

Robot Communication

Team CotsBots

- Greg Donaldson
- Johnathan Flake
- Jason Kemp
- Gabe Pearhill
- Matt Trana

Sponsor

University of Idaho CS Department

- Dr. Robert Heckendorn
- Dr. Terence Soule

Mentor

- Bruce Bolden

Overview

- Problem
- Project Goal
- Project Learning
- Solution Design
- Summary

Problem

C.O.T.S.

- Commercial Off-The-Shelf
- Research Robot
 - Evolved Path Following [1]
 - Color Following
- Robots are individuals and unable to coordinate



COTS Requirements

- Affordable < \$500
- Easy to assemble
- Computationally Powerful
- Programmable using modern languages
- Durable



Project Goals

- Add Communication hardware
- Create software to handle inter-network communication
- Create a Java API library for Android
- Design within COTS requirements

Key Design Goals

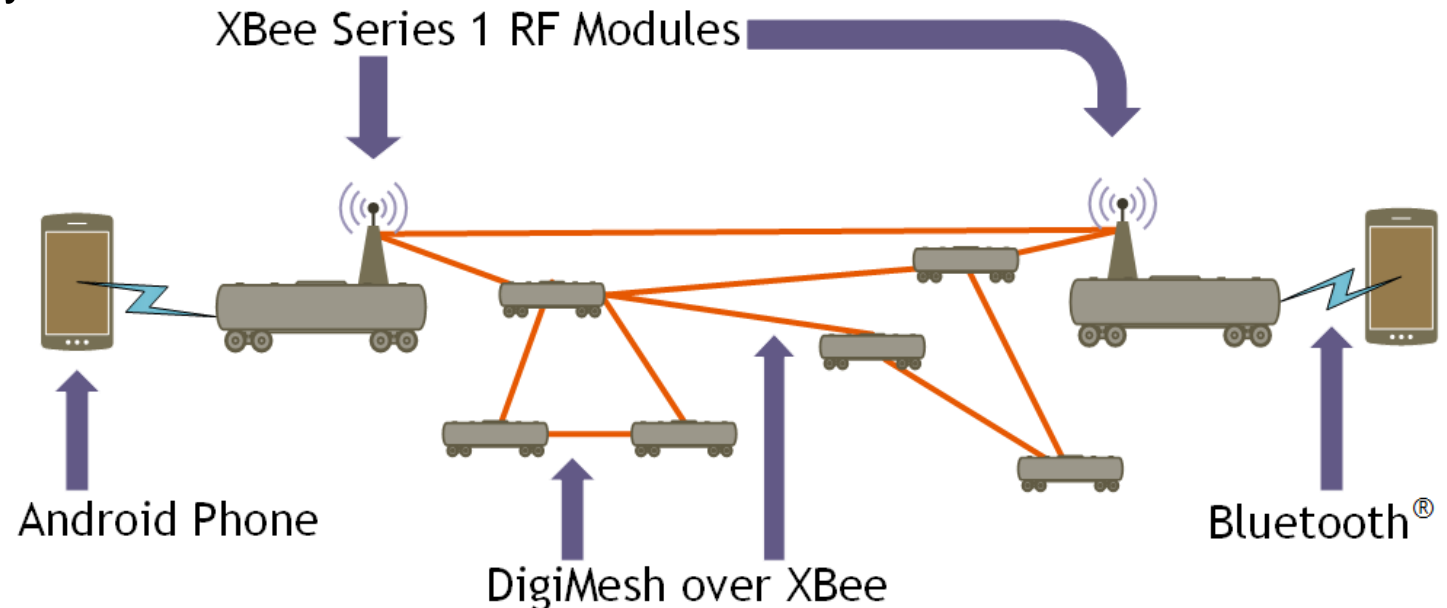
- Simplicity for the end-user
- Small communication packet size
- Extensibility
- Flexibility
- Reliability

Project Learning

Communication Hardware

- XBee Series 1 from Digi International
- Digimesh 2.4 Protocol [2]
 - Unicast with reliable delivery
 - Self-healing network
 - Reactive route discovery

- 2.4 GHz frequency
- 1 mW transmit 45mA @ 3.3V
- Up to 300ft range
- 250 kb/s RF data rate

