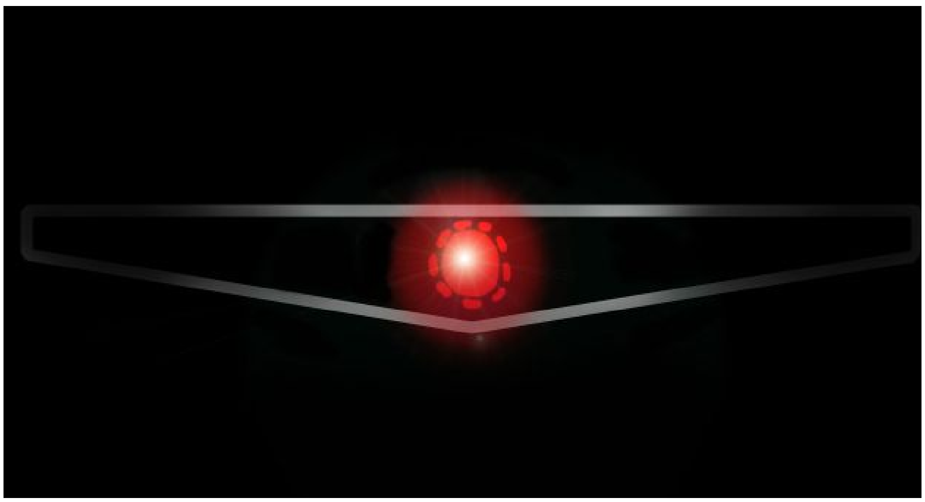
Senior Design I
CSS: Car Sentry System



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Customers, Sponsors, Contributors:
IEEE Standards University (Tentative)

Project Description

Driving is a dangerous activity. People do not realize the risks associated with driving. When it is put into perspective, a human operating three-thousand pounds of moving steel with others on the road seems daunting. To make matters worse, human error increases the chances of vehicle accidents to occur. Many civilian vehicles are not equipped with any form of surveillance camera systems to log these instances.

The motivation behind the project stems from personal experience driving around the city of Orlando and seeing first hand situations in which it would be useful to quickly obtain a vehicle's license plate information. This could be the case of a hit and run situation, reckless driving, simply remembering a vehicle for future reference, or any other myriad of reasons to obtain a vehicle's license plate information. Therefore, this brings up the biggest question, why not simply purchase a dash cam? As it currently stands, a good dash cam with reasonable video quality will cost more than a hundred dollars, if not even more than that. Even then, it might still be hard to read the license plate information of a vehicle more than twenty feet away. Additionally, it takes up a lot of storage and fills up SD cards rather quickly, thereby limiting the amount of data that can be stored and for how long. This could be remedied with cloud backups or manual backups, however this adds to cost and time. The alternative solution is a license plate scanner.

