VALET

VAriable **L**ocation **E**lectronic **T**ransport

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VALET: VAriable **L**ocation **E**lectronic **T**ransport

- GPS a useful tool in unmanned navigation — but several other sensors need to be incorporated
- GPS can not detect and avoid objects, and is a bit fuzzy at close ranges (1-10m, depending on conditions)
- We want to build an end-to-end delivery system that incorporates a robust sensor suite to accomplish the task of unmanned delivery with high precision

Prime Autonomous Delivery

Dominoes Autonomous Delivery

FedEX Autonomous Delivery

Problem Description

- Amazon, KiwiBot, Dominos, Walmart, and others are all looking to enter the automated delivery space
- Imagine UberEats in urban environments, or college campuses, without drivers
- These systems would present a tremendous upside in labor savings, as well as work-around-the-clock capabilities for delivery companies
- Last-mile delivery is typically the hardest in the delivery chain

The Future is Here!

Use Cases

- Unmanned Delivery: Food, grocery, and package delivery to consumers
- Farming / Agriculture: Summon tools, farming implements over distance
- Industrial: Summon tools, parts, and documents over large plants, offices
- Military: Deliver supplies into otherwise hard-to-reach areas

BAE Systems Military Vehicle

Automated Agriculture Bots

Proposed Solution

- Accurately drop off package in a desired location
- Develop object avoidance
- Able to be summoned to a specific location
- Needs to locate desired location through GPS, Bluetooth technologies with the assistance of a sensor suite for negotiating local obstacles

Demonstrated Features

1. Summon Feature: Directs car to predetermined GPS location
2. Communication with a Smart Device: Relevant for summon feature, Bluetooth pinging
3. GPS Path Following: VALET will follow GPS paths to its final objective
4. Object Detection/Avoidance: Must also navigate closer to it’s target while doing so
5. Target Identification: Computer vision based

Available Technologies

Chassis/Drivetrain

- **4 Wheels Scout Platform Robot Kit**
  - Price: $169.99
  - Includes wheels, motors, mounting platform

- **Motor Driver**
  - Texas Instruments
  - $1.68 Each DRV8876

Power System

- **Tracer 12V 4Ah Lithium Polymer Battery Pack**
  - Dimensions: 115 x 76 x 32 (mm)
  - Weight: 330g
  - Capacity: 4Ah, 48 kwH
  - Price: ~$100

Scout Platform Robot Kit

Available Technologies

Microcontrollers

- **Raspberry Pi 3 Model A+**
  - Price: $19.99
  - Includes Bluetooth/Wifi Support
  - Enables use of Python's OpenCV package

- **dsPIC33**
  - Familiarity is a major +
  - Dedicated hardware support for PWM/Motor Control

Raspberry Pi3 Model A+

Available Technologies

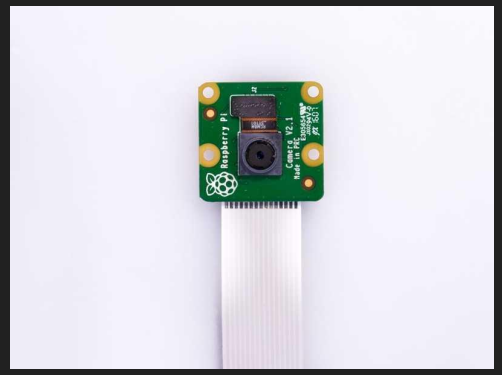
Sensors

- GPS: TESEO-LIV3F - Tiny GPS Module
  - Price: $14.22
  - Manufacturer: STMicroelectronics
  - -163 dBm tracking sensitivity

- Magnetometer/Accelerometer: FXOS8700CQR1
  - Price: $4.72
  - Manufacturer: NXP

- LiDAR: LIDAR-Lite v4 LED Rangefinder
  - Price: $59.99
  - Manufacturer: Garmin

- Raspberry Pi Camera Module V2
  - Price: $24.83



R. Pi Camera Module V2

Garmin LiDAR Rangefinder

Engineering Content

- Design/construct electric vehicle: Group will purchase this, but requires that we have knowledge of motor interface, controls of vehicle
- Get Computer Vision, Bluetooth, WiFi working on Raspberry Pi
- Get GPS summon, path following working
- Get LiDAR rangefinder, Pi's CV functionality working in tandem for object detection/avoidance

Conclusions

- Transfer to industry is real, w/ a position in the rapidly growing automated delivery space
- Project models a real-life autonomous system, which has a large number of redundant sensors (LiDAR, IR, Optical, etc.)
- Focused on the nuances of last-mile delivery — object avoidance, choosing the right delivery location
- Want to design, develop and test a system that will work well in various Notre Dame environments — DeBart Quad, Stinson Remick