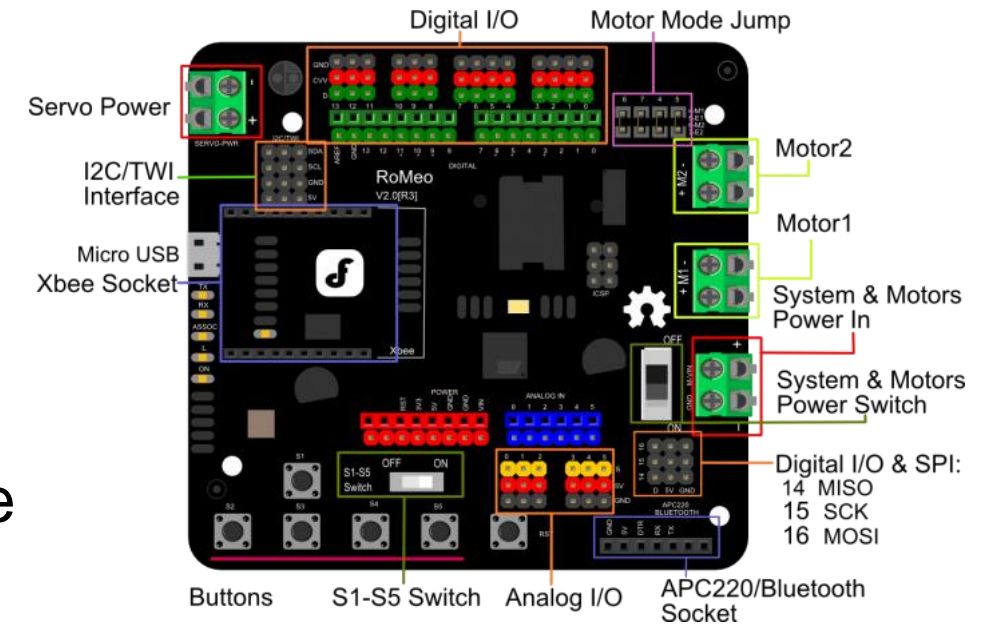


Project Learning

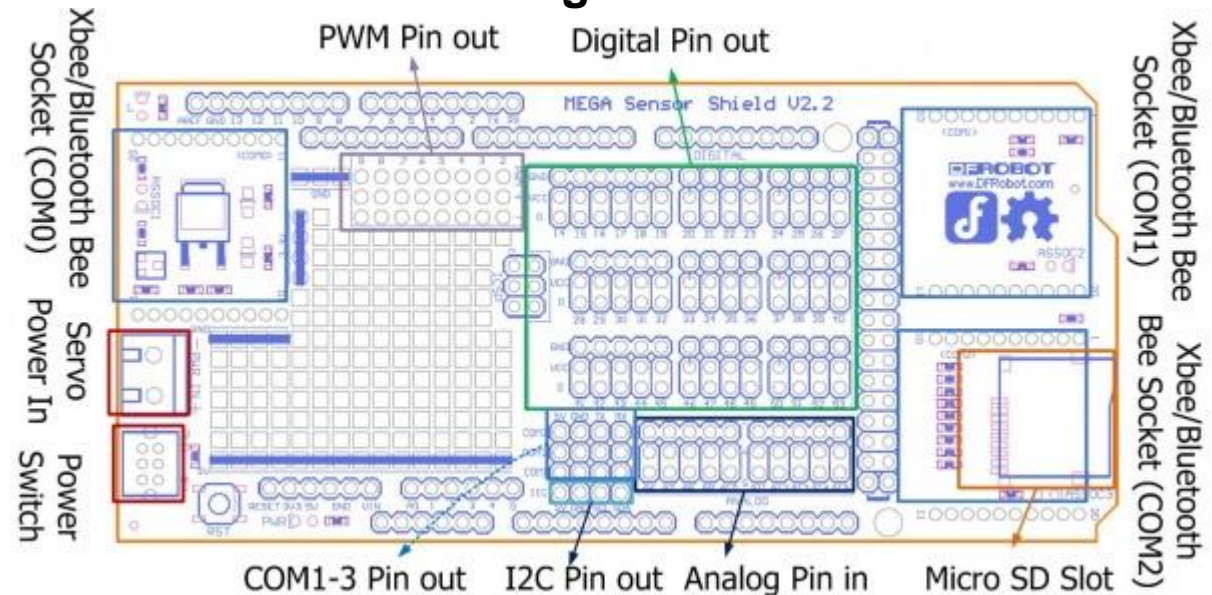
Hardware Upgrade

- Existing Arduino Controller – Romeo [3]
- Continued use of Arduino based hardware
- New Hardware
 - Bluno Mega 2560 [4]
 - Mega Sensor Shield [5]
 - XBee Sockets
 - Servo PWM
 - 2A Motor Shield [6]
 - DC motors
 - Stepper motor

