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Rash Driving Detection and Alert System Using Computer Vision

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1.Introduction

The present world is advancing so fast in various areas such as trade and business, partly due to the rapid pace of development of various technological innovations. Despite the rapid technological advancements, the road infrastructure in most parts of the world, including Ghana is not sophisticated enough to handle some of the outcomes of these technological advancements. Some of these include the ever-increasing vehicular population.

[1]This has lead to an increase in the number of road accidents recorded annually. According to statistics published by the National Road Safety Commission (NRSC) from January to June 2019, there has been a total of 6844 car crashes, involving 11167 vehicles, which has killed 1252 people and has left 7043 people injured. These numbers are however expected to rise by the end of the year.

Figure 1

Figure 1 give us an idea of how devastating the effects of road accidents can be if caution is not taken in addressing this problem, which is prevalent worldwide.

2.Problem Statement

[2] Car crash statistics are taken from the national road safety commission, in the year 2016 states that there was an increase of 15.6% in the number of fatalities and 6.7% increase in the number of serious injuries suffered by Ghanaians across the country.
More information, states that the traffic system risk (TSR) index, [3]which is described as the road safety measure for detecting various risk factors and informing drivers in real-time about the risks associated, with using a particular road segment by taking into account various factor such as the number of accidents that have occurred, and the surface anomalies on the road. The figures given by the NRSC is 9.24 fatalities/10,000, which simply means that for every 10,000 vehicles that use a single stretch of road in Ghana, 9 of those vehicles are likely to meet with an accident. Which is just unacceptable!

Crash Analytics From The National Road Safety Commission (NRSC)

Figure 2

3.Relevance of work

In this section, we will make compelling arguments, on why we think our proposed system, has the potential to reduce the number of accidents recorded, and why it is relevant in the Ghanaian society.
Reducing the number of accident victims by a significant number.

- [3]Real-time detection and monitoring of vehicles that exceed, the average of a given road, to enforce traffic laws such as Road Traffic Act – 2004 (Act 683).
- [4]Providing reliable evidence, to combat insurance fraud, by misrepresentation of facts about an accident in order to get some financial benefits.
- Helping law enforcement agencies, track missing vehicles.

4.Literature Review

- [5]Biologically Inspired Composite Vision System For Traffic Monitoring
  A composite vision system with multiple depth-of-field viewing abilities, that largely extended the tracking range of traditional traffic monitoring systems. By defining the over-speeding result and the result obtained form tracking the car, a strong coherence between vehicle identity and speed information was established. The addition of a separate license plate detection camera of the composite camera system provided sufficient evidence for law enforcement officials.

  Drawbacks
  The system needed to be hybridized, by adding a RADAR module to give a more accurate result for traffic monitoring.
  The system was, exclusive to only a desktop client.

- [6]IoT based framework for vehicle over-speed detection.

  A smart over-speeding vehicle speed detection system, using IoT technology, for alerting users about the current speed of a vehicle, when their speed had surpassed the speed limit of the particular stretch of road. They made use of the google map API, to tell the current speed limit of a given road, hence made the system more dynamic since they were able to determine if a user was either driving too fast or too slow on a given stretch of road.
  They made use of various modules such, as the GPS module, which was used to measure the position of a vehicle on the ground. Below is the architectural diagram of the system.

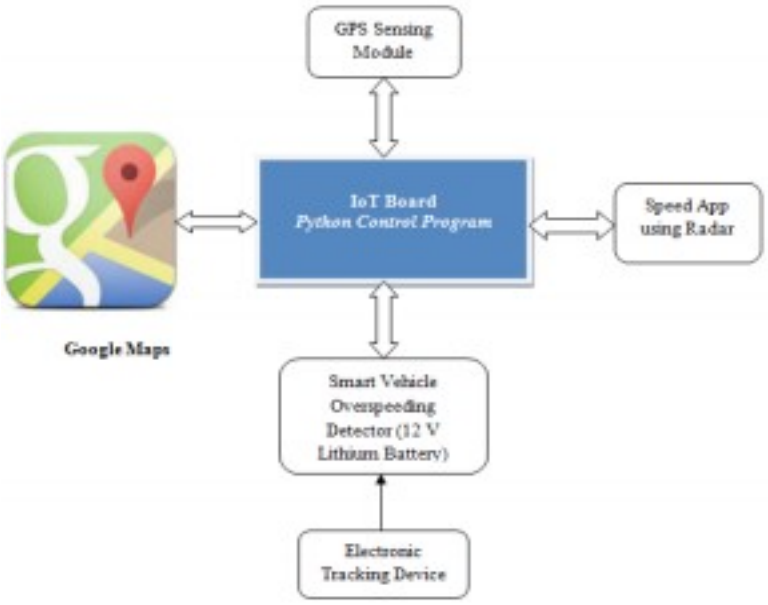

Figure 4

Drawback

The system can only be used for one particular car at a time, hence making it nearly impossible for being configured to measure the speed of different cars on a given road. The system is not able to detect the license plate number of a given car, hence won't be able to aid law enforcers, unless the number plates were hardwired into the system.

