MAS.S61 Final Project

ÆVITA's Eyes: (part of) the living EV recognition system

directMessage: (part of) the living EV announcing system

group: changing places

adviser: kent larson

student: nicholas pennycooke

feedback systems

traditionally actuated via human

- eye contact
- horns
- turn signals
- flashing headlights
- hand ‘gestures’

autonomous vehicles have to be considered robots with which we have to interact

how do we handle these intuitive conventions when we remove the human factor?

the robotic valet

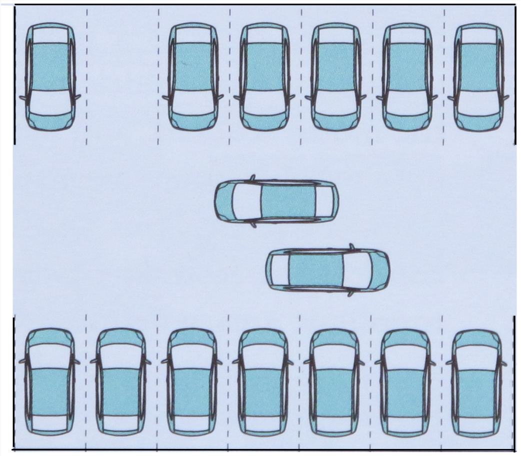
autonomous research is on the rise

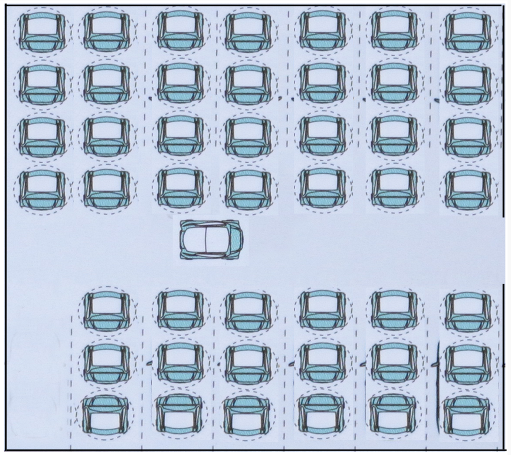
Stanford | MIT | Carnegie-Mellon | Google | most OEMs

occurring on a spectrum

parking assist ← robotic valet → highway capable

moving computing/sensing from the vehicle, into the parking structure





problem space

how do we know what an autonomous vehicle is about to do

how can the vehicle communicate recognition and intent

is it possible to achieve this in immediately intuitive ways to people

can we find design cues from the living world

implementation recognition system

headlights are analogous to eyes

seeks to replicate recognition through eye contact

utilizes various technologies to actively track people

decide which person/group to communicate with

the vehicle makes and maintains eye contact

Computer vision | Microsoft Kinect (Next level using Mobile Eye tech)