DF Robot Romeo V2



DF Robot Mega Sensor Shield



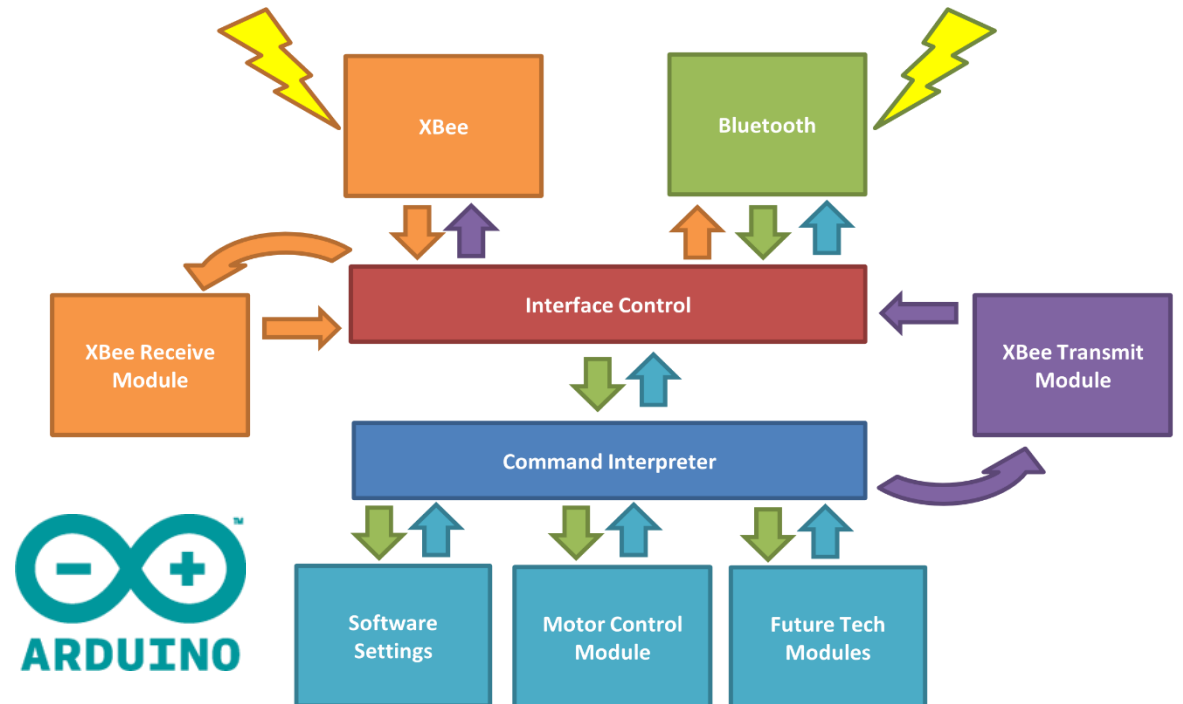
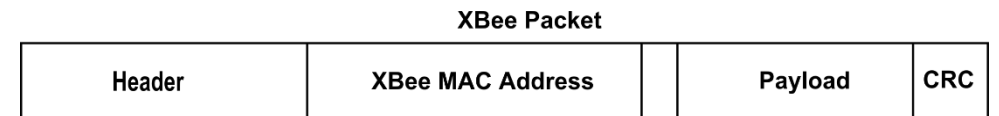
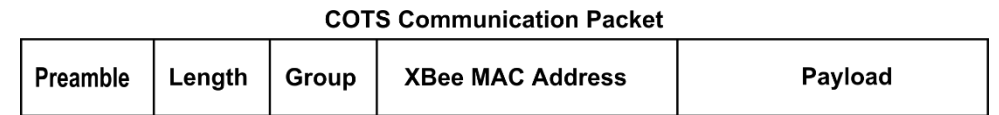
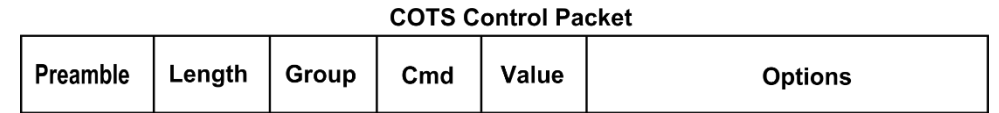
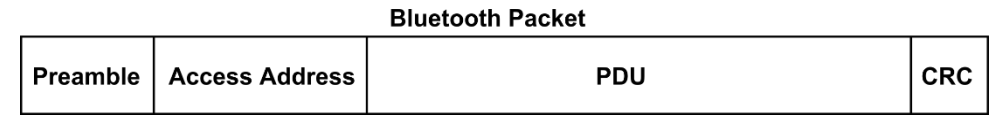
Solution Design

