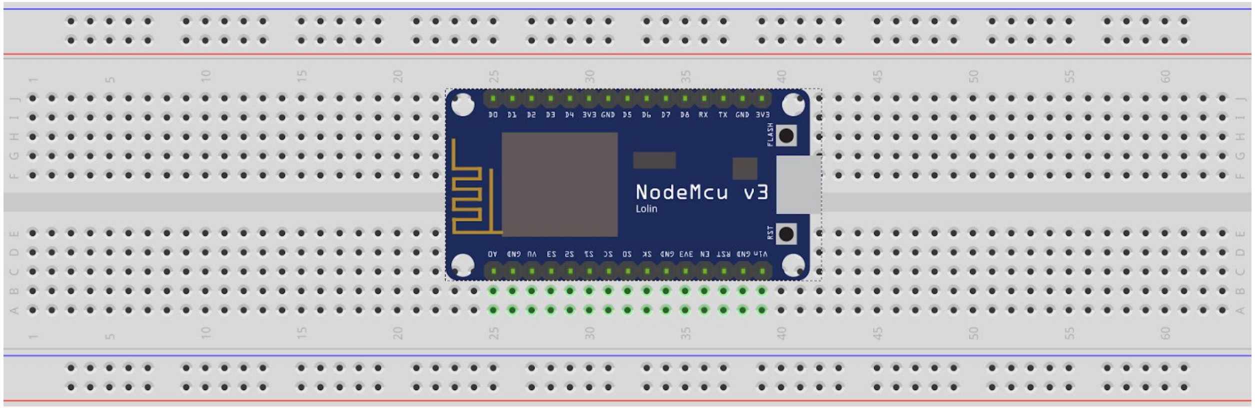
Source: Fritzing

Entrance Node Circuit Diagram

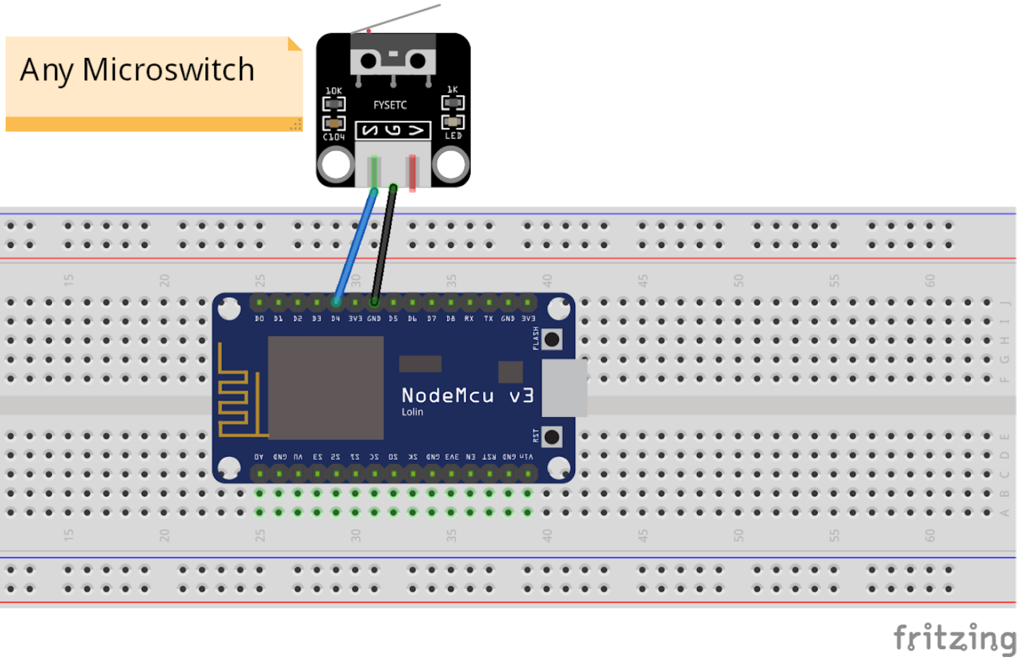


fritzing

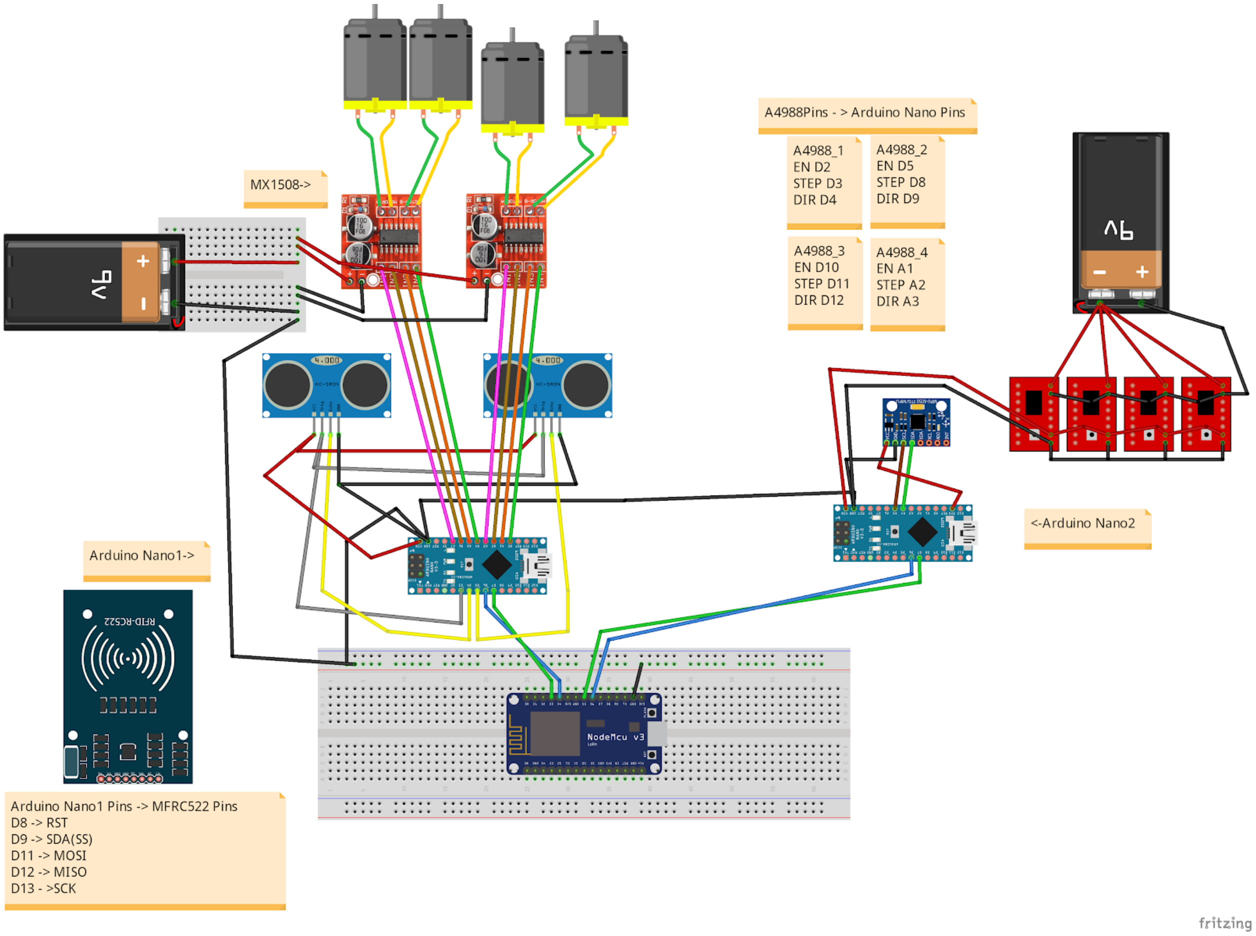
Controller Node Circuit Diagram



PayBox Node Circuit Diagram


Any Microswitch
10K
FYSETC
1K
C104
LED
S G V
D0 D1 D2 D3 D4 3V3 GND D5 D6 D7 D8 RX TX GND 3V3
FLASH
NodeMcu v3
Lolin
RST
A0 GND VU S3 S2 S1 SC SO SK GND 3V3 EN RST GND Vin
fritzing

Rider Node Circuit Diagram



[High resolution circuit diagrams are present in the CircuitDiagrams folder.]