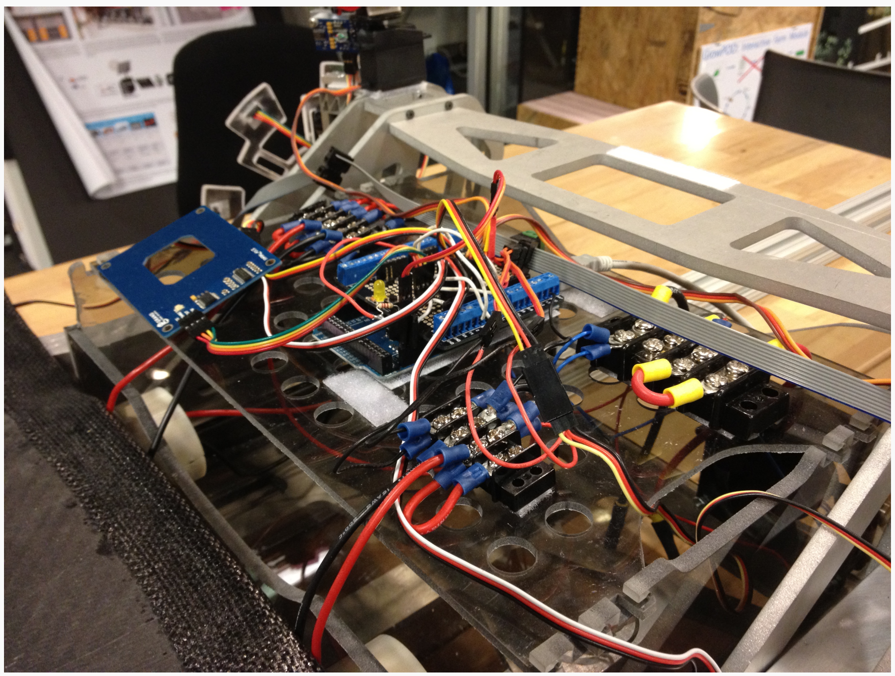
Ultra-wide band location system | Lynx

Pan/tilt servo mounted headlights

LED iris ring

ÆVITA's Eyes pictures

Microcontroller bridge between Kinect and actuators



Kinect

Processing

Mac

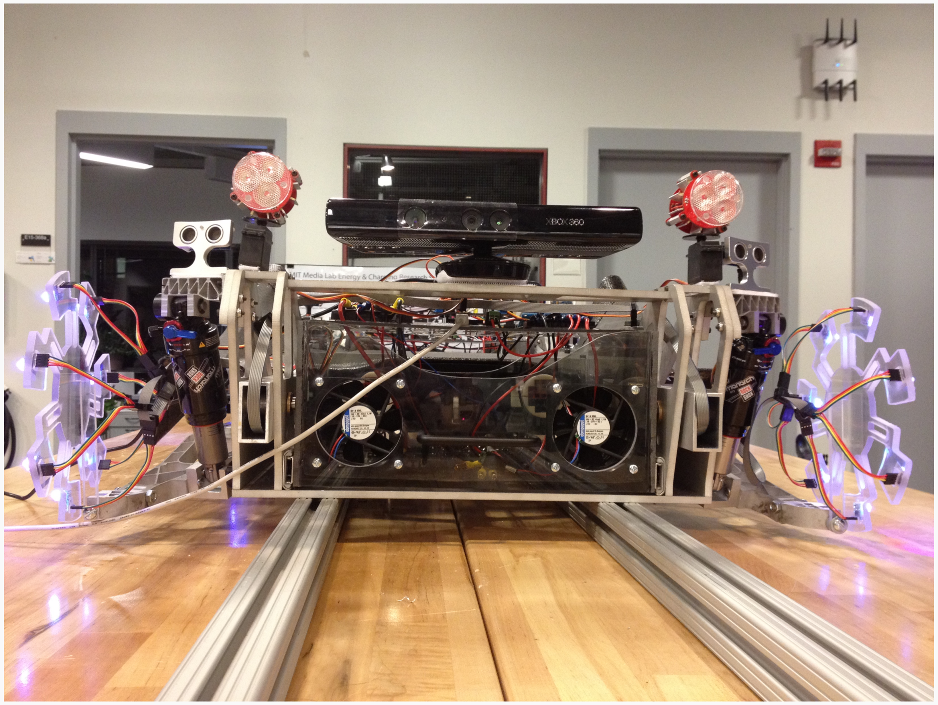
Serial

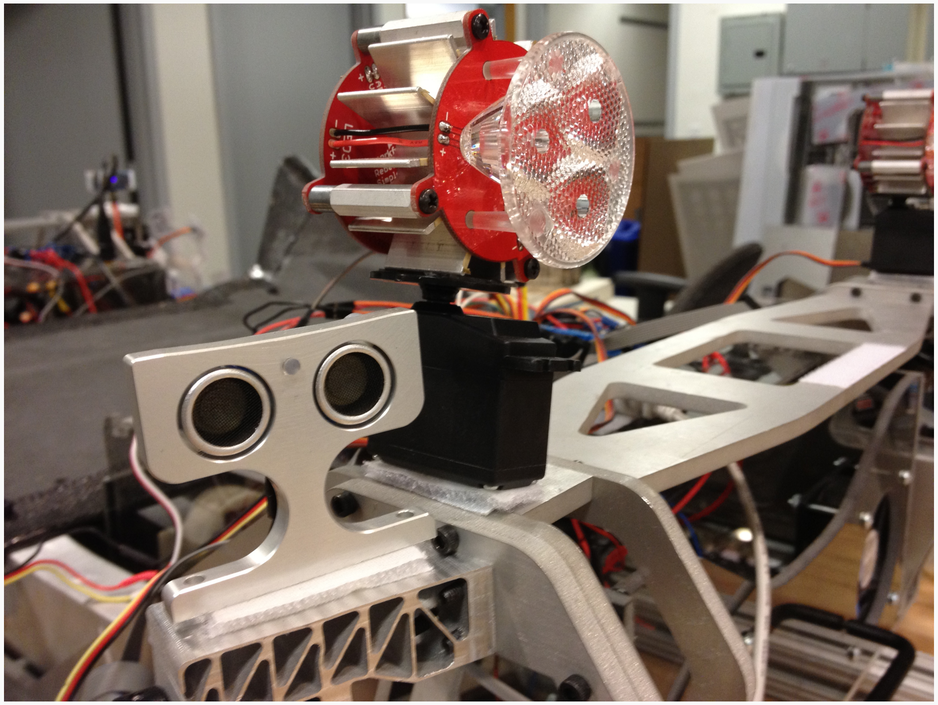
Microcontroller

PWM

