ADVANCED VEHICLE BLACKBOX

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Problem Background

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- Chances of collision increase as drivers perform unsafe maneuvers.
- Drivers are unaware of their driving behaviours.
- Insurance companies charge for insurance based on assumptions of age and car model. Creates unfair system.
- Accidents are preventable.

Needs Statement

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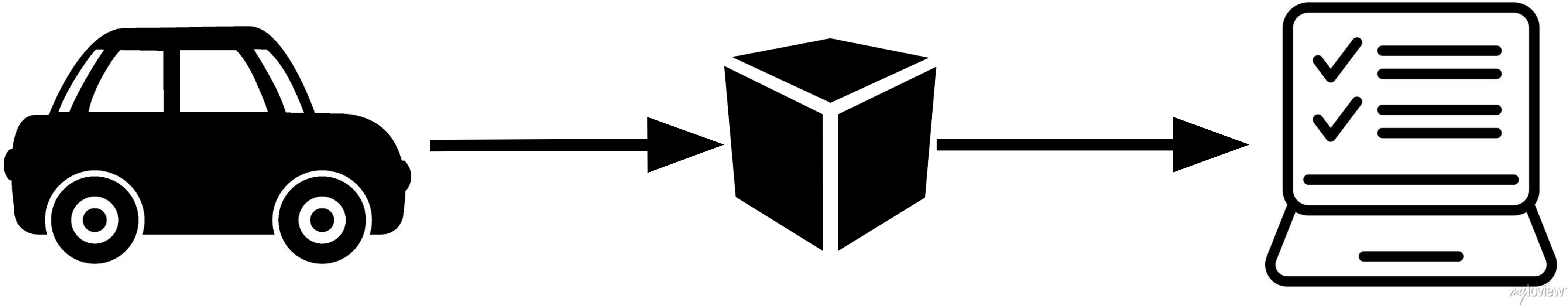
- Drivers need to recognize their bad driving habits in order to determine areas of improvement and awareness of their consequences.
- Drivers need a device that constantly monitors their driving behavior.
- Drivers need a customized user interface that develops a holistic driving profile for them.



Goal and Objectives

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The goal of this project is to encourage healthy and responsible driving practices through automatic, real-time monitoring systems. Incorporating a user-specific interface creates an accurate profile such that it increases self-awareness. We hope that by creating a time sensitive profile algorithm, we are able to realistically grasp a driver's current driving behavior and through consistent monitoring, reduce their chances of collisions or accidents.

Literature Review

- Military Vehicle Blackbox - Ahmad Asi, Benjimin Chang, Mehdi Dadfarnia, Serge Kamta, and Ifzalul Khan
    - Prevent Data Loss: high-speed SSD, pressure sensor, GPS, data rotator software.
    - Funded by US Military
- IoT-based Blackbox - Karthika M*, Anitha A
    - Data sent to IoT via ESP8266 chip
    - Alcohol sensor, gyroscopes, light and ultrasonic sensor
    - Output displayed in LCD Screen, saved on cloud
- IoT-based Blackbox - IEEE
    - Similar to the above project
    - Sends text messages for data retrieval
    - Contacts medical assistance during collisions
    - Focus on protecting victims of car crashes.
- DVR Dashcams
    - Contain Event Data Recorder
    - Cost-efficient

Design Constraints and feasibility

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- Technical
  - We will be relying on a combination of wired and wireless sensor implementation (i.e OBD) to reduce wiring issues.
  - Proper Wiring is main focus here
- Physical
  - We are designing our prototype with compactness in mind, in order to make our product accessible for various vehicles.
  - Our outside “hull” for our microcomputer will be 3-D printed such that it contains ports for outside connections and a space to fit the raspberry pi inside.
- Economical
  - Provided $600 Budget: Purchase of materials for embedded system
  - Remaining budget for unexpected purchases
- Time
  - End of April
  - Create bi-weekly sprints + burn up charts.