Data Packet Design

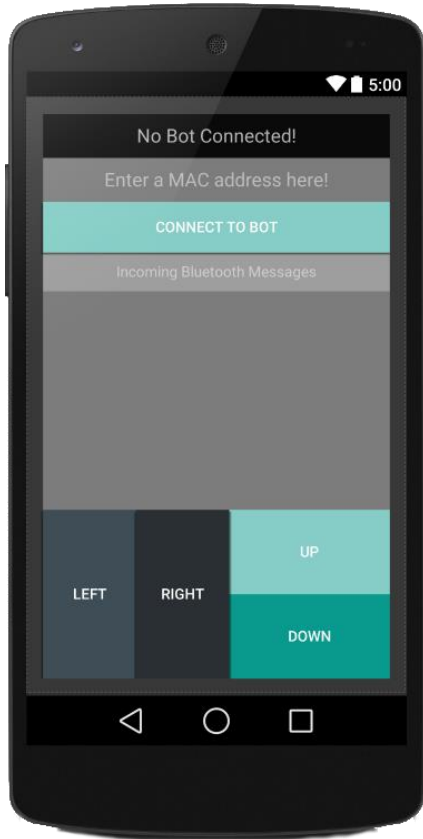
- Simple packet design
- COTS Control Packet
- COTS Communication Packet
- No CRC byte

Arduino Software Design

- Low memory usage
- Least amount of processing
- Minimal checks on commands
- Error Handling
- Future Extensibility



Solution Design



Android API and Human Interface

Remote Control Functionality

- Drive the bot from the phone
- Send strings over the XBee network

Debugging

- View debugging information from the Arduino

Android API for Bluetooth Communication with the Robot

- Easily send and receive XBee packets
- Control motors, and other robot hardware
- Quickly develop new functionality with the existing Bluetooth packet system

Summary – What Works?

Bluetooth API

- The Arduino software is easily controlled via Bluetooth.
- The Android API makes sending Bluetooth command easy.

XBee Communication API

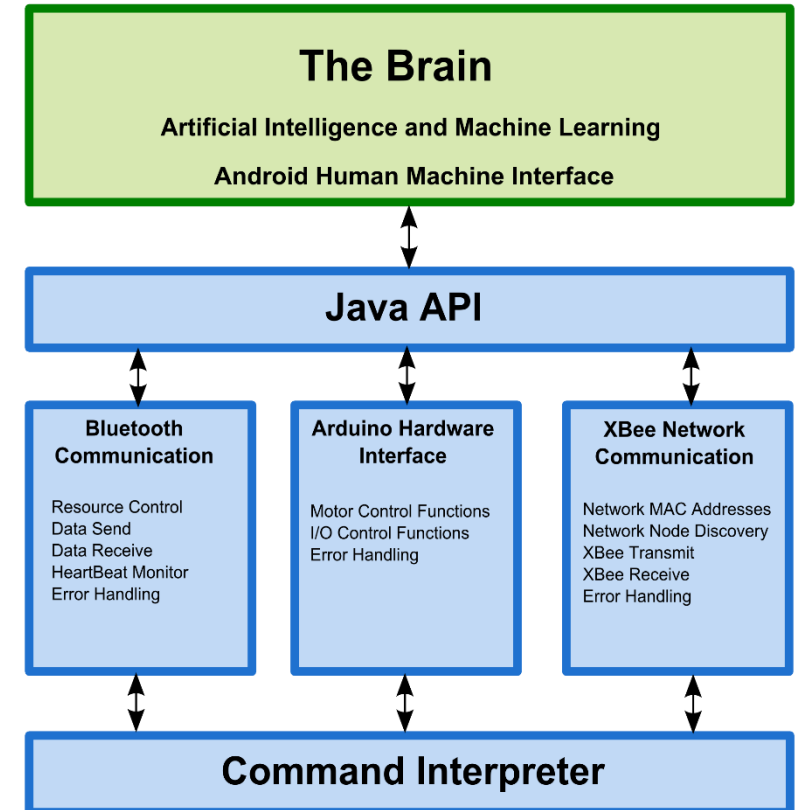
- Packets are sent from one robot to the next using the Digimesh network.
- Packets can be easily sent from the Android or Arduino API.