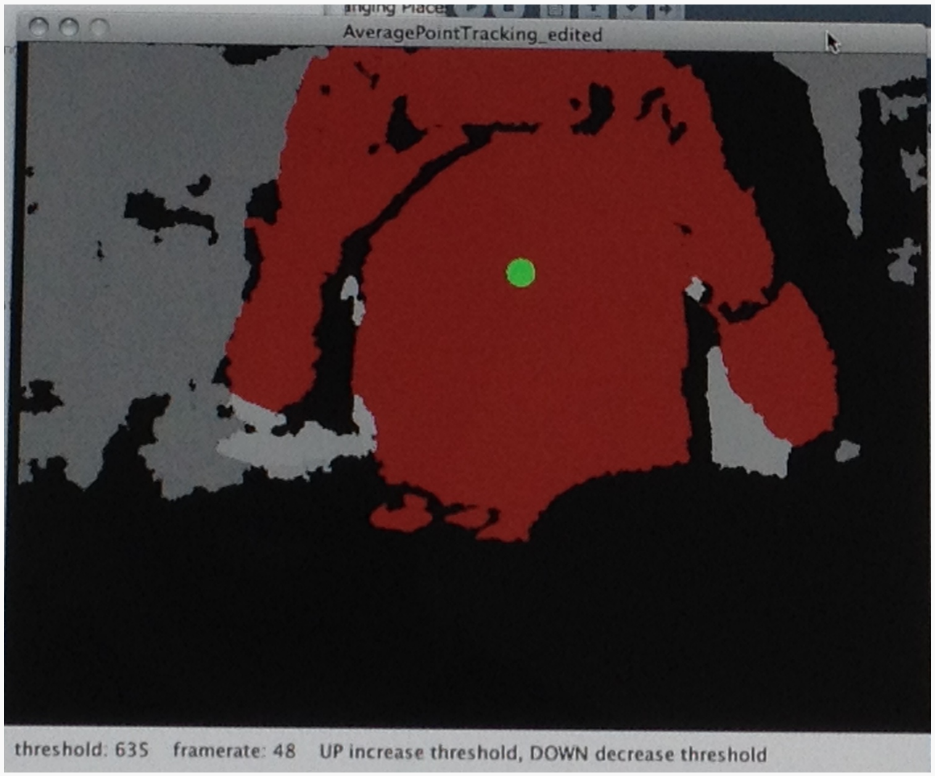
Actuators

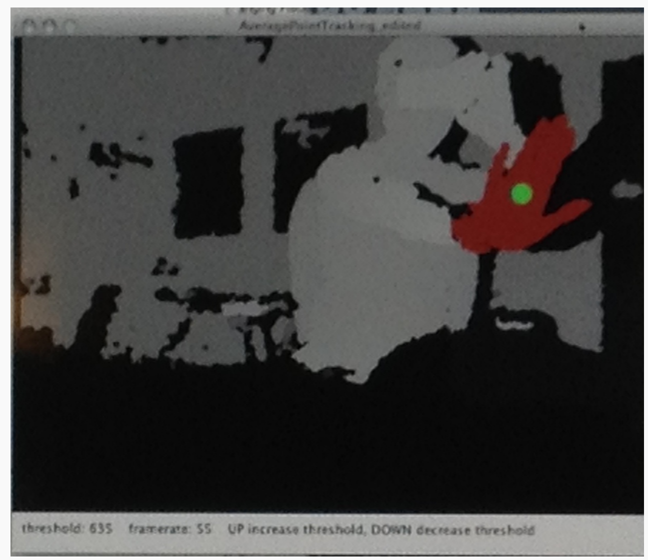
ÆVITA's Eyes pictures



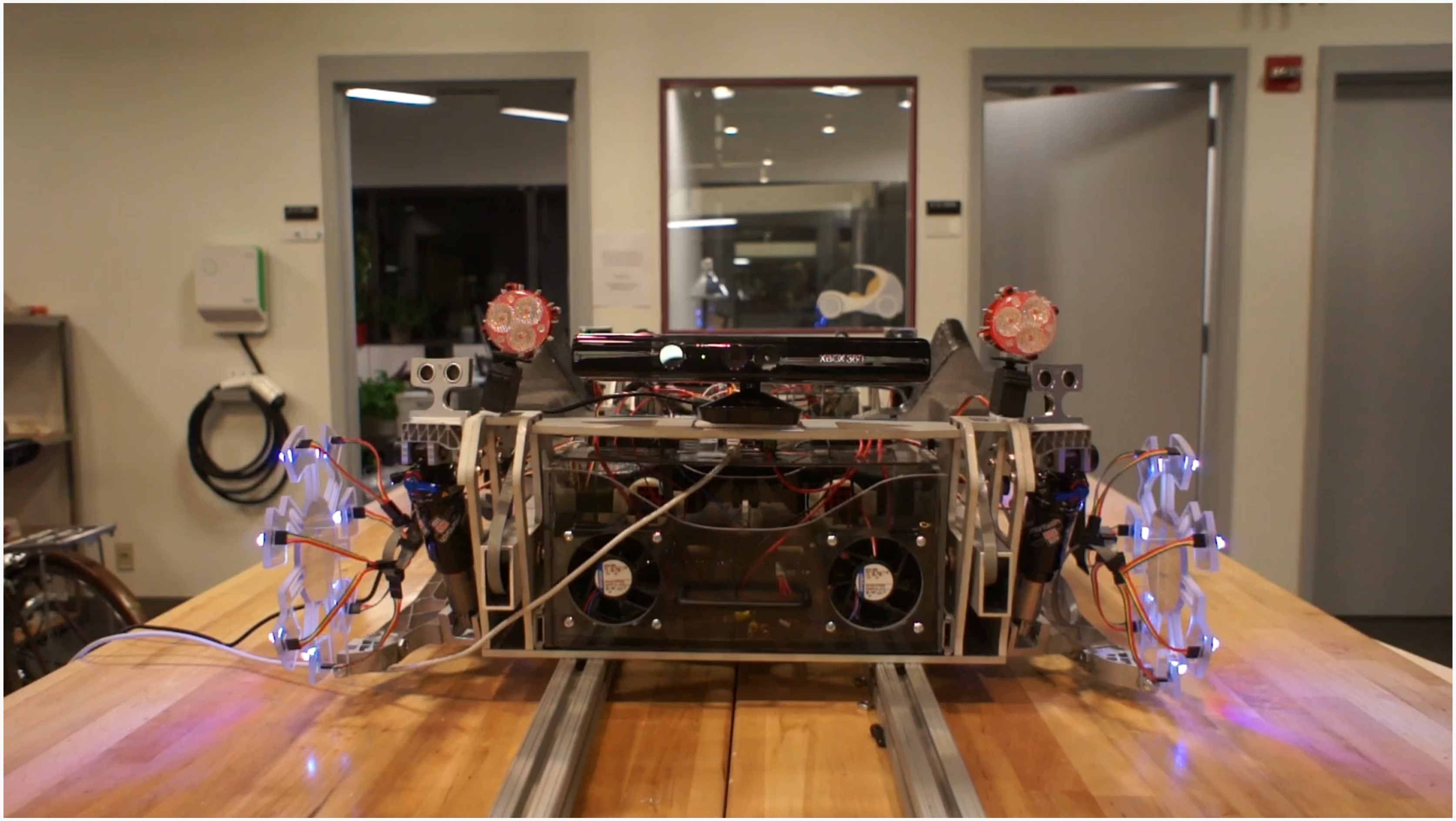


ÆVITA's Eyes pictures



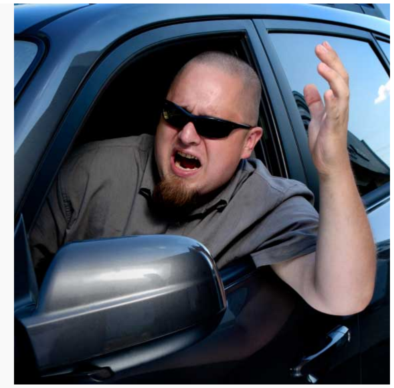


ÆVITA's Eyes video



ÆVITA's Eyes video

implementation announcing system



direct messages to pedestrians