Evaluation of alternative solutions

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- Dash Cams
  - Standard dash cams lack the implementation of GPS, IMU and OBD
  - They are only helpful in the case of collision, as they keep videographic proof of lanes leading upto the collision.
  - Therefore, it cannot identify the driver's behavior because anyone can get into a bad accident, whether they are good or bad drivers.
- Front+Rear Camera
  - Image recognition is expensive and difficult, making it a tough starting point for our project.
  - Does not guarantee accuracy and often requires training models several times on lane detection to get it to work well.
  - limits insightful data on a user’s holistic driving behavior.
- Standard IMU
  - IMU lacks insight from road conditions (i.e bumpy, traffic giving inconsistent speed reading) needed for an advanced driving detection system.
- GPU based Web Platform
  - Location tracking and speed detection through GPS may lack context in situations where driving above or below the speed limit is realistic.
- Speed Alert System
  - Creating an alarm system that sounds an alarm each time a user goes above speed limit can result in distracted drivers, causing them to be frustrated and reduce their focus from responsible driving.

Proposed Design

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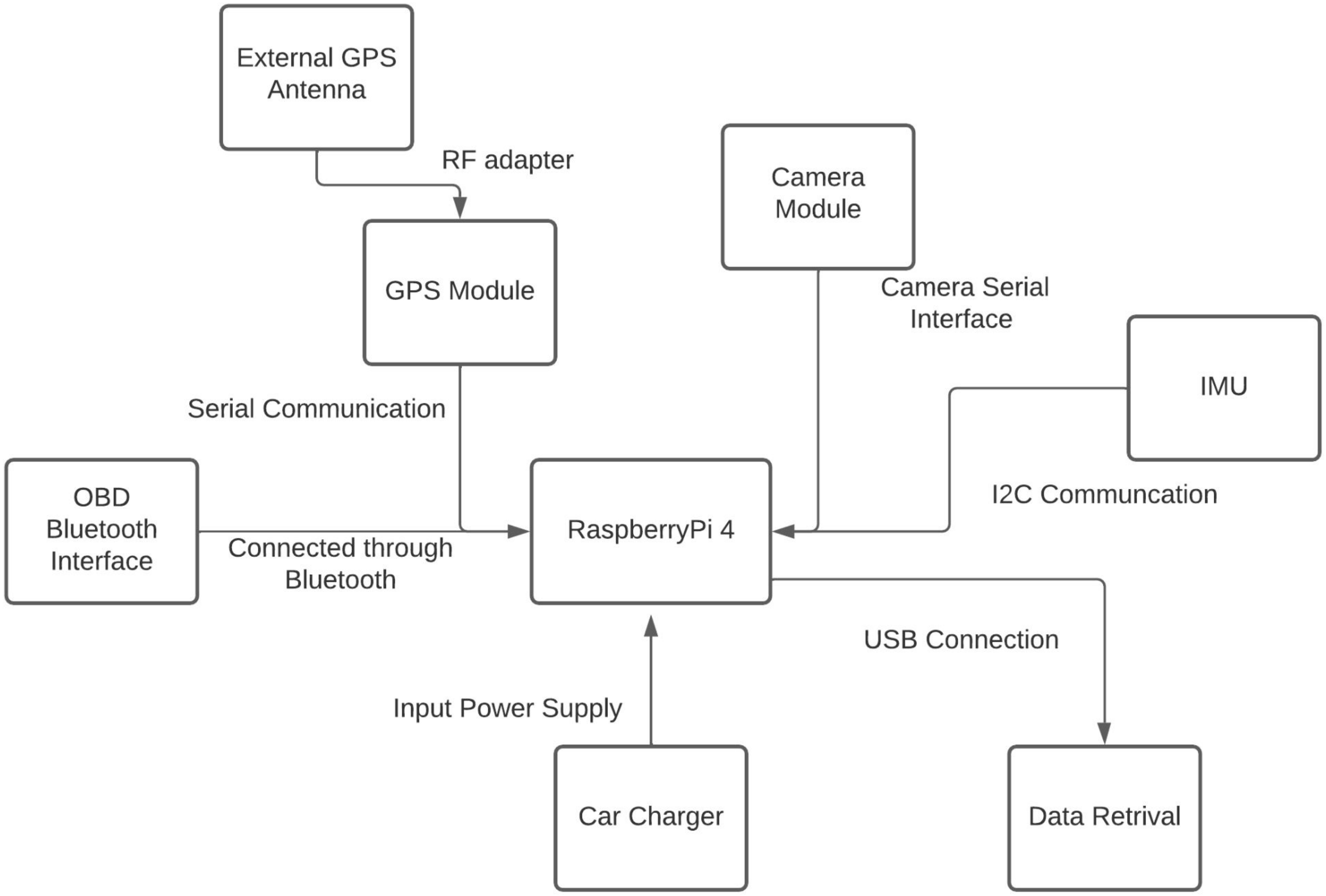
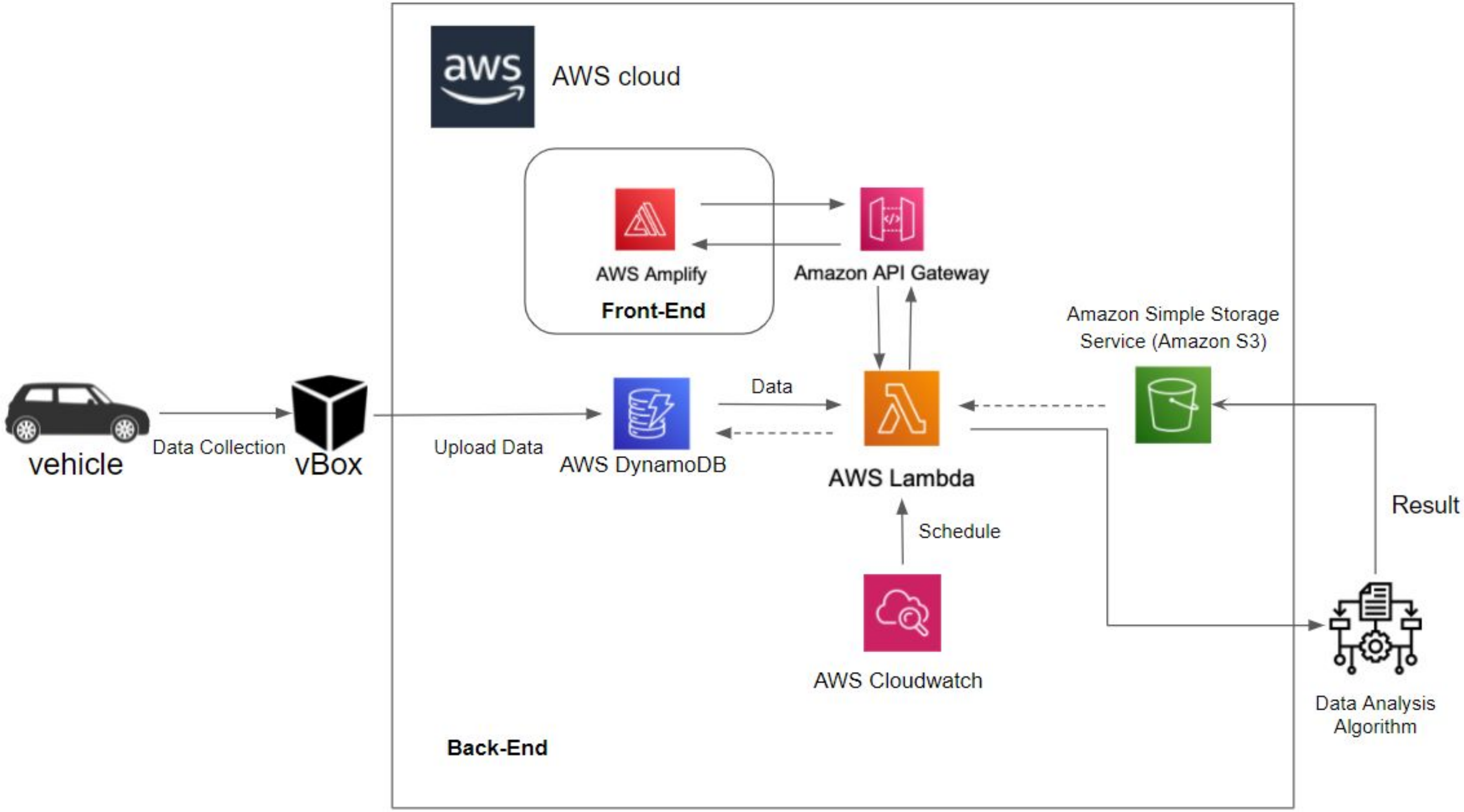
High Level Block Design

Proposed Design

Sensor & Data Retrieval Flowchart



Proposed Design



Embedded System Design Flowchart

Approach for design validation

Our design is intended to transition from prototype to final deployment through a series of layered testing that allows us to thoroughly examine the functionality of hardware and software aspects of our project.

