Trackless Tram system

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Outline

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Introduction

- Main means of transportation emissions:
  - Cars 61%
  - Trucks and buses 18%
  - Reduces QoL
- Electrical cars solve this problem.

Introduction

- Available Current solution:
  - Electric Tram System.
- Problems with it:
  - Major work (city planning wise)
  - Implementation can cause unnecessarily large congestions until it is done.
  - Costly. Upwards of $500.000.000 (1.875B S.R)
    - Half of that cost is to implement foundation (tracks).

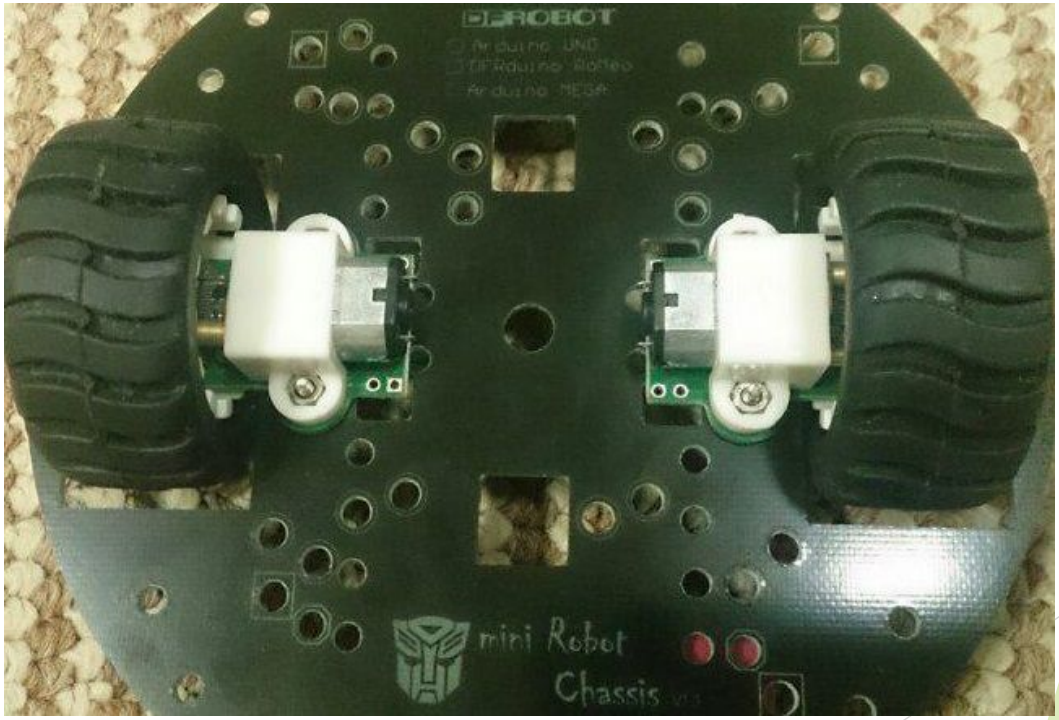
Problem Statement

- a trackless (railway-free) multi-car electric tram.
  - Efficient to implement in newer cities.
  - Can go through traffic.
  - can be electric or fossil fueled.

Impact

- Positive:
  - Greatly reduce emission.
  - Reduce cost immensely.
  - Make public transportation more readily available.
- Negative:
  - Can cause congestion if not driven properly.

Our Implementation



Design Decisions

- Communication:
  - XBee.
  - WiFi.
  - Bluetooth.
- Final Decision:
  - XBee.
    - Time delay is not a problem in communication.
    - Familiarity, faster to implement.

Design Decisions

- Propulsion:
  - DC Motors.
  - Stepper motors.
- Final decision:
  - DC motor:
    - Pulse-width modulation for speed.
    - Speed feedback.

Design Decisions

- Steering:
  - DC Motors.
  - Stepper motors.
- Final decision:
  - Stepper motor:
    - More precision.