group broadcast or singled-out announcing

takes advantage of tracking system
decide which person/group to communicate with

the vehicle can direct an aural or visual message of its intentions

Currently solely relying on UWB System

Directional speakers

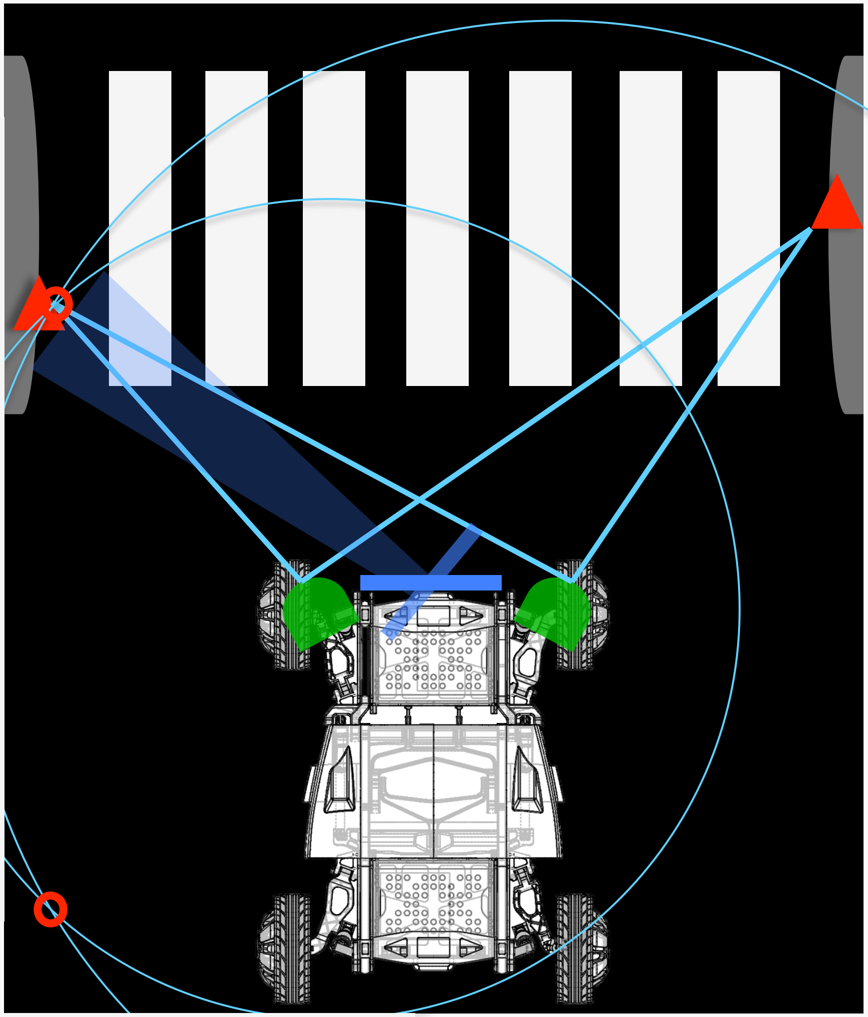
Servo mounted Holosonic AR-16 Sound Spotlight System