Motor and Hardware Control API

- The Arduino software makes it easy to drive the robots motors and external hardware.
- Interfaces easily with the wireless systems.

Android Human Interface

- Control the robot remotely.
- Easily capture debugging output.



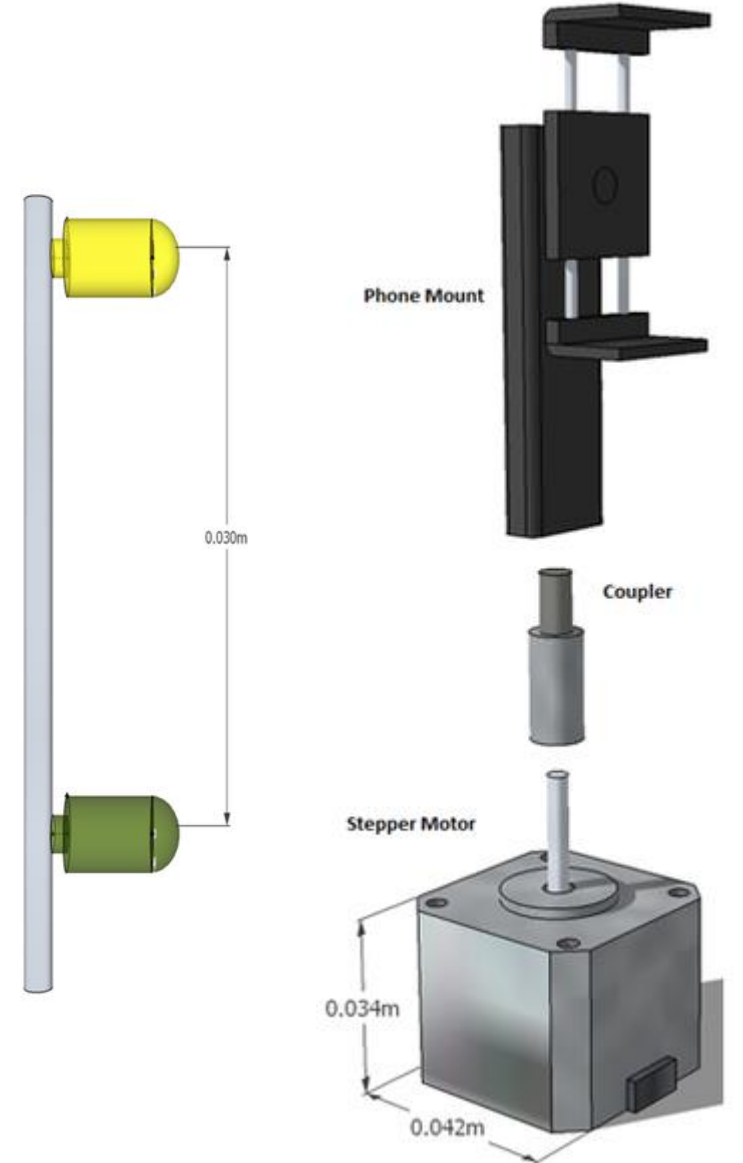
Future Work – What's Next?

Robot to Robot Location Detection

- Allow the robots to find each other.
- Possibly use computer vision, to achieve this task.