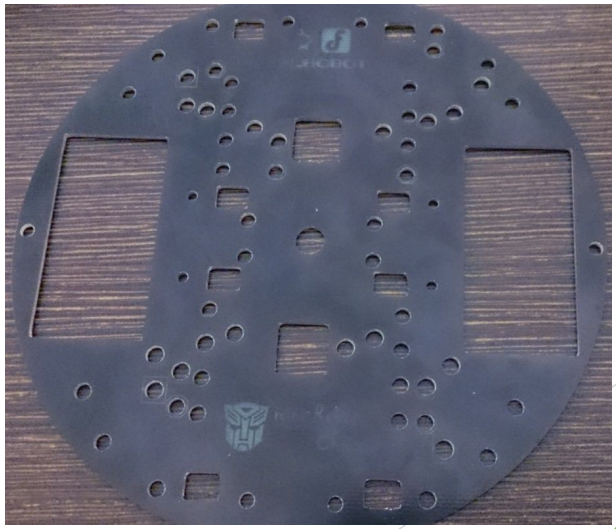
Issues Faced

- Shipment Error:
  - Missing parts.
  - Late to arrive.
  - handled by pushing back implementation of hardware and focusing on the software.
- Front wheel mechanism:
  - We lacked the skills to make one.
  - Handled by: sending Basil on an 80s montage in a journey to figure it out in the FABLAB.