Utilizes beam forming array of speakers to create a directed tunnel of sound. Those outside of the direct beam hear a significantly lower/muted sound

directMessage

opt-in ‘dongle model’

People who know about these vehicles can attach UWB anonymous tags to their keyrings.



directMessage

UWB Advantages

IsoLynx tags give XYZ, speed and acceleration data, allowing the system to not only identify a person within the car’s reference space, but also program vehicle reactions based on the behavior of those people.

UWB Implementation Issues

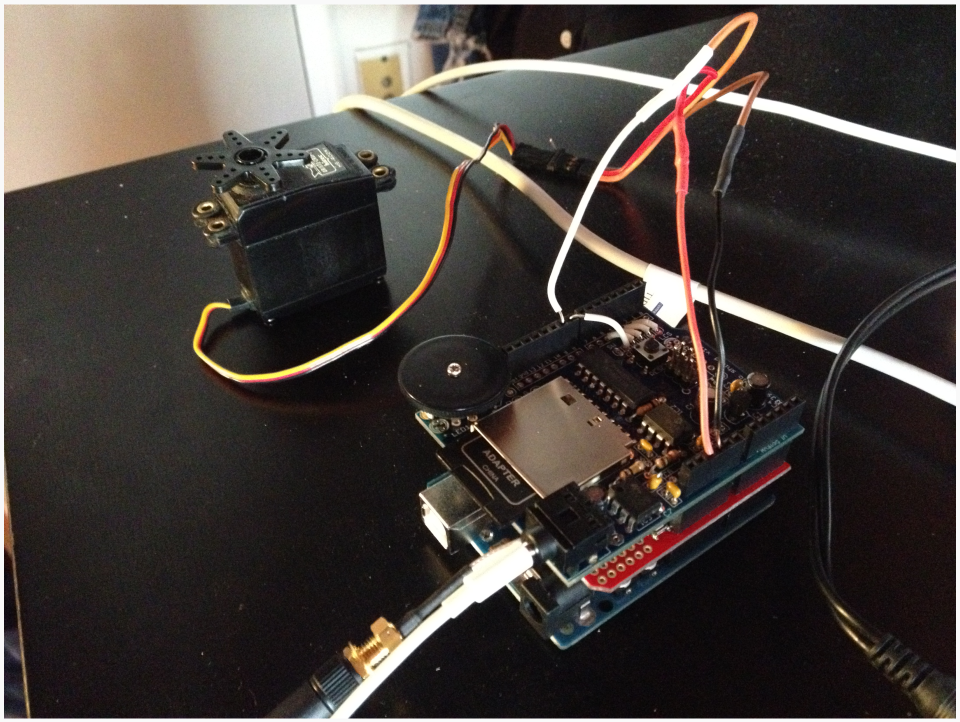
IsoLynx tags require preregistration with the system. For the anonymous opt-in to work, tag registration would have to be on the fly.

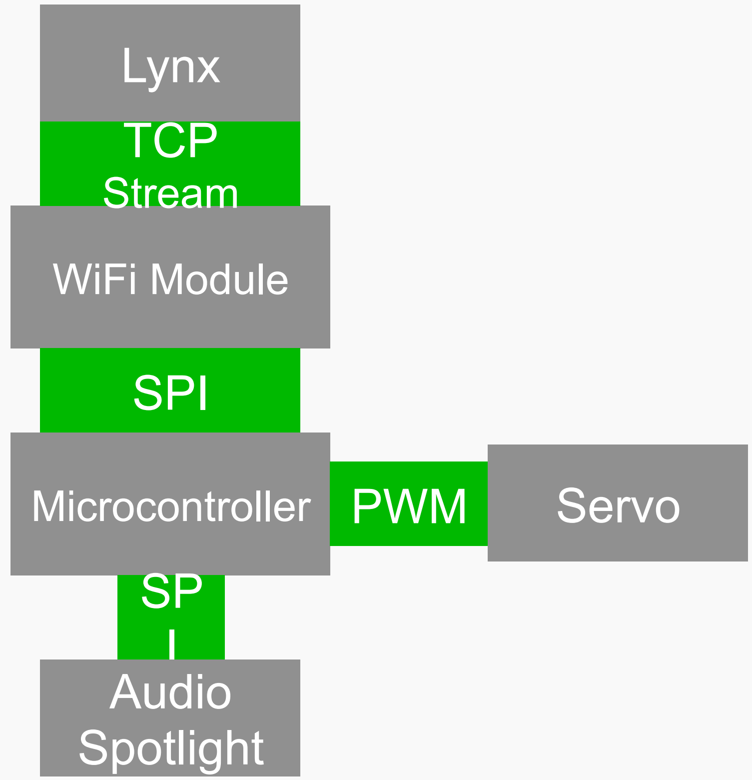
In order to maintain user privacy, tags cannot hold any identifiable data (randomize tag ID, tag ID only known to the system when it pings)

