Detecting Negative Driving Patterns and Promoting Positive Driving using Smartphone Technology

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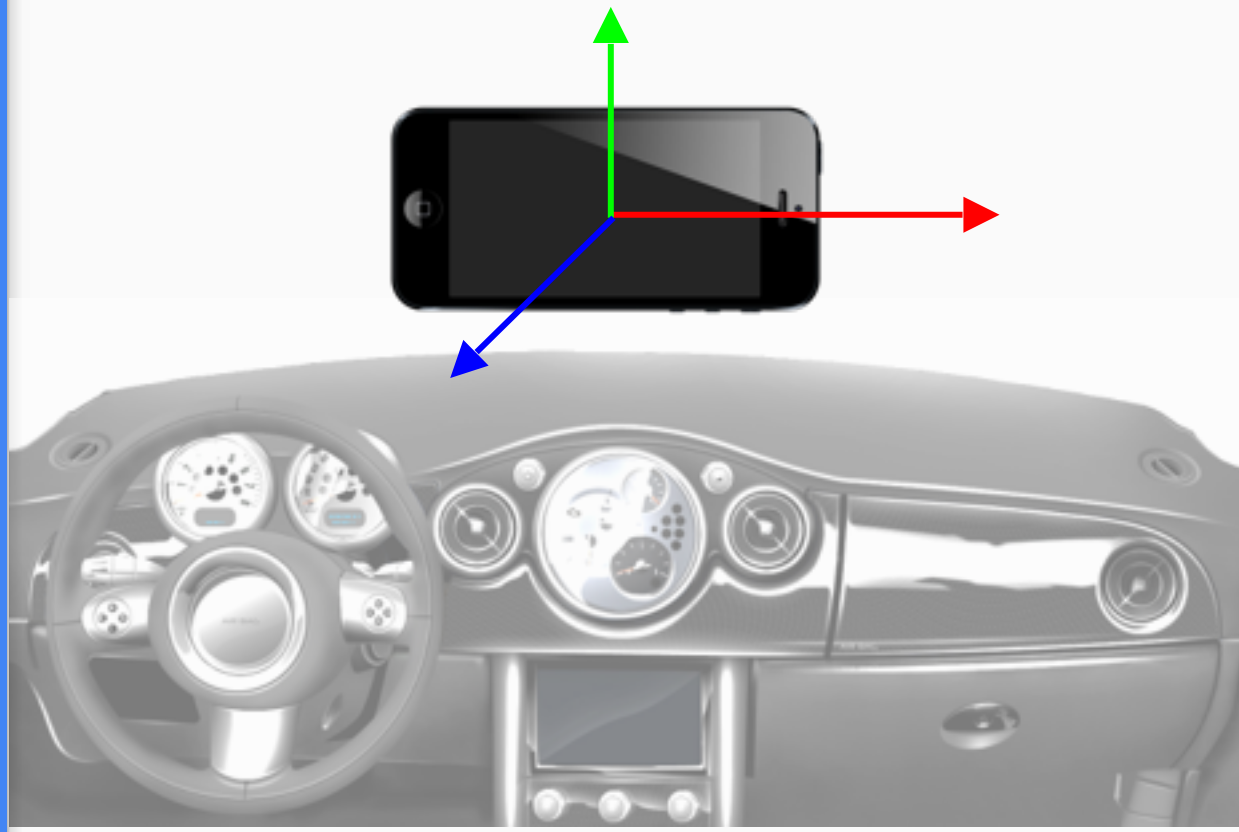
Overview

- ➔ Background and Motivation
- ➔ Related Works
- ➔ Project Goals & Contributions
- ➔ Detecting Negative Driving Patterns
- ➔ Architecture & Design
- ➔ Future Work
- ➔ Conclusion