Body

Toys

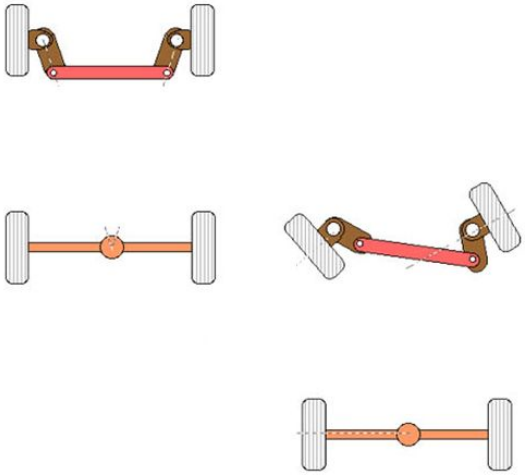
Market

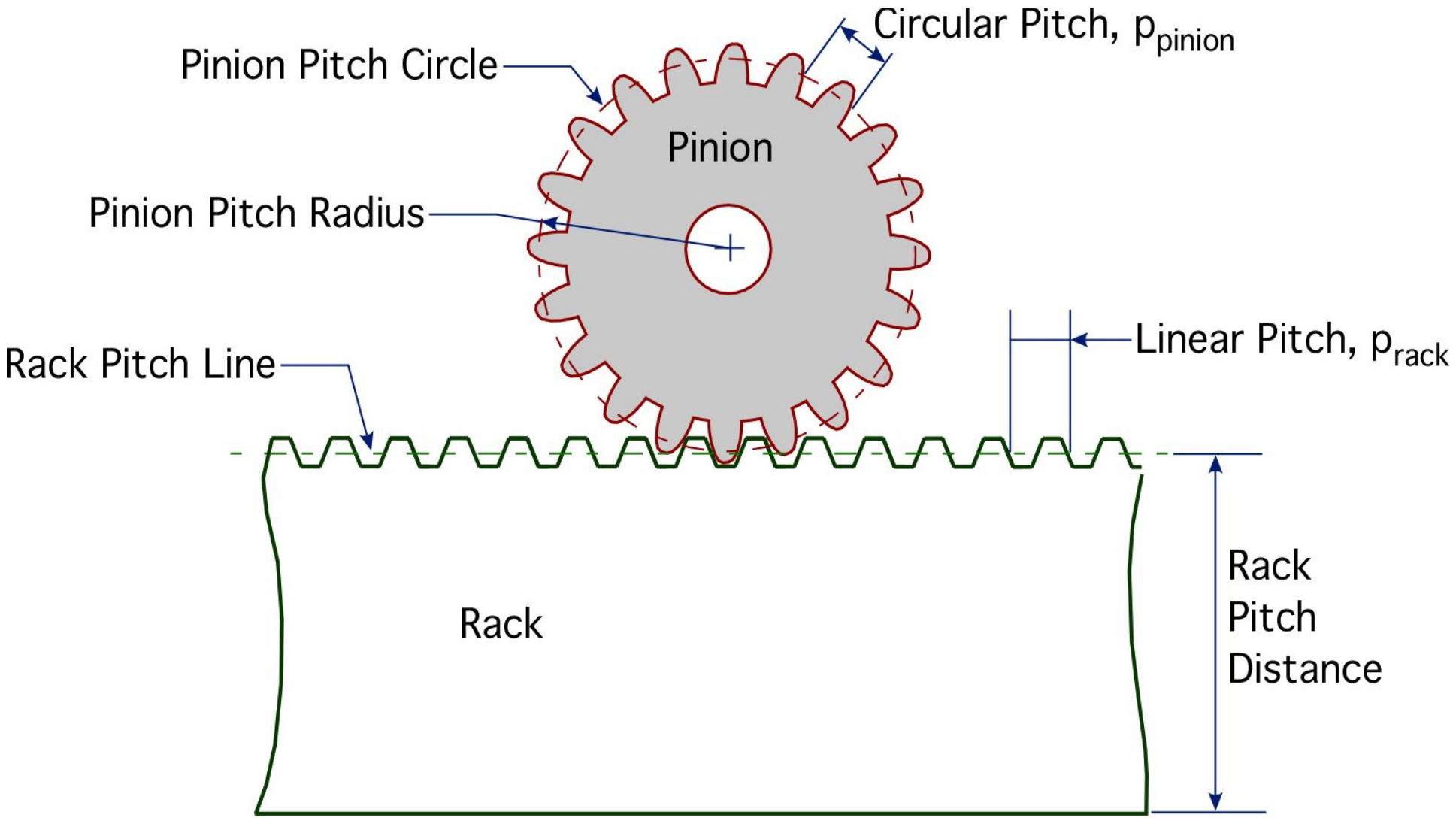


Steering Mechanism

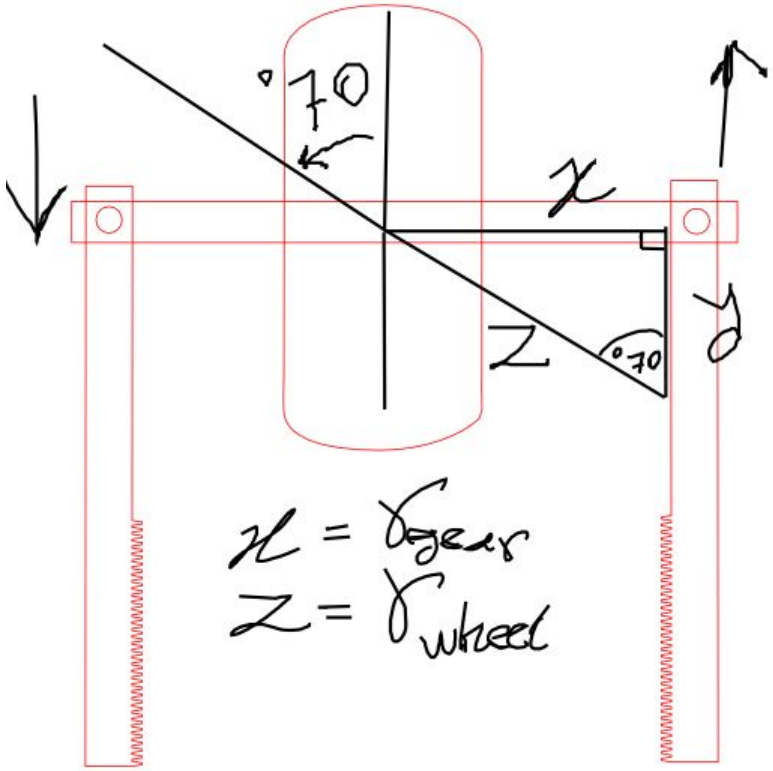
Differential Drive Mechanism