Firmware and Configurations

Softwares and Frameworks Used

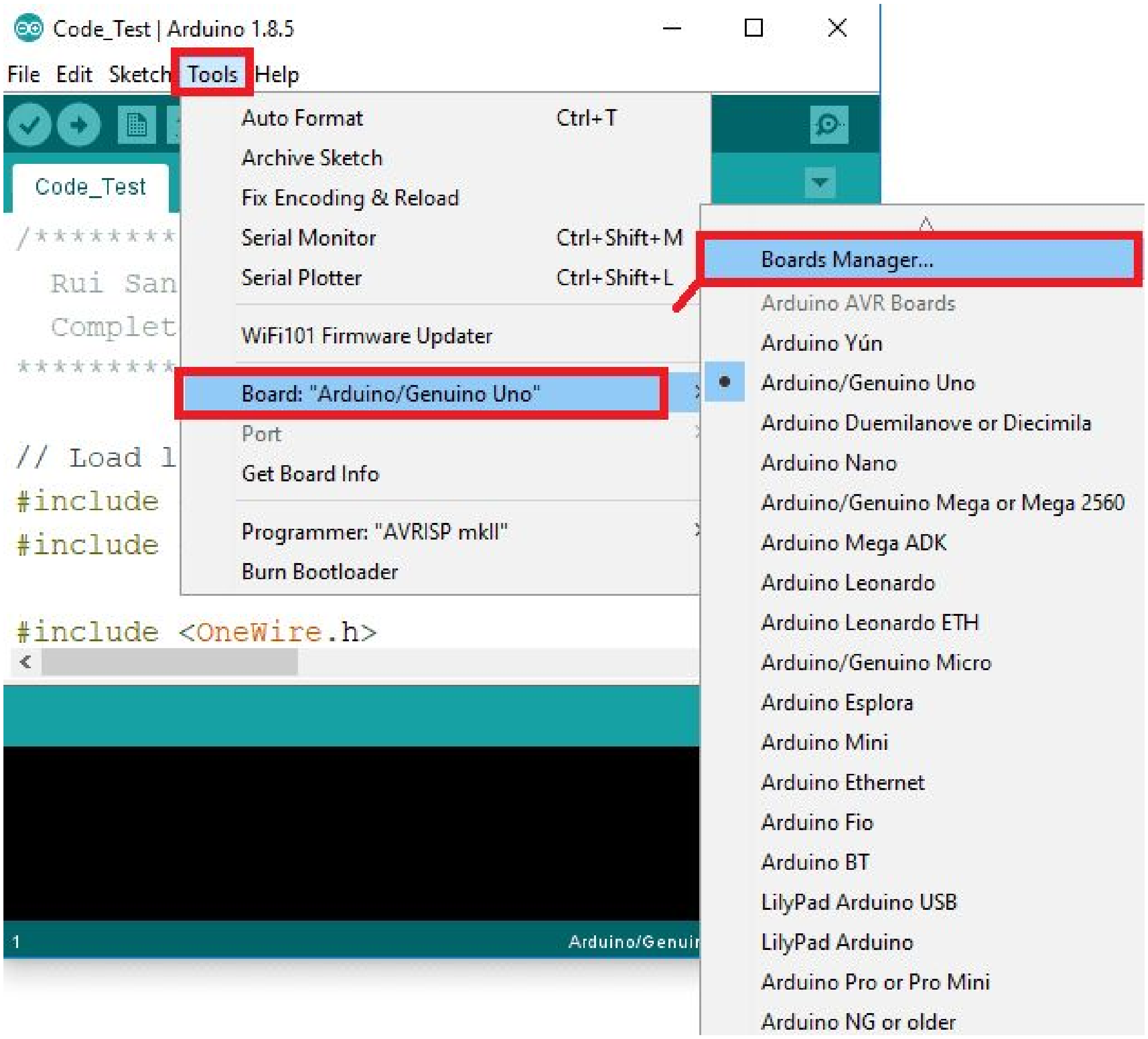
- Arduino IDE https://www.arduino.cc/en/Main/Software
    - For .ino files
- Fritzing https://fritzing.org/home/
    - For circuit design for .fzz and .fzpz files.
- NodeRED https://nodered.org/
    - As a test-bed along with MQTT Lens

Programming Arduino

- Download latest Arduino IDE from https://www.arduino.cc/en/Main/Software
- And open it.

