May 2020

Poultry Farm Security Gate: Autonomous Vehicle Recognition System

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Poultry Farm Security Gate: Autonomous Vehicle Recognition System

BIOSYSTEMS ENGINEERING AND SOIL SCIENCE

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Background

Many broiler poultry farms lack proper security on the access roads to their farms. This has become more of an issue with a rise in vandalism and the continued need for biosecurity. One reason for the lack of security is its interruption of daily farm operations, mainly feed truck access. Farms often have feed trucks arriving multiple times a day who need immediate access without requiring human intervention. This system seeks to address this issue by providing autonomous security that will not impede farm operations.

Objectives

Develop a visual and LiDAR-based system that is able to accurately recognize commercial poultry feed trucks and other vehicles under multiple lighting and weather conditions.

- 100% Recognition of commercial poultry feed trucks
- Must operate both day and night
- Feed trucks cannot be stopped for longer than 1 minute
- No required interaction between the system and the driver
- Nothing can be placed in or on vehicles

Approach

Automated License Plate Reading Software

The open source automated license plate reading (ALPR) software OpenALPR is utilized in this system.

A Raspberry Pi 3 and Raspberry Pi camera are used to take a picture of the license plates and run the ALPR software on the image.

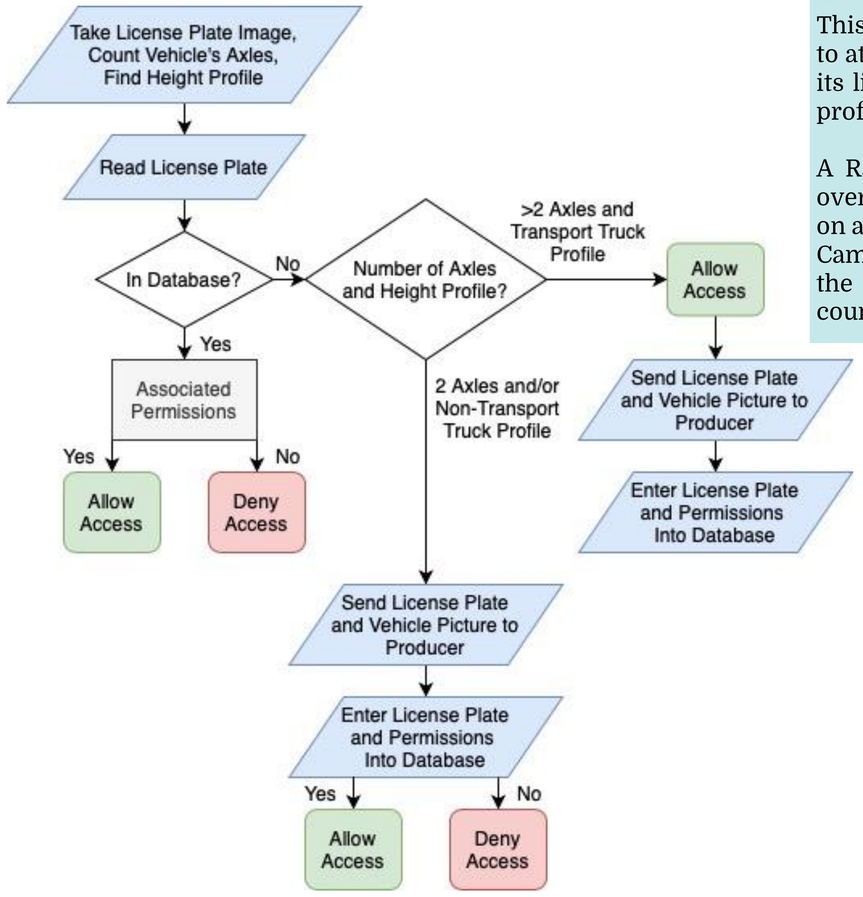
Light Detection and Ranging Sensors

Light Detection and Ranging (LiDAR) Sensors are used in this system to measure heights of vehicles and detect the number of axles on vehicles passing through the system.

An Arduino microcontroller uses the information measured by the LiDAR sensors to determine the size of the vehicle.

Strings of characters such as “Large” or “Small” are then sent from the Arduino to the Raspberry Pi to tell the system what type of vehicle is attempting to access the farm.