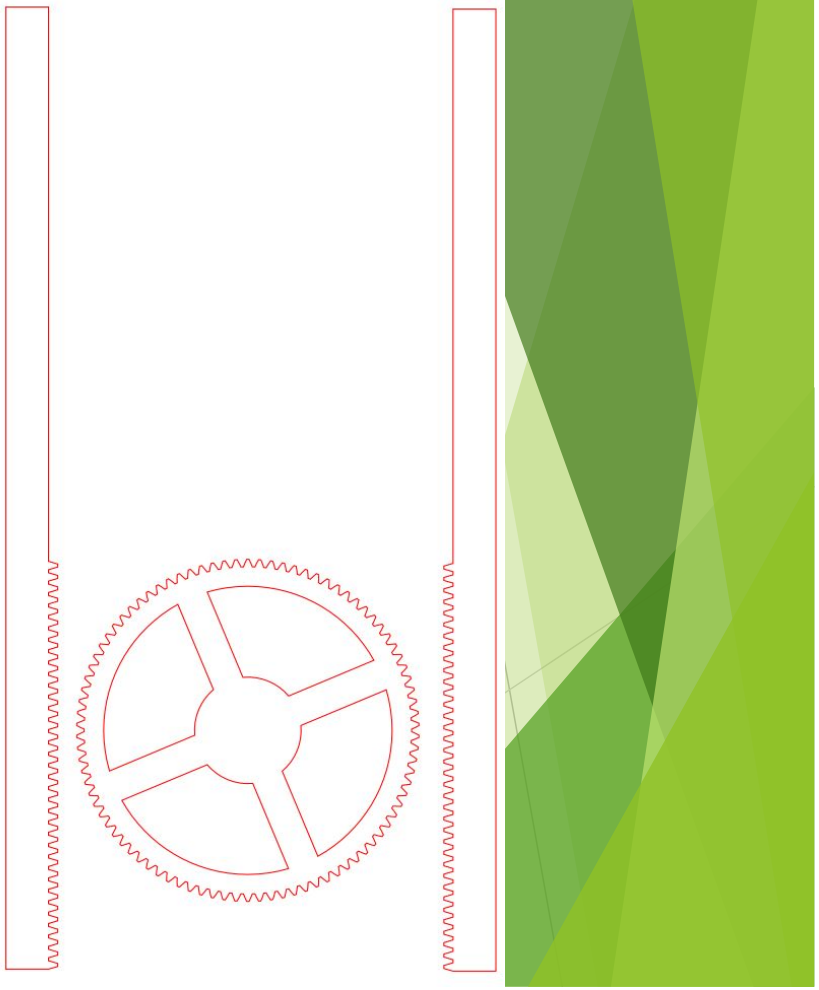
Ackermann Steering Geometry




Circular Pitch, p_{pinion}
Pinion Pitch Circle
Pinion
Pinion Pitch Radius
Linear Pitch, p_{rack}
Rack Pitch Line
Rack
Rack
Pitch
Distance