- Hardware
  - Run simple python commands on Raspi terminal to check each sensor status.
  - Use multimeter to check soldering connection
- Software
  - Viewing ‘Transaction Logs’ in SQL Server to check if new data entry has been made for a given timestamp
- Usage Scenario
  - Slow-speed Area
  - Fast-lane roads
  - High Traffic Area
  - Rough Terrain Area

Economic analysis and budget

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- Total = $345.50
- Economical viability: Volume Production $250.
- Sustainability: Parts are ordinary common parts that can easily be found from more than one vendor
- Manufacturability: Highly modularized and flexible since data is handled on the cloud side

Description	Price	Quantity
Raspberry Pi 4 Camera	$24.59	1
Adafruit GPS Hat	$29.95	1
External GPS antenna	$19.95	1
IMU (Accelerometer & Gyro)	$14.95	1
Standoffs for Pi HATs	$0.75	1
RF Adapter cable	$3.95	1
Bluetooth interface OBD port	$13.99	1
Raspberry Pi 4	$167.95	1
SD card with 512 GB	$29.99	1
Car charger for Raspberry Pi 4	$14.44	1
Suction Cup Mount	$24.99	1
3D Printed Enclosure	$25.00	1

Schedule of tasks

Task #	Task Description	Start Date	End Date
1	Web Application starter code	02/17/2022	02/22/2022
2	Dashboard Design	02/22/2022	02/24/2022
3	Assemble and install Camera, IMU, GPS	02/24/2022	02/28/2022
4	Connect Raspberry Pi to Server	02/24/2022	02/28/2022
5	Connect OBD port interface	02/24/2022	02/28/2022
6	Setup AWS Database	02/24/2022	03/10/2022
7	Setup AWS Lambda & API	02/24/2022	03/10/2022
8	Obtain raw data from modules	02/28/2022	03/03/2022
9	Integrate OBD python library	02/28/2022	03/07/2022
10	Concurrently obtain data from GPS and OBD	03/08/2022	03/15/2022
11	Format data file	03/10/2022	03/24/2022
12	Record Camera video and store as needed	03/10/2022	03/20/2022
13	Retrieve data and make error handlings	03/15/2022	03/29/2022
14	WebApp Google API integration	03/10/2022	03/17/2022
15	WebApp: Login View	03/10/2022	03/17/2022
16	WebApp: Report View	03/10/2022	03/22/2022
17	Implement uploading data to server	03/17/2022	03/24/2022
18	Develop analyzing algorithm	03/22/2022	04/05/2022
19	Testing-WebApp displaying retrieved data	03/24/2022	04/07/202
20	Determine metrics for reckless behavior	04/05/2022	04/12/2022
21	Final testing	04/05/2022	04/19/2022
22	Correct/Perform minor improvements	04/14/2022	04/21/2022

Major Tasks Schedule Breakdown:

- Assemble and install necessary packages of the modules by the 02/28/2022
- Software: Setup necessary AWS API functions, tables in database, among other AWS configurations by 03/10/2022
- Hardware: Working on concurrently obtaining and storing data of all the modules by 03/17/2022
- Web Application Development with basic data and APIs functionality: 03/24/2022
- Develop Analyzing Algorithm by 04/05/2022
- Metrics testing and final testing by April 19, 2022

Project Management and teamwork

- Due to the project encompassing hardware and software at a similar level. The team will split into two groups:

Hardware

Software

Societal, safety and environmental analysis

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- Societal
  - Society benefits directly from reduced poor driving practices -- more saved lives.
- Safety
  - Blackbox will be manufactured in a compact design such that driver's ability to drive is not impacted by the device
- Environmental
  - Reducing carbon footprint through use of car's battery outlet instead of external source of power.
  - Reusing data during training purposes to reduce gas emissions caused from project

We appreciate your attention
Questions?