Distance between sensors on vehicle may be problematic

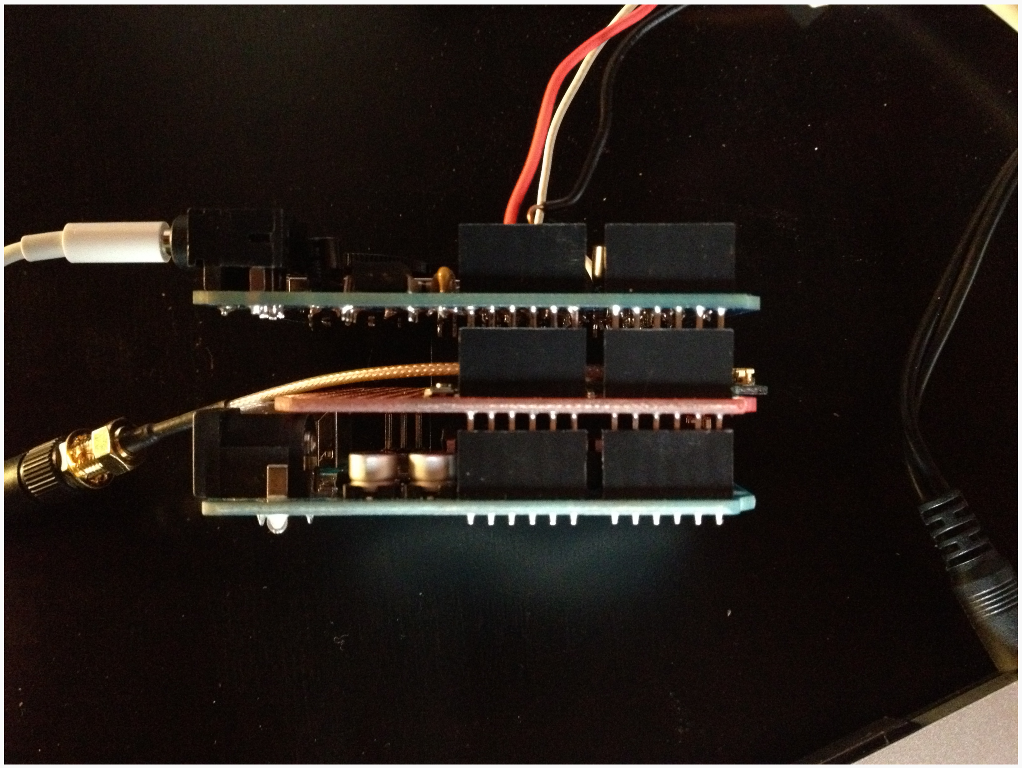
If successful, how well will the system handle very large numbers of tag pings (possible filtering using location grouping/ CV grouping