Open the RiderAN1.ino file from the Rider->RiderAN1 Folder

3) Open boards manager. Go to **Tools** > **Board**



```
/*********
  Rui San
  Complet
*********

// Load l
#include
#include

#include <OneWire.h>
```

4) Select Arduino Nano

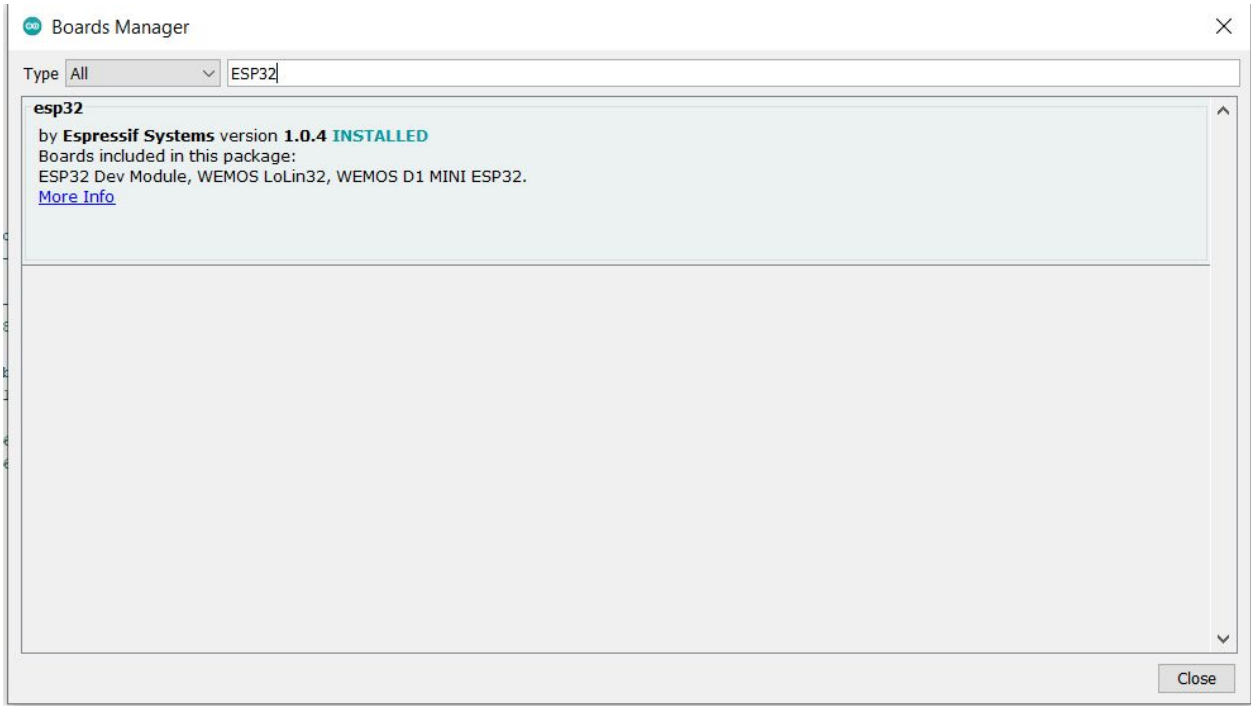
Make sure that you have selected Arduino Nano from Boards Menu.

5) You can now upload the code to Arduino Nano

6) Do the same with 2nd Arduino Nano and upload RiderAN2.ino code to it.

Programming NodeMCU

- Open Arduino IDE
- Click on File->Preferences
- In the additional Board Manager URLs put the following line
    - **http://arduino.esp8266.com/stable/package_esp8266com_index.json**
- Then click ok
- Now go to Board Manager from Tools->Boards menu
- Search for ESP8266 and click on install to install it



esp32
by **Espressif Systems** version **1.0.4** **INSTALLED**
Boards included in this package:
ESP32 Dev Module, WEMOS LoLin32, WEMOS D1 MINI ESP32.
More Info

- Now from RiderFirmwareNodeMCU folder you can open RiderFirmwareNodeMCU.ino file
- Select NodeMCU v1.0 from Tools->Board
- Select correct COM port from Tools->Port
- Now you can upload the code to your NodeMCU.

Before Uploading to the NodeMCU

Open MQTTHandler.h of each node and change

- Change WiFiName to your WiFi router name
- Change WiFiPassword to your WiFi Router password.
- Note: you have to change all MQTTHandler.h files present in all folders.

Then save the changes and upload the code to the NodeMCU.

You can then upload FirmwareController, FirmwarePayBox, FirmwareEntrance similarly.