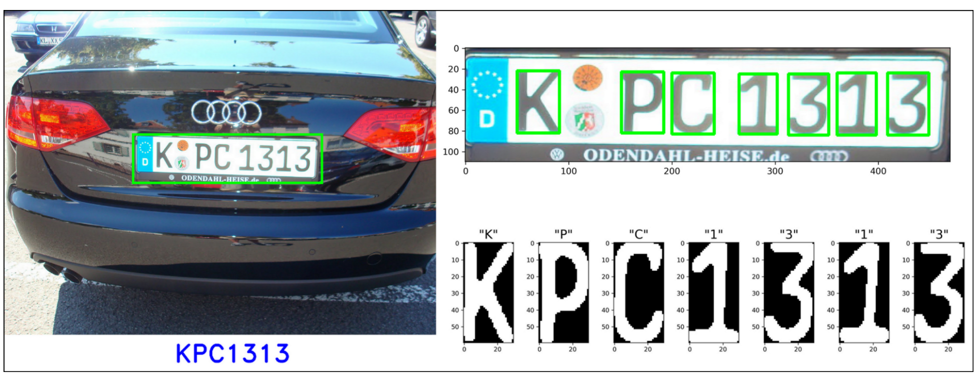


Figure 1.0: License Plate Detection Using Computer Vision

A device capable of being able to instantly record a vehicle's license plate information provides the primary goal for creating a portable and low-profile license plate scanner. The device will have the ability to log the date and time and obtain a vehicle's license plate information using computer vision (Figure 1.0) powered by openCV. Through the use of computer vision, the capabilities of the scanner can be extended to also include logging a vehicle's color, and model. This will make it easier to distinguish data later when it is being reviewed. In this manner, the device will only be storing essential data about a vehicle rather than continuous video streams, thereby significantly reducing the amount of storage space taken up and greatly extending the amount of relevant data that can be stored on an SD card. This will decrease the number of manual backups required in addition to freeing up the need for cloud storage services. Further saving on costs post purchase.

Additionally, since a license plate scanner will not have to be taking a continuous video to obtain its data, it has the added benefits of an extended battery life. This can be further extended by programming additional modes of operation into the device, so that a user could select the mode that best fits their needs. The default mode would have all components active and the device is scanning and logging the information of all vehicles with a license plate that comes into view. The other mode would be a low-power mode (LPM) that would turn off all unnecessary components and only have the accelerometer and relevant components on. Then, when a jolt or collision-like movement is detected, the device will power up all components and begin recording data for several minutes before returning to LPM. In this manner it will increase battery life and reduce storage consumption even more.

The benefit of the increased battery life is that it provides a user with flexibility in placement. Currently, most common dash cams require being wired in or plugged directly into a car charging port. In addition to the loss of a charging port, a user has to figure out a way to route the wires of the dash cam in such a way that the wires are out of the way and not distracting. Even then, bumps could knock wires out of place unless they are strapped down. The increased battery life of the license plate scanner would provide users with the flexibility of choosing whether they want to have it constantly plugged in or simply run it off the battery only and charging it only when necessary.

Requirement Specifications

Project Standards

- IEEE standards
- Battery Storage, Charging, Power Supply
- Controller to Sensor Communication
- U.S License Plate Standards

Requirements for Hardware

- Battery life will last several days. (3 - 5 days)
- Camera of at least 1080p and greater than 20 fps to read vehicle attributes
- Troubleshooting LEDs to indicate storage capacity and battery life
- Plug and play functionality

- Lightweight (< 2lbs.)
- Feature a portable design
- Will not exceed a size of (4” x 4” x 2”)
- Contain an accelerometer to detect speed of vehicle
- Will not obstruct the view of the driver
- Have a GPS Module to determine vehicle location*

Requirements for Software

- Have the ability to recognize/read license plate information
- Ability to detect an accident (impact vs. hard braking)*
- Have the ability to backup or offload data
- Features multiple power modes to provide users with flexibility:
  - Low Power Mode (LPM) - Only stores data when collision detected
  - Default Mode - Always on and storing data
- Automatically activate Low Power Mode (LPM) when the vehicle is stationary
- Will have the ability to write vehicle attributes onto storage unit
- The software/application will be synced to the hardware via wireless network*
- Timestamp instances where a license plate is detected/read
- Will have Active Mode which will turn on all components.
- Have the ability to write location coordinates onto storage unit*
- Features multiple security modes to provide users with flexibility:*
  - Essentials Mode - Only stores license plate information, vehicle model, vehicle color, and time stamp.
  - High Security Mode - Stores Video as well