directMessage pictures





directMessage original design



Stand-alone stack
Prototype portability

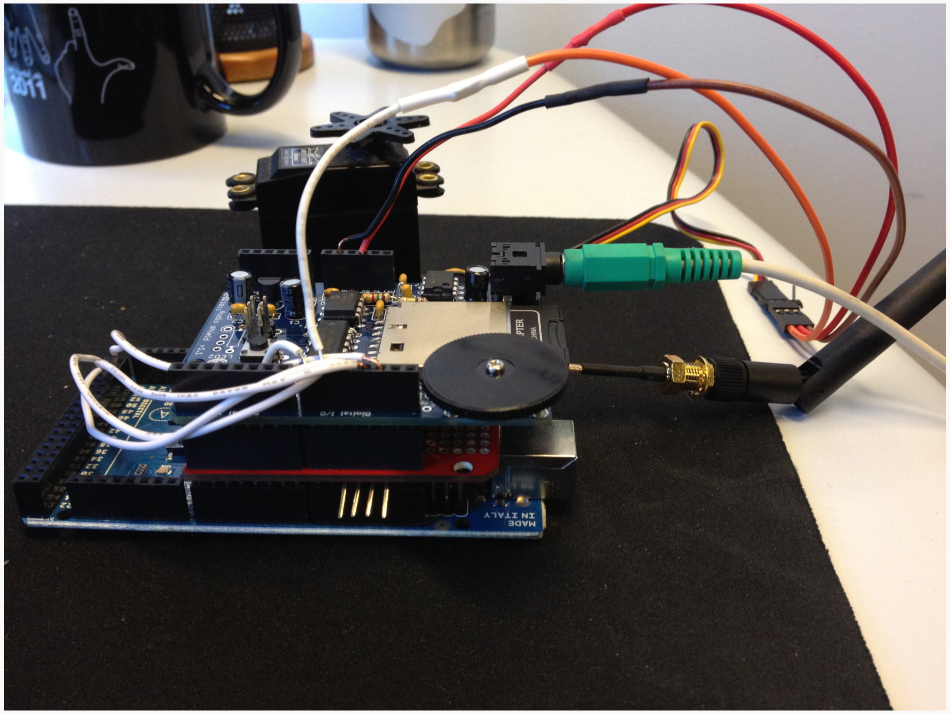
Wave Audio Shield

WiFi Module

Arduino Uno

(RAM issues with Uno trying to parse the stream)

directMessage revised design



TCP buffering issues

The feed pauses as the sound is played, because both sound and WiFi communicate with the arduino over SPI and have to take turns. Unfortunately, the TCP stream does not skip to live data, but holds incoming data in a queue. Over several audio playbacks, delay becomes large. Currently rewriting to continuously do HTTP requests on the JSON formatted data, ensuring only live data.

UPGRADE

All data processing is handled on-board

Wave Audio Shield

WiFi Module

Arduino Mega 2560

The microprocessor block pulls the tag data posted to the TCP stream, parses each parameter and stores it in arrays.

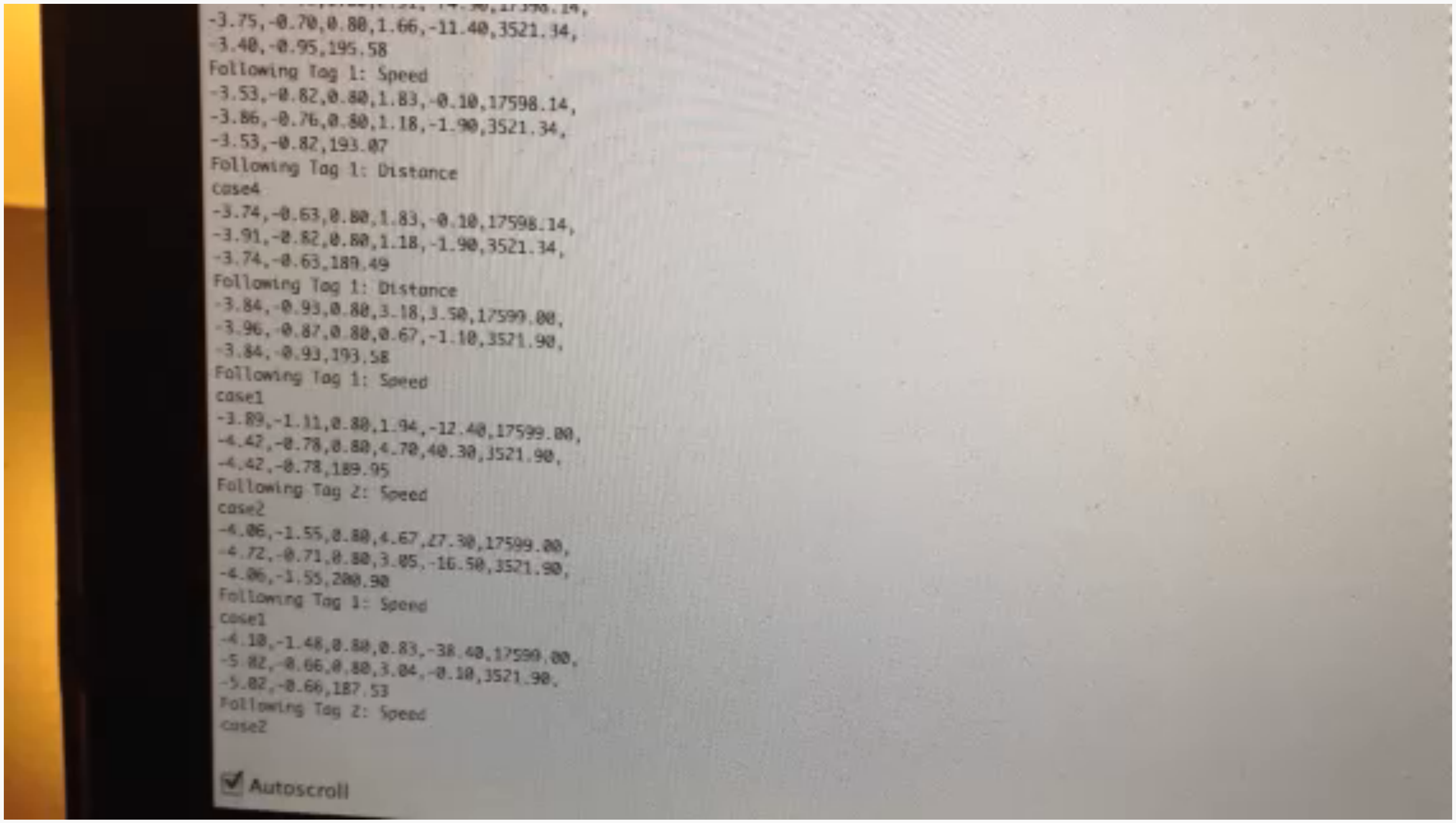
Using Cartesian to polar coord transformations, angle and distance from the system origin are calculated.

