



# DELAY TOLERANT NETWORK FOR AUTONOMOUS ROBOTIC VEHICLE CHARGING

Senior Design Project 2014

By Tolga Zeybek, Victor Ansart, and Kip Denoyer  
Sponsor: Professor Hwa Chang



## THE PURPOSE

To create a Delay Tolerant Network (DTN) and a set of robots that can autonomously find a charging station.

## THE PROBLEM

In remote areas, modern communication networks can be ineffective, and vehicles need a distributed and reliable method of sharing data.

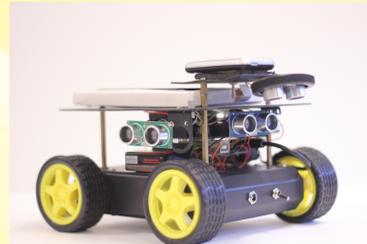
## HOW NAVIGATION WORKS

- Ultrasonic sensors for obstacle detection
- Arduino for controlling ultrasonic sensors and drive motors
- GPS receiver for navigation data
- Android app to calculate the optimal path

## HOW COMMUNICATIONS WORK

- Bots communicate with each other and charging stations over DTN, using XBee wireless radios to share data.
- Bots collect charging station information when in range, store and share it with other bots encountered.

## THE BOTS



The first bot



The second bot with charging interface

## THE CHARGING

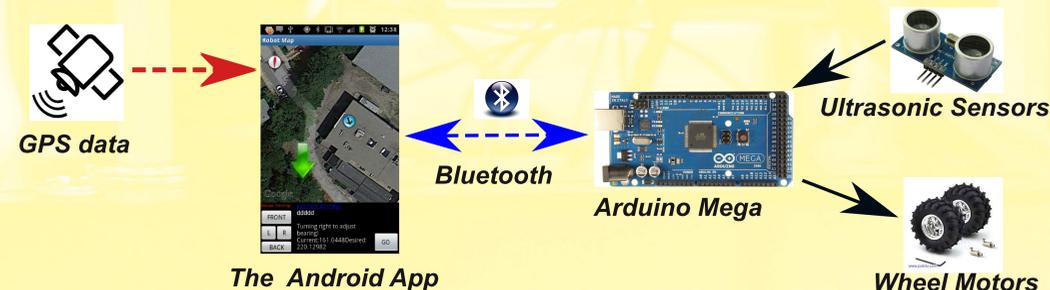


Charging station detection on camera

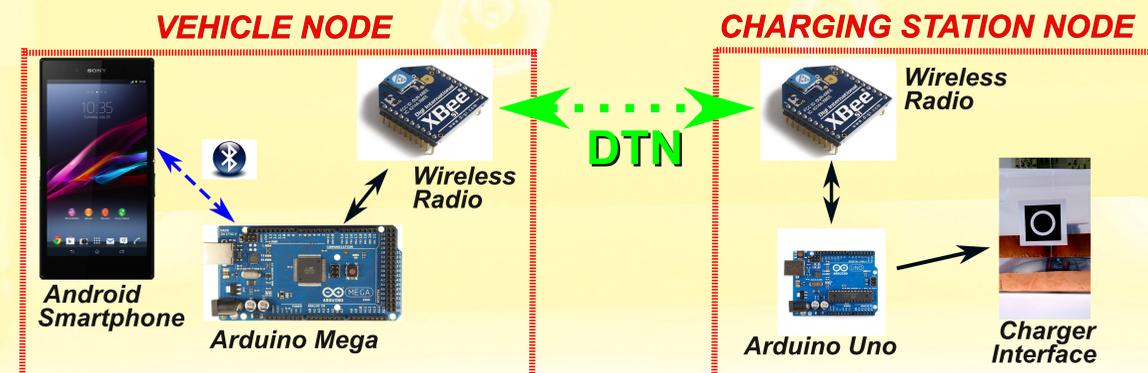


Docking to the charging station

## THE NAVIGATION



## THE COMMUNICATIONS



## HOW CHARGING WORKS

- The bot navigates to suitable charging station when battery low
- Reserves station via DTN when in range
- Uses smartphone camera for precise docking to station
- Senses the charging voltage and begins charging
- Notifies station via DTN when charging is done and disconnects

## RESULTS

Success at autonomous navigation and charging. Working on integrating the DTN with the charging and navigation systems.

## GOING FURTHER WITH DTN

- Sharing traffic data
- Detecting and relaying road hazards
- Relaying information for disaster relief
- Remote healthcare monitoring

## ACKNOWLEDGEMENTS

Prof. Hwa Chang  
Members of Tufts Wireless Laboratory  
Prof. Ron Lasser and Anders Simpson-Wolf