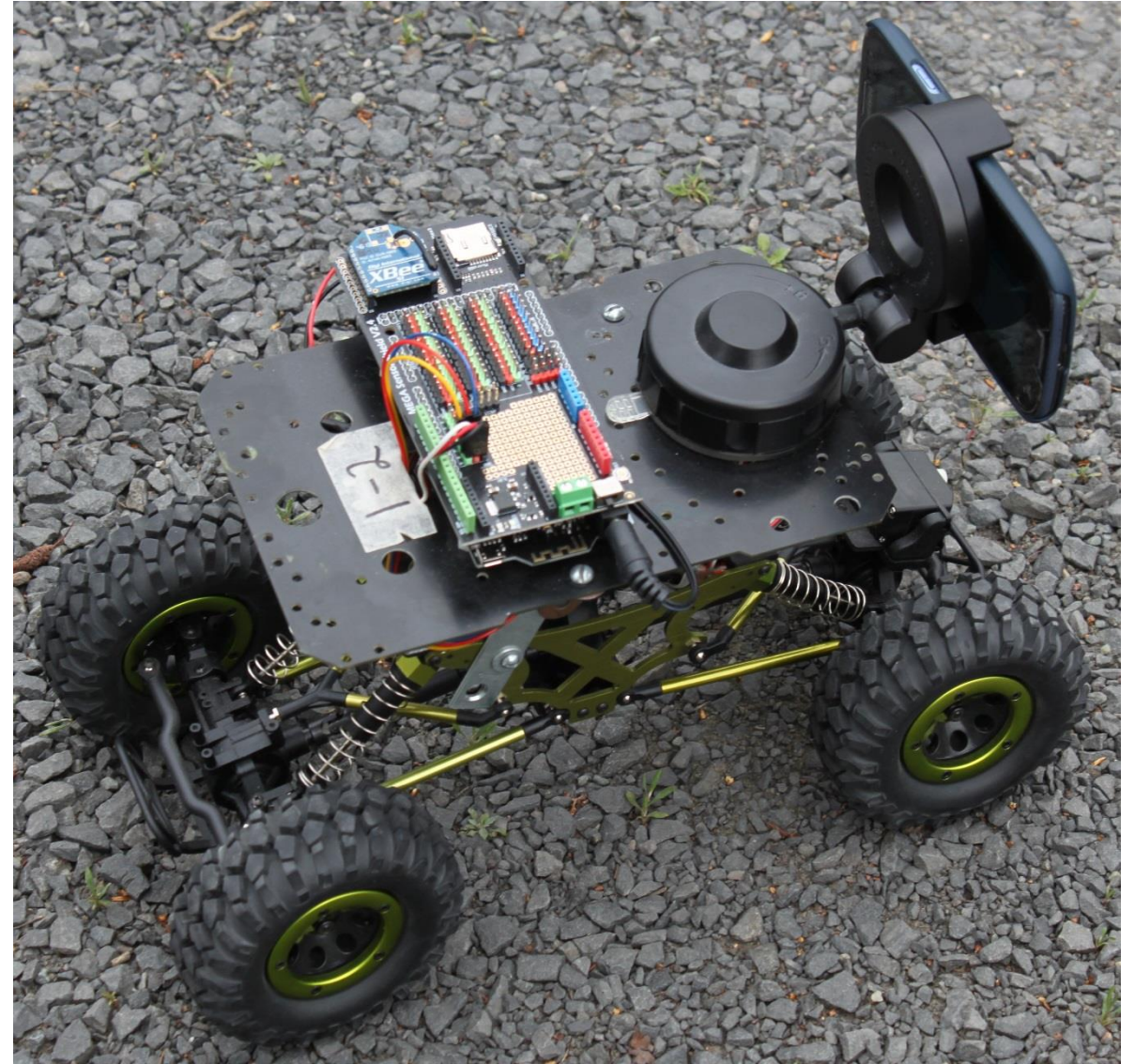
Apply the API to Artificial Intelligence

- Follow the leader.
- Computer vision.
- Terrain mapping.



Thank You

Questions?



References

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- [6] DFRobot, 2A Motor Shield for Arduino Twin. http://www.dfrobot.com/index.php?route=product/product&path=35_124&product_id=1180