The audio spotlight mounted on the servo is placed at system origin, and based on behaviors defined in a decision engine, the system will direct specific messages.

Currently tracks 2 tags, and prefers to track the closest tag to origin (the car), but switches to a tag found to be running.

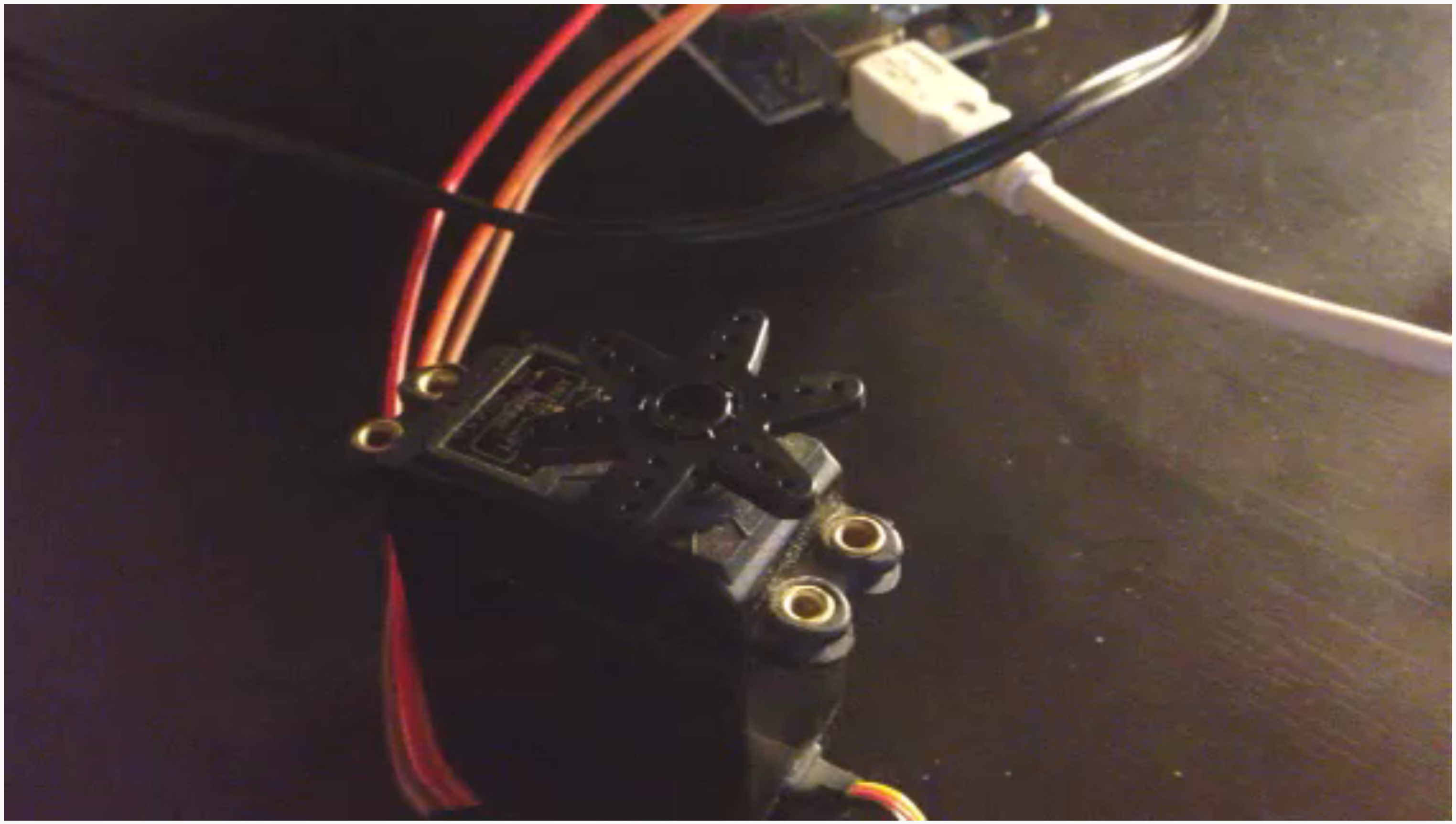
directMessage

Video (using prerecorded tcp test stream data)



directMessage

Video (using prerecorded tcp test stream data)



Thank you

questions.comments