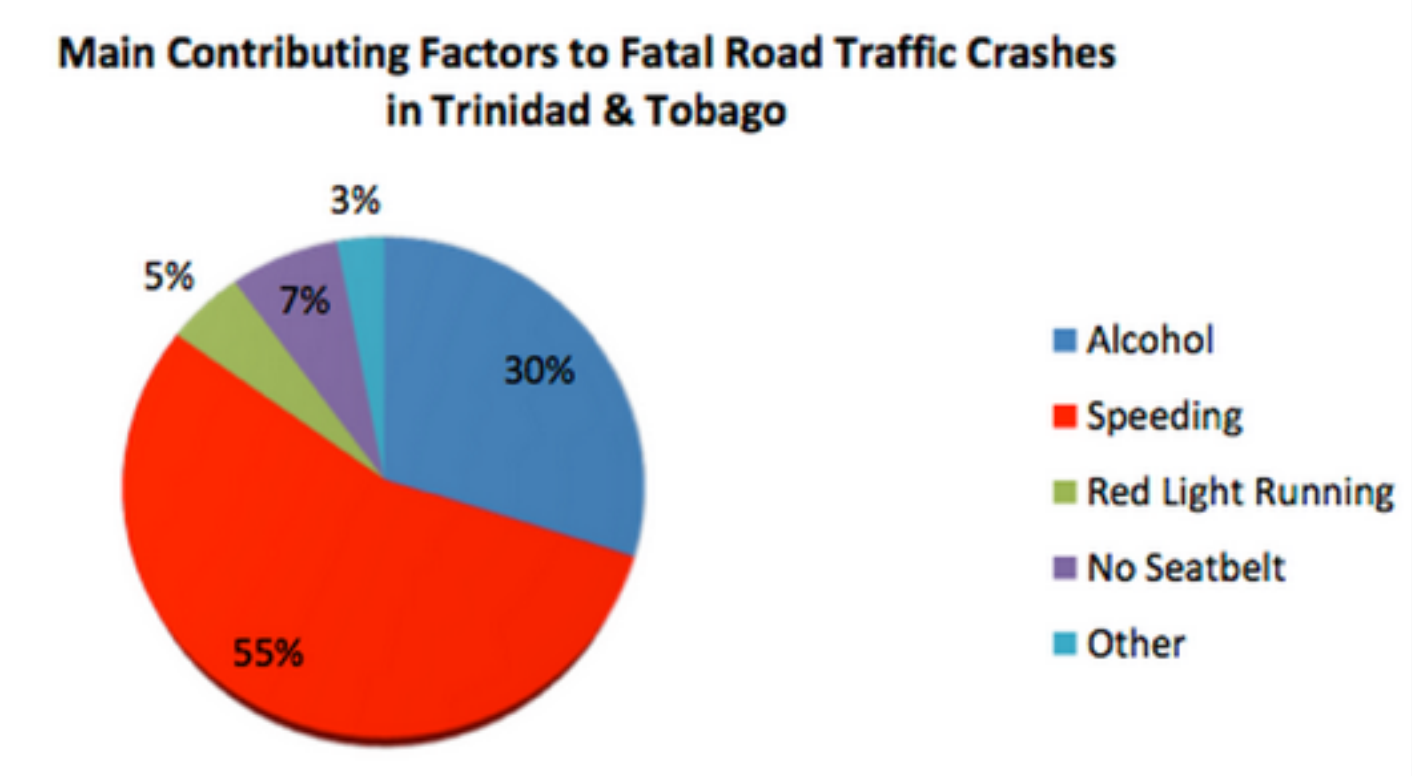
Detecting Negative Driving Patterns and Promoting Positive Driving using Smartphone Technology



Project is currently ongoing in its early stages.

Background and Motivation

- Currently, there are approximately 700,000 vehicles that are registered in Trinidad and Tobago[1]
- For the period 2007 to 2012, there have been over 200,000 collisions with the following statistics[1]



1. *Arrivealivett.com, "Statistics - Arrive Alive Trinidad and Tobago", 2015. [Online]. Available: http://www.arrivealivett.com/index.php?page=statistics.*

Background and Motivation

Country	Road fatalities per 100,000 inhabitants per year	Road fatalities per 100,000 motor vehicles	Road fatalities per 1 billion vehicle-km	Total fatalities latest year (2013)
Iran	32.1	92.7	n/a	24,896
Saudi Arabia	27.4	119.7	n/a	7898
South Africa	25.1	133.9	n/a	13,273
Vietnam	24.5	55	n/a	22,419
Malaysia	24.0	29.9	12.6	7129
Brazil	23.4	50.3	55.9[6]	41,059
Iraq	20.2	151.2	n/a	6826
Russia	18.9	53.4	n/a	27,025
China	18.8	104.5	n/a	261,367
India	16.6	130.1	n/a	238,562
Trinidad and Tobago	**14.1**	**58.9**	**n/a**	**189**
Bangladesh	13.6	1020.6	n/a	21,316
United States	10.6	12.9	7.1	34,064
Poland	10.3	15.8	n/a	3931
Greece	9.1	12.6	n/a	1013
Italy	6.1	7.3	n/a	3753
Canada	6.0	9.5	6.2	2114
Japan	4.7	6.5	8	5971
Germany	4.3	6.8	4.9	3540
United Kingdom	2.9	5.1	3.6	1827
Sweden	2.8	4.7	3.5	272