Designing Model

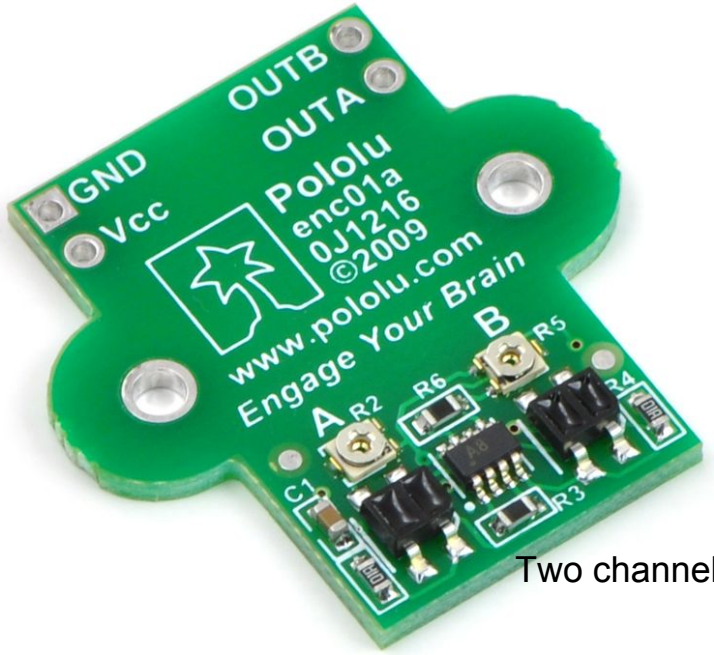




Encoders

Output

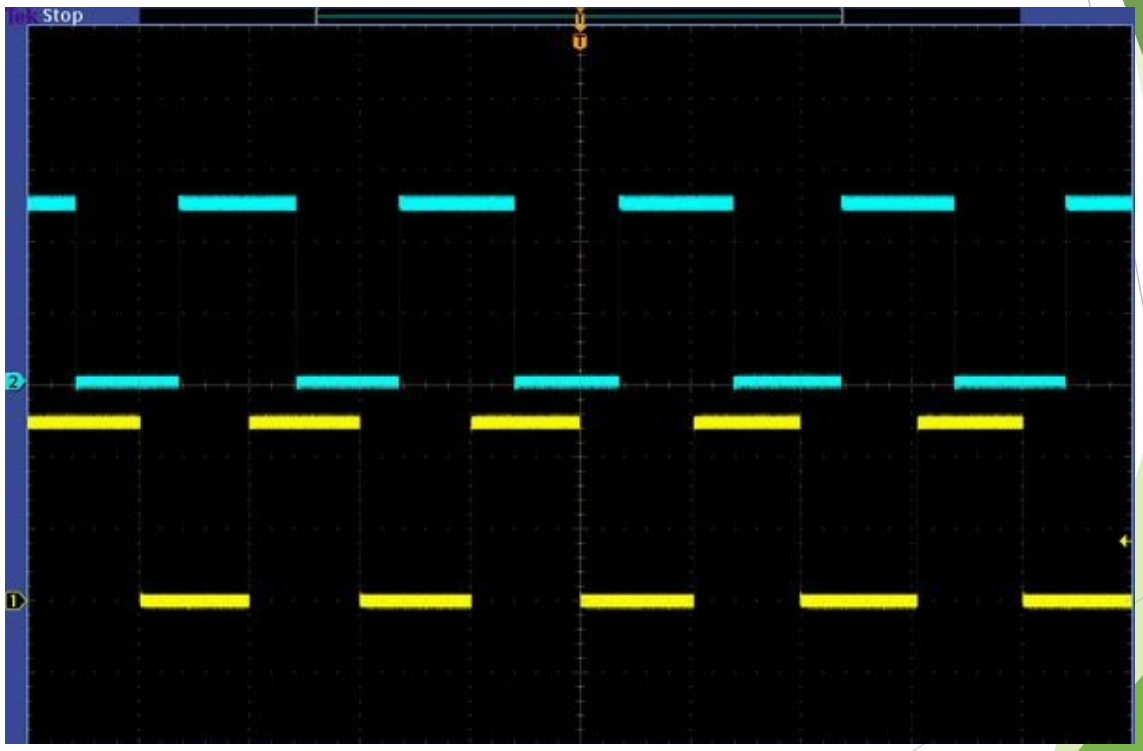
Inputs



Two channel sensors

Encoders implementation

Encoder signal



Encoders software

issues:

