# Lane Keeping and Navigation Assist System

Yash Sharma and Vishnu Kaimal
Advisor: Carl Sable

THECOOPERUNION

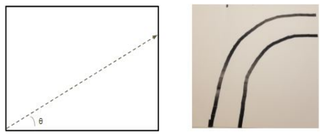
We built an autonomous vehicle which can navigate through maps consisting of various road topologies. Our system is comprised of a perception module, for detecting lanes and intersections, and a control module, for lane keeping and turn making.

## Motivation

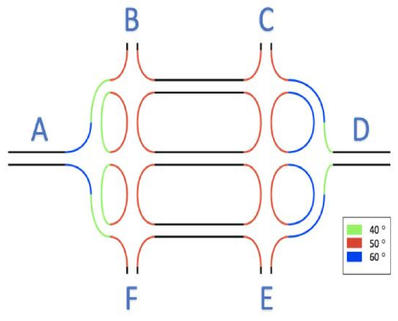
The possibility of self-driving cars has fascinated us for decades now, but only recently have they appeared to be an impending reality. Despite this progress, little public research is available, as most researchers working on this topic are in industry. aiming to beat their competitors in bringing an autonomous vehicle to market.

Thus, we independently designed and built a system based on classical image processing and control techniques, and validated its performance on a map consisting of various curves.

## Experimental Design

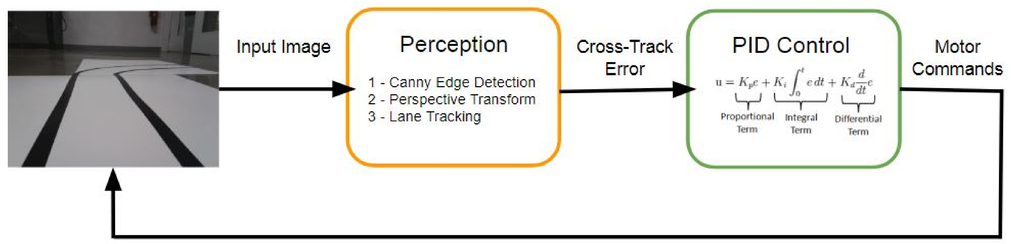



Configured right and left lanes at 40, 50, and 60 degrees. Lanes are construced by fitting a second degree polynomial between the bottom and top vertices.

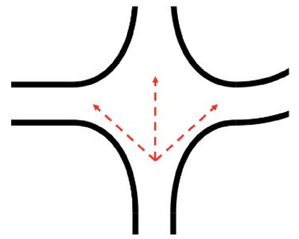



Printed 20' x 10' map consisting of all curved lane configurations. Intersections are constructed in this way due to the single lane nature of the map. Implemented path planner to make decisions at intersections encountered between the source and destination points.

## Lane Keeping

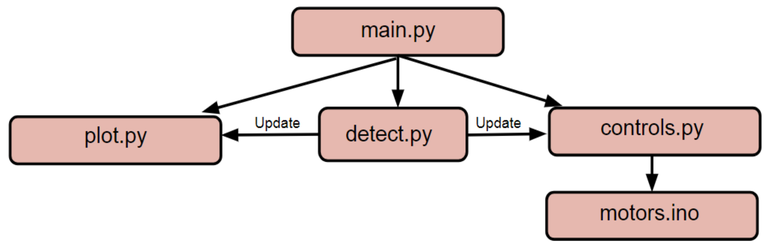



## Turns



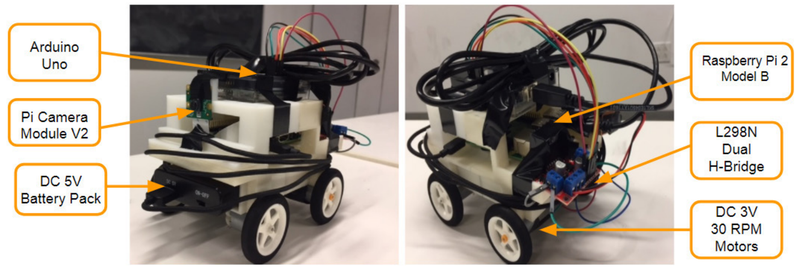
Turns are made by detecting the intersection, asking the path planner for the decision, and then lane keeping to the appropriate curve.

## Multhithreaded Software Design




Multiple python modules are simaltaneously run in parallel to perform lane detection and lane keeping. The detect module performs lane detection and calculates the cross-track error, which is then used as input to the controls and plot modules. The plot module produces real-time animations, while the controls module passes the appropriate steering commands to the motors.

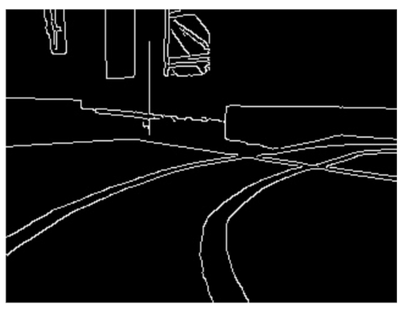
## Vehicle Design




The vehicle drives with differential steering, and the back axle is propelled by the motor, making the vehicle "rear-wheel drive". Images are taken at 10fps and processed onboard with the quad-core Raspberry Pi. The L298N H-Bridge is used by the Arduino Uno to provide appropriate voltages to each of the respective DC motors. Separate battery packs are used for the Pi, Arduino, and L298N motor driver.

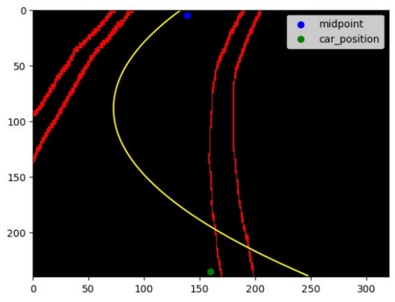
## Perception Pipeline

Original Image



Canny Edge Detection

Perspective Transform




Cross-Track Error