- [7]Vega Smart Speed Advance System For Speed Violation Detection.
  The creators of this project used 2 light and compact cameras to enable the system to recognize objects in harsh weather conditions. The system performs real-time processing of all events and has an Automatic Number Plate Recognition (ANPR) system installed that serves the purpose of, capturing and storing the number plate of speed violators. The system also uses an embedded multi-tracking radar, that tracks the speed of multiple vehicles traveling on the same road at the same time. The system can cover two lanes at 7.5 meters width maximum and detects vehicles at a speed of up to 250 km/h. Additional standard functionalities include embedded ANPR, monochrome vehicle images and color context vehicle images, and an optical speed evaluation as well as the capability to read reflective and non-reflective license plates. An extra-sensitive sensor mounted on the Vega Smart 2HD's context camera ensures quality images also in low light conditions. The modular system architecture allows easy customization of the hardware platform according to the complexity of each given application.
  Firstly, a system can be added to recognize the vehicle brand, vehicle class, and even the vehicle color and additionally offer High Definition (HD) streaming for video surveillance. Also, the Smart camera can be equipped to simultaneously run two different Optical Character Recognition Systems (OCRs) on-board. The Real-time license plate identification is then performed by two independent software tools inside the system that provides maximum accuracy. Through the Double OCR, the validated license plate data is a direct output from the camera and any additional third-party analysis software is redundant which reduces complexity and system costs for the user. The system is also made to function with a smartphone and/or tablet App for remote camera configuration. Through the Easinstall App, various install packs can be uploaded to the camera via remote connection to upgrade the system's firmware. Its embedded intelligence provides a maximum output at extremely low system costs since all algorithms are inside the system and deliver an output ready to be interpreted by the user.

Figure 3

5.Project Objectives

- Design and implementation, of a system that can correctly monitor the speed of a given car on a stretch of road.
- Design and implementation of a system that is intelligent enough to retrieve various the meta-data of a given road such as speeding-limit and the streets name.
- Design and implementation of a system that efficiently ans securely protects the user's data.

6.System Design

The given system, will be created by getting input from the camera, when the event of a car exceeding the speed limit had occurred, the recorded video, is then processed on the raspberry pi, by first preprocessing the recorded video. The video is then passed through an object detection algorithm to detect the vehicle and various parameters of the vehicle such as the velocity, number plate, and vehicle model. Which will all be passed onto a data store, via a RestFul APIs, which is then used by native application and website to communicate with the with data warehouse.

Architectural Diagram

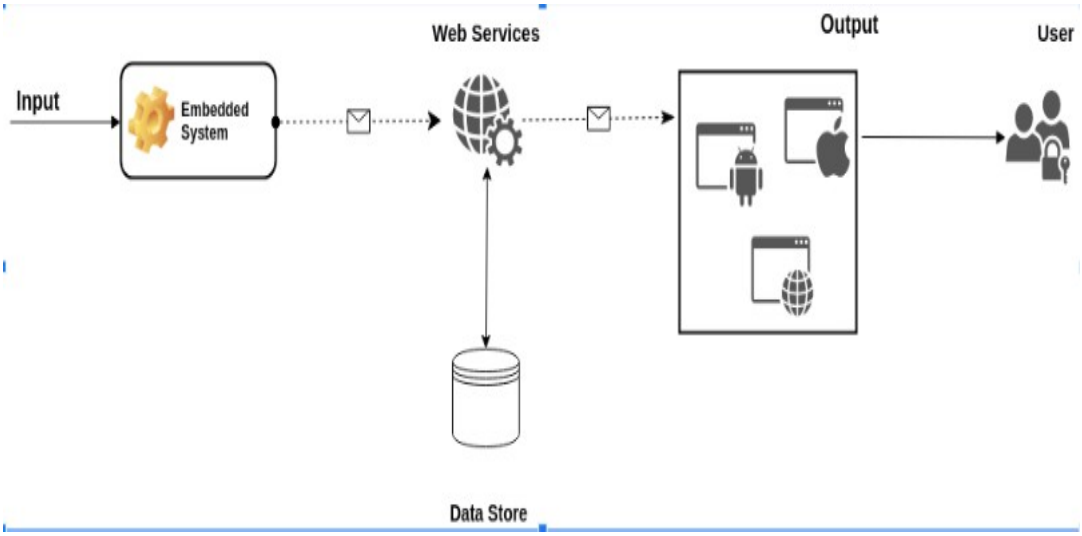

Figure 3

7.Expected Outcome

After completion, the system is expected to:

- The system must be able to accurately monitor the velocity of any given vehicle, it must also be able to determine if the vehicle is moving over the expected speed limit for that road.
- The system must be able to correctly capture and extract the number plate details of a given car.
- The system must be able to take a video of cars, that have been flagged to have exceeded the speeding limit.
- The system must provide a desktop and mobile client, through which officials can interact with the system.

8.Resource Requirements

The table below highlights the number of resources that are estimated to be adequate for the successful, completion of the project.

(#)	Resource Name	Market Price	Status

1.	Development Machines	Variable	Available
2.	Internet Connection	Variable	Available
3.	Raspberry Pi Micro-controller	Ghc 305.00	Available
4.	Raspberry Pi NoIR Camera	Ghc 197.00	Unavailable
5.	Electrical Components	Variable	Available
6.	Server Space	Ghc 45.00	Unavailable
7.	Free and Paid External Libraries	Variable	Unavailable

9.Technical Requirements

The section below, describes briefly the various technologies that will be used for a successful implementation of the project.

Python: The python programming, language would be used for interacting with the various libraries such as OpenCv (Open Computer Vision) and SimpleCV (Simple Computer Vision).

Java: The java programming language, would be used in the creation of a native, mobile or desktop application that would be used by various admins of the system.

RestFul APIs: These refers to services, that would be used in communicating with the various components of the IoT system, such as servers that would hold the database, native software (iOS, android and web).

Rasberry Pi: The stated system would serve as a platform, for holding the various algorithms that would be used by the system.

Linux OS: Knowledge of the linux operating system, would be used in the creation of in creating the system.

MongoDB: The mongo database, will be used as the data warehouse of the application where all relevant data will be stored for future use.

BlockChain: The blockchain, will be used to successful secure all data from tampering.

SMS and Email Libraries: SMS and email libraries, will be used for alerting drivers, who have violated speeding regulations.

10.Project Timeline

The diagram below, depicts the various activities that will be performed and the order in which they will be performed to bring about a successful implementation, of the project within the given timeline.

Type	Status	Title	Start date	End date	Duration (in days)	% Complete
Task		Requirements Engineering	10/01/2019	10/07/2019	5	0
Milestone		Database Design and Implementation	09/30/2019	09/30/2019	-	-
Task		Data Gathering and Analysis	10/01/2019	10/15/2019	11	0
Task		Hardware Design And Implementation	10/16/2019	10/31/2019	12	0
Task		Design and Implementation Of Hardwa	11/01/2019	11/15/2019	11	0
Task		Implementation of Image Processing Te	11/16/2019	11/30/2019	10	0
Task		Object Tracking Algorithms	12/01/2019	12/31/2019	22	0
Task		Implementation of Lane Analysis Algori	01/01/2020	01/31/2020	23	0
Task		Design and Implementation Of Web Ser	02/01/2020	02/29/2020	20	0
Task		Implementation of Web Applications	01/01/2020	03/15/2020	53	0
Task		Testing	03/31/2020	03/31/2020	1	0

11.Roles and Responsibilities

The table below, describes the roles and responsibilities of the various members, in the group. To bring about a successful implementation of the given project.

Task #	Sedem Quame Amekpewu	Samuel Kobina Obeng Andam
1.	Requirement Engineering	Requirement Engineering
2.	Hardware Design & Implementation	Database Design & Implementation
3.	Design & Implementation of desktop client.	Design & Implementation of Web Services and Web Apps
4.	Implementation of image processing	Implementation of object detection and lane analysis

	techniques.	
5.	System Integration	System Integration
6 .	Testing	Testing

12.Conclusion

Upon a successful completion of this, project we expect to deliver a working IoT device, that is cost effective and efficient in performing all its stated functions. The system, must be able to accurately detect vehicles that are being driven recklessly and as a result it should reduce the number of road accidents, by providing law enforcement agencies with appropriate information to make convictions on recklessly driven vehicles.

13.References

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