- frequency "not the same"
- syncing

void loop(){

while(high){} while(low){}

//the code }

- **Event Driven Programming**

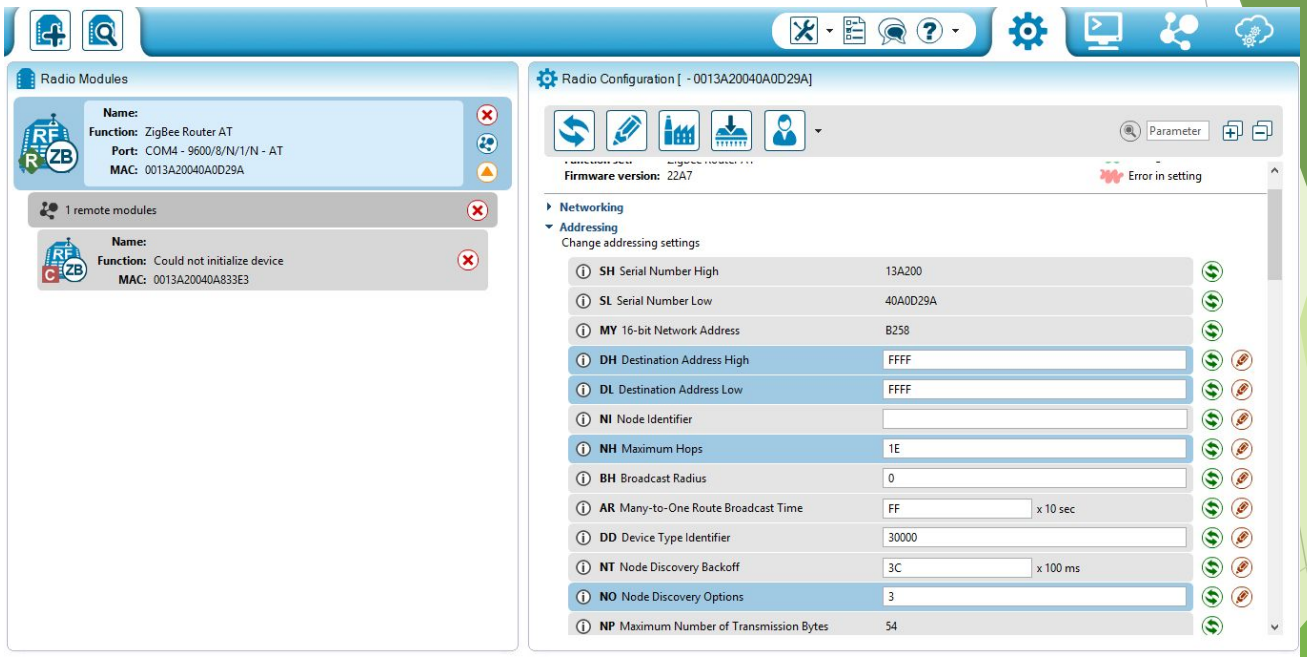
1. Event checker. current signal state .last signal state.
2. Event Handler. for each case.

Communication

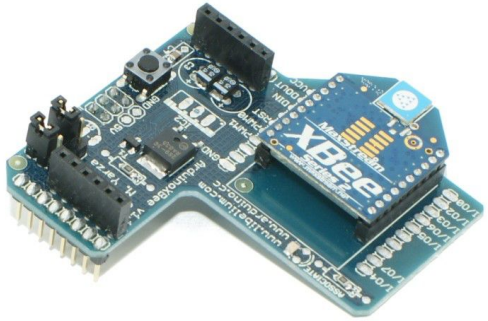
- 4 Xbee
- one for each of the three cars
- one connected to the computer for user input

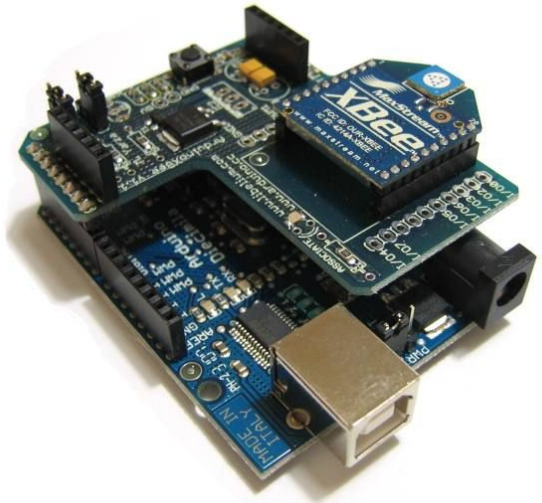
XCTU - software

XCTU


Radio Modules
Name:
Function: ZigBee Router AT
Port: COM4 - 9600/8/N/1/N - AT
MAC: 0013A20040A0D29A
1 remote modules
Name:
Function: Could not initialize device
MAC: 0013A20040A833E3
Radio Configuration [- 0013A20040A0D29A]
Parameter
Firmware version: 22A7
Error in setting
Networking
Addressing
Change addressing settings
SH Serial Number High 13A200
SL Serial Number Low 40A0D29A
MY 16-bit Network Address B258
DH Destination Address High FFFF
DL Destination Address Low FFFF
NI Node Identifier
NH Maximum Hops 1E
BH Broadcast Radius 0
AR Many-to-One Route Broadcast Time FF x 10 sec
DD Device Type Identifier 30000
NT Node Discovery Backoff 3C x 100 ms
NO Node Discovery Options 3
NP Maximum Number of Transmission Bytes 54