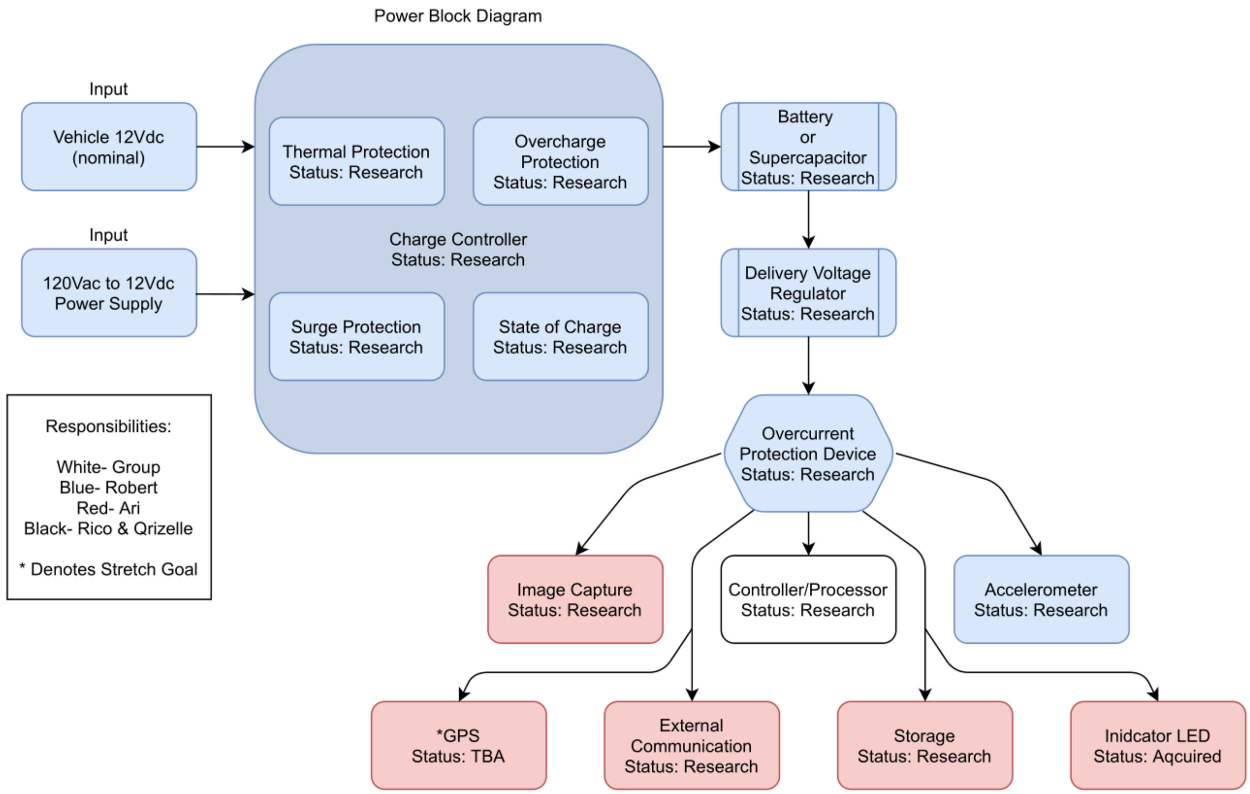
* Stretch Goal

Project Constraints

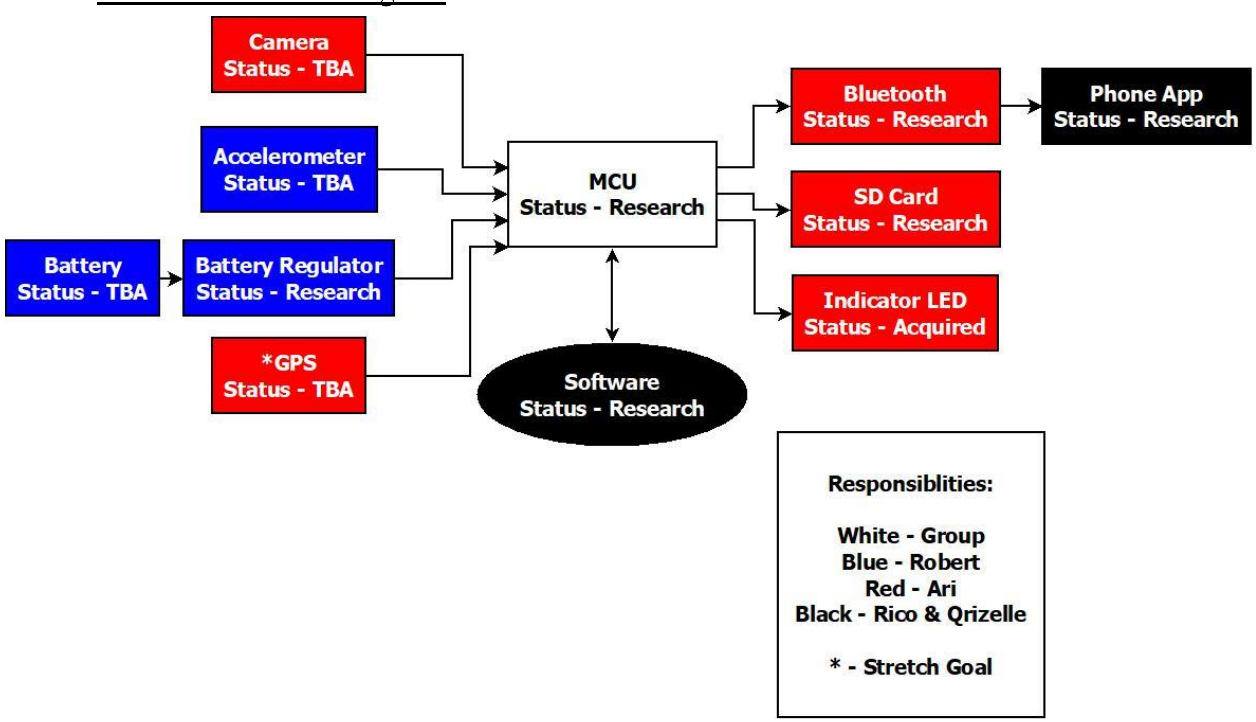
- Weight
- Weather Conditions (Heat vs. Cold)
- Crash Survivability
- Time
- Cost of System Controller
- IEEE Student Grant Specifications
- Image Processing capability of controller/processor
- Obstructions in Camera View
- Obstruction in Driver View
- Compatibility of Components