Design and Proposed System



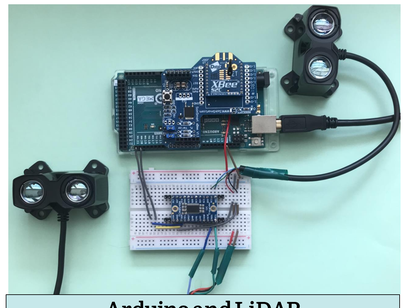
Overview

This system utilizes ALPR and LIDAR to attempt to identify a vehicle by using its license plate, axle count, and height profile.

A Raspberry Pi is used to control the overall system as well as run the ALPR on an image captured by a Raspberry Pi Camera. An Arduino Mega is used with the LiDAR sensors to obtain an axle count and height profile data.

Axle Count and Height Profile

An Arduino mega collects data from two Garmin LiDAR sensors to find the axle count and height profile of the vehicle. This data is processed on the Arduino and the vehicle determination is then sent to the Raspberry Pi via radio communication.

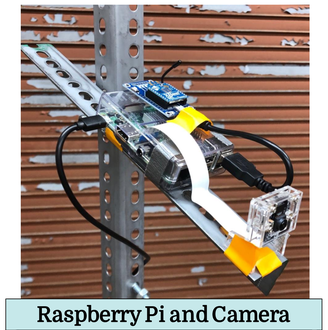


Arduino and LiDAR

System Controls and ALPR

The Raspberry Pi No-IR camera is used to collect images of the license plates. OpenALPR is then run on these images on the Raspberry Pi 3.

Node-RED, a programing tool used to connect hardware devices, is utilized to control the flow through the system and is also run on the Raspberry Pi.

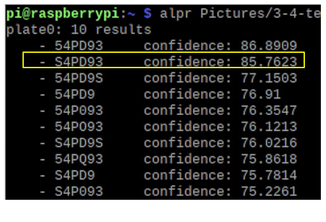


Raspberry Pi and Camera

ALPR Test Results

When a license plate was detected by the software, the correct license plate number was almost always within the top three results.

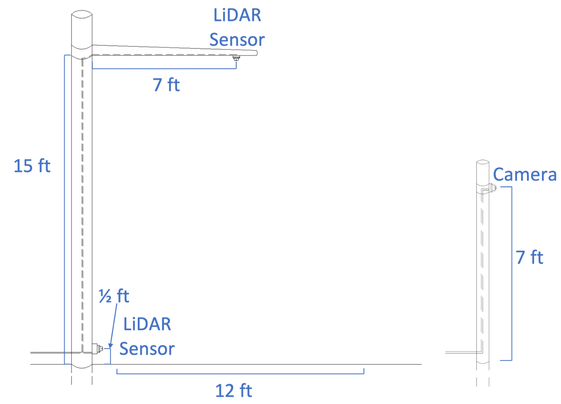
The software worked very well in cloudy or overcast conditions, but had issues detecting the license plate in sunny conditions. This is most likely caused by issues with the camera type and settings.

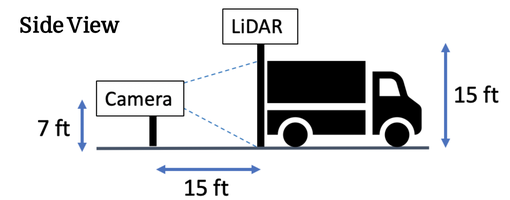


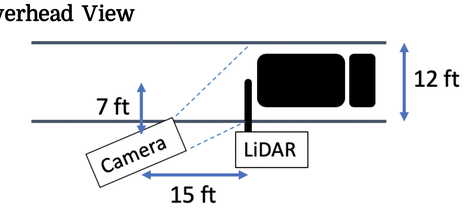
Future testing would involve changing camera type and/or. settings and testing at night with the aid of IR illumination

Further Considerations

Full-Scale Model







Nighttime lighting

Additional lighting components are needed for nighttime operations of ALPR:

- Camera with an IR cut filter
- External IR illumination directed at the license plate

In addition to specific lighting for ALPR, some form of visible lighting, such as a lamp post, should be near the gate for added visibility of the system to vehicles.

Future Testing

Future testing will use various types of vehicles to measure the accuracy of the LiDAR sensors in determining types of vehicles present.

References

OpenALPR Techonology, Inc. (2017). OpenALPR Documentation. Retrieved from http://doc.openalpr.com/

Acknowledgments

Dr. Shawn Hawkins, Dr. Hao Gan, Dr. Daniel Yoder, Dr. Julie Carrier