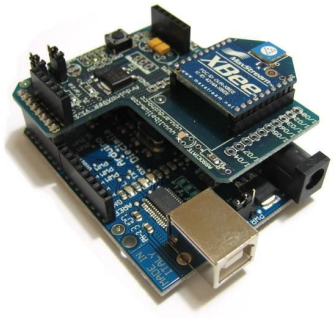
Xbee shiled , Arduino



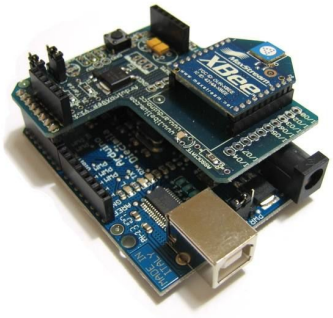


Mesh Network

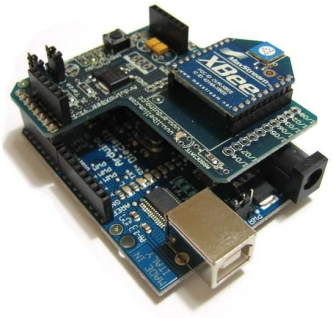
Cordinator



Router car pilot



Router car trailer1

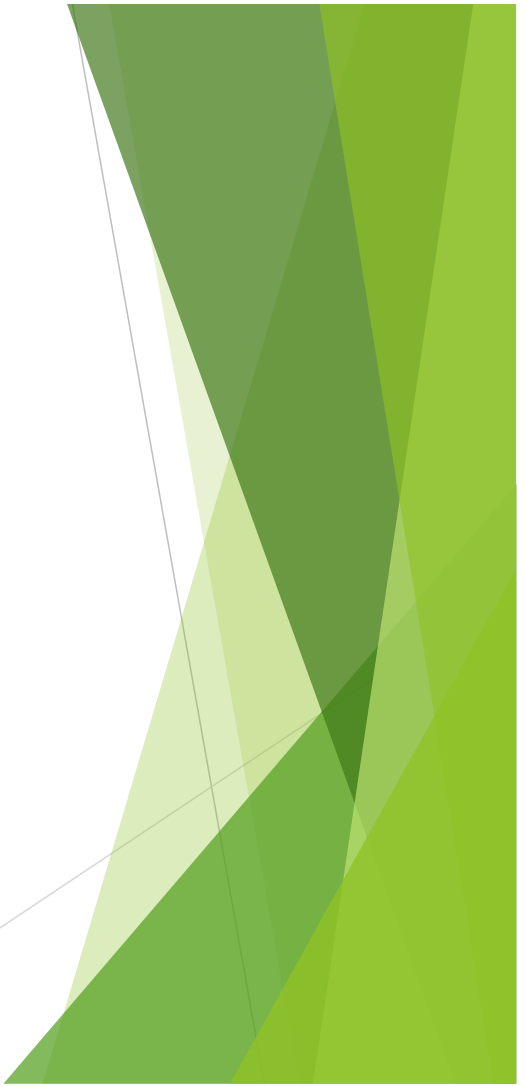


Router car trailer2

Network software

```
#include <XBee.h> //add the xbee library

XBee xbee = XBee();//define a xbee object
void setup(){
  xbee.setSerial(Serial);
  Serial.begin(9600);
  Serial.println("Simple Xbee Communication");
}
void loop()
{
//some useful methods from XBee.h
xbee.readpacket(); xbee.getResponse();
xbee.getDataLength():xbee.isAvaliable();
}
```



Conclusion