2. *WHO (World Health Organization), ed. (2015). "WHO Report 2015: Data tables" (PDF) (official report). Geneva, Switzerland: World Health Organisation (WHO).*

Related Works

Summary and Conclusions drawn from related works

Data analysis and decision making is done on the smartphone device as opposed to server side	*Pholprasit et al., 2015* *Dai et al., 2010* *Johnson et al., 2011*
Smartphone device needs to be mounted in the vehicle in a fixed position	*Bergasa et al., 2014* *Koh et al., 2015* *Chen et al., 2015*
Statistical anomaly detection systems are used or described	*Chaovalit et al., 2013* *Chen et al., 2015* *Meseguer et al., 2013*
Data gathered is based on negative driving experimentation	*Bergasa et al., 2014* *Meseguer et al., 2013*

Related Works

Summary and Conclusions drawn from related works

- Prior work do not take into consideration road infrastructure quality as well as inclined roads.

- Prior work do not take into consideration current weather situations.

- Prior work do not take into consideration user motivation and app retention

Project Contributions

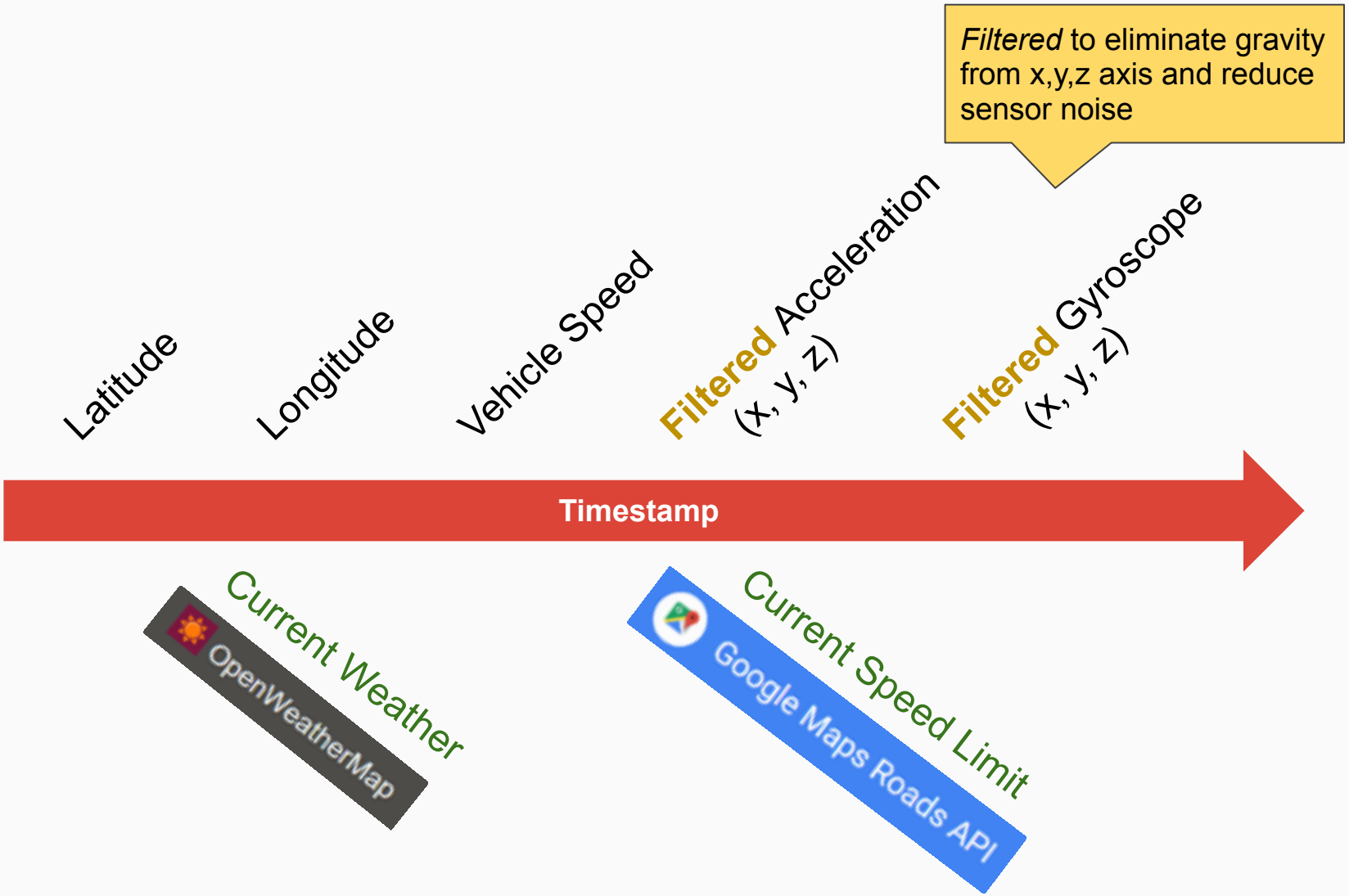
- Utilization of current weather data in identifying negative driving patterns
- Utilization of current road speed limit data in identifying negative driving patterns
- Provide a needed focus on user motivation and retention

Project Goals

- Determine if the mobile device is currently in a moving vehicle
- Determine the speed of the vehicle if in a state of motion
- Calibrate mobile device sensor data accordingly
- Detect and log changes in sensor data
- Determine negative driving patterns or events
- Alert subscribed contacts of any negative driving patterns detected
- Motivate user to perform more positive driving patterns
- Application should not be intrusive to the user

Detecting Negative Driving Patterns

Data Capture



Detecting Negative Driving Patterns

Anomaly Detection

Data matching

Determine if current data set falls within a predefined set of negative driving data.

Algorithmic Based Detection

Uses predefined variables and conditions in predicting if a set of data implies negative driving.

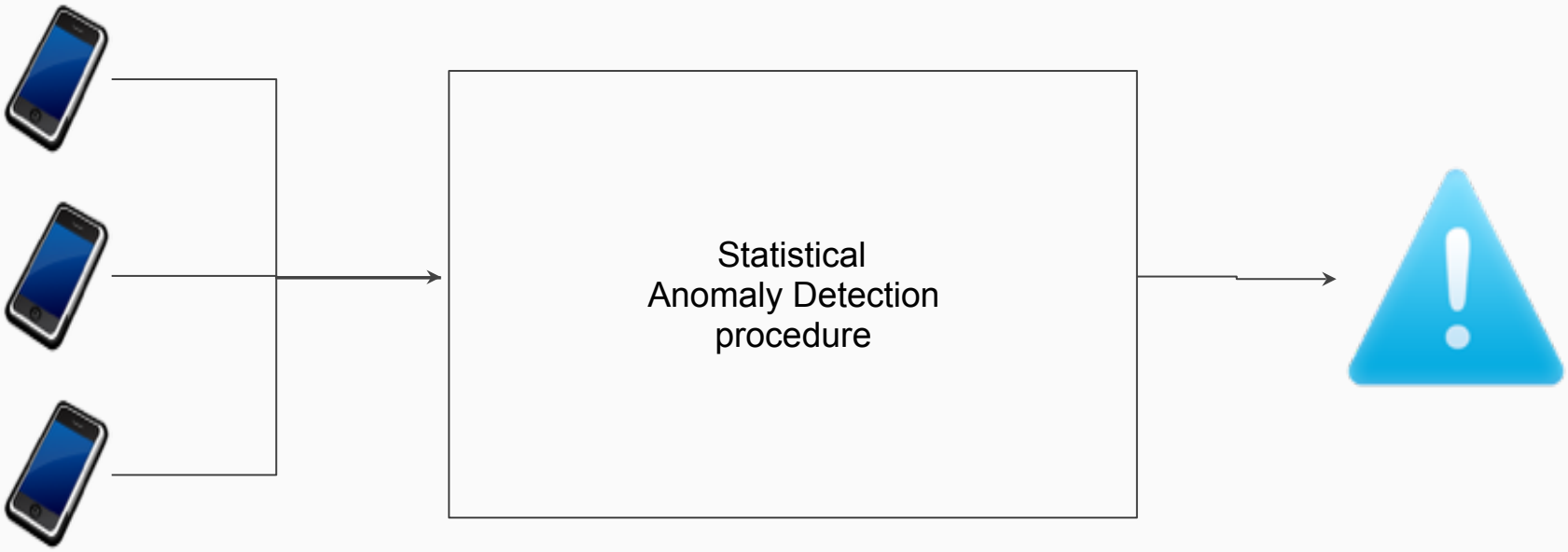
Detecting Negative Driving Patterns

Anomaly Detection