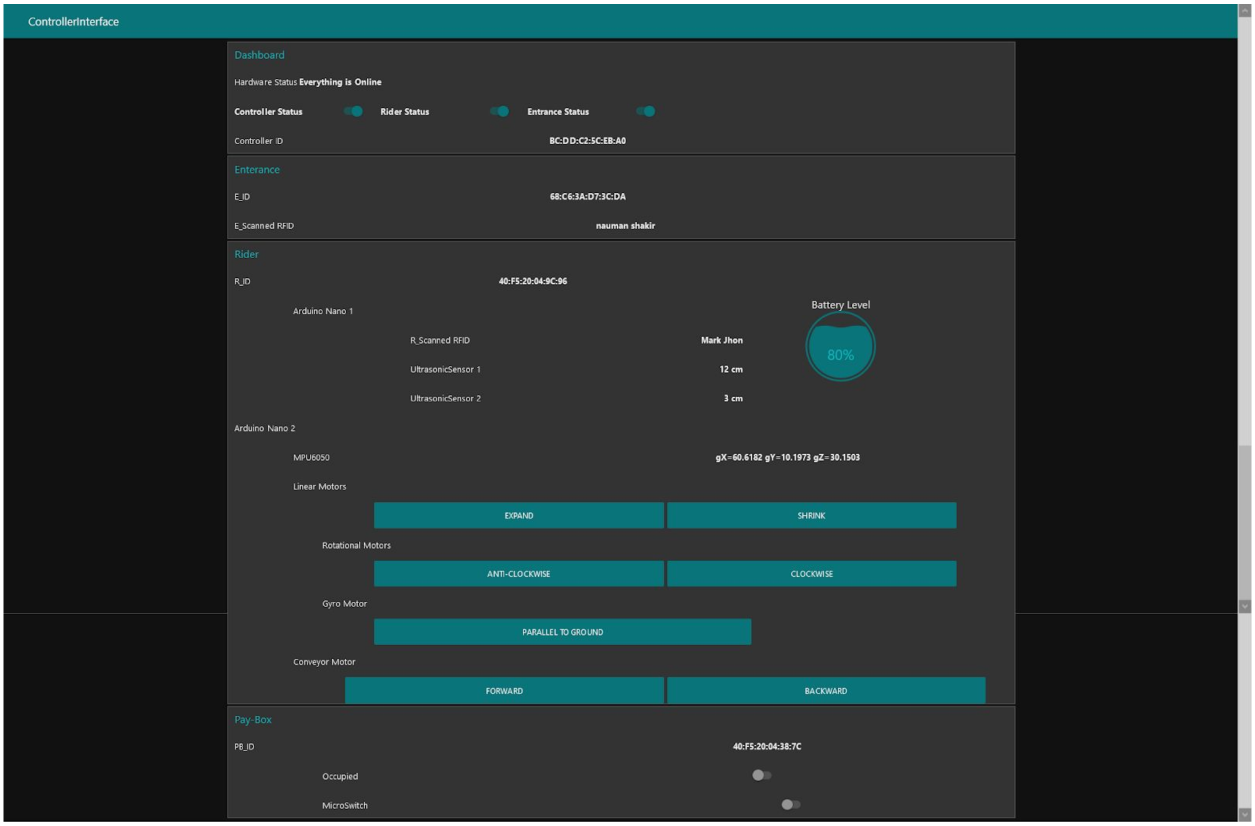
Testing the System

Power up all the nodes after assembling the circuit and then open the WebApp dashboard.

WebApp

The WebApp can be accessed from

http://nodered.production.wrapdrive.tech:1880/ui/#!/6



ControllerInterface

Dashboard

Hardware Status **Everything is Online**

Controller Status ● **Rider Status** ● **Entrance Status** ●

Controller ID **BC:DD:C2:5C:EB:A0**

Enterance

E_ID **68:C6:3A:D7:3C:DA**

E_Scanned RFID **nauman shakir**

Rider

R_ID **40:F5:20:04:9C:96**

Arduino Nano 1

R_Scanned RFID **Mark Jhon**

UltrasonicSensor 1 **12 cm**

UltrasonicSensor 2 **3 cm**

Battery Level 80%

Arduino Nano 2

MPU6050 **gX=60.6182 gY=10.1973 gZ=30.1503**

Linear Motors

Rotational Motors

Gyro Motor

Conveyor Motor

Pay-Box

PB_ID **40:F5:20:04:38:7C**

Occupied ○

MicroSwitch ○

Issues

No issues as of now.

Profile

Name: Nauman Shakir

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I'm a Full-Stack IoT Developer and have done more than 150 hardware projects and running an IoT and Hardware Design House

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