Block Diagrams

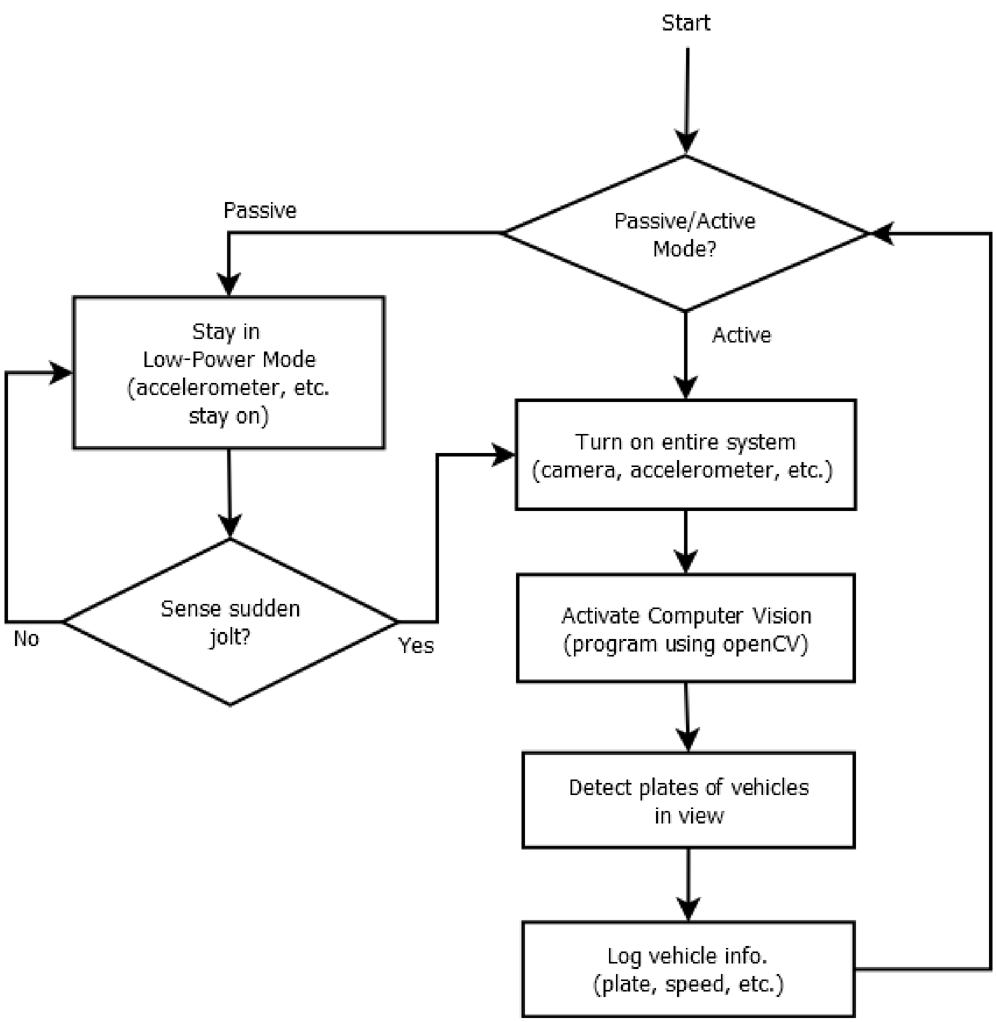
Power Block Diagram



Electronics Block Diagram



Software Flow Diagram



Estimated Budget & Financing

The budget will be self-funded with the anticipated assistance of the IEEE Student Grant. Based on current estimates, we will have an excess amount of funds. Excess funds will allow for further enhancements or cover the costs of broken/malfunctioning parts. Shown below are the estimated calculations for one-time purchasing.

Item	Quantity Estimate	Cost Estimate
Camera	1	~$5 - $30

SD Card Reader (circuit)	1	~$20
Bluetooth transceiver	4	~$80
Battery	1	~$80
Battery Regulator	1	~$15 - $20
Accelerometer	1	~$5 - $20
GPS Module	1	~$5 - $30
PCB Board	4	$50
Total Estimated Cost		$260 - $330

Funding	**Assistance**
IEEE Student Grant	- $500

Estimated Refund	$170 - $240

Project Milestones

Senior Design I	
Objective	**Time - Date of Completion**
September	
Initial D&C (<= 10 pages)	12:00 PM - 09/17/21
Updated D&C	12:00 PM - 10/01/21
October	
Order Parts/Resources	By 10/04/21
Acquire Parts/Resources	11:30 AM - 10/18/21
Develop/Test Version 1.0 of Software	10/18/21
November	

Individual Part Testing (Breadboard)	10/18/21 - 11/05/21
Senior Design I Report (60 Page Draft)	12:00 PM - 11/05/21
IEEE Application	11/08/21
Develop/Test Version 1.1 of Software	11/10/21
Prototype #1 Designed	11/12/21
Senior Design I Report (100 Page Draft)	12:00 PM - 11/19/21
December	
Prototype #1 Testing	11/19/21 - 12/03/21
Final Senior Design I Report	12:00 PM - 12/07/21
Senior Design II	
January	
Develop/Test Version 1.2 of Software	01/03/22
February	
PCB Design Testing Done	02/19/22
PCB Ready To Ship	02/21/22
March	
PCB Delivery	03/25/22
Begin Solder Process	03/28/22
April	
Have Working PCB	04/08/22
Final Testing/Revisions	04/01/22 - END

Sources

OpenCV:
https://opencv.org/about/
https://www.tutorialspoint.com/opencv/opencv_storing_images.htm

JetsonHacks:
https://www.jetsonhacks.com/

IEEE Student Grants:
https://www.standardsuniversity.org/grants/

Examples:
This Tesla Mod Turns a Model S Into a Mobile 'Surveillance Station' | WIRED

Collision Detection:
Airbags (iihs.org)
What Causes an Airbag to Deploy? | Findlay Volkswagen Henderson (findlayvw.com)
Air Bags | NHTSA

System Controllers:
Jetson Nano Developer Kit for AI and Robotics | NVIDIA
Compute Module 4 – Raspberry Pi
Arduino - Products
MSP430FR6989 data sheet, product information and support | TI.com
Arm-based processors | Products | Microcontrollers (MCUs) & Processors | TI.com
AMD Embedded G Series SoC Family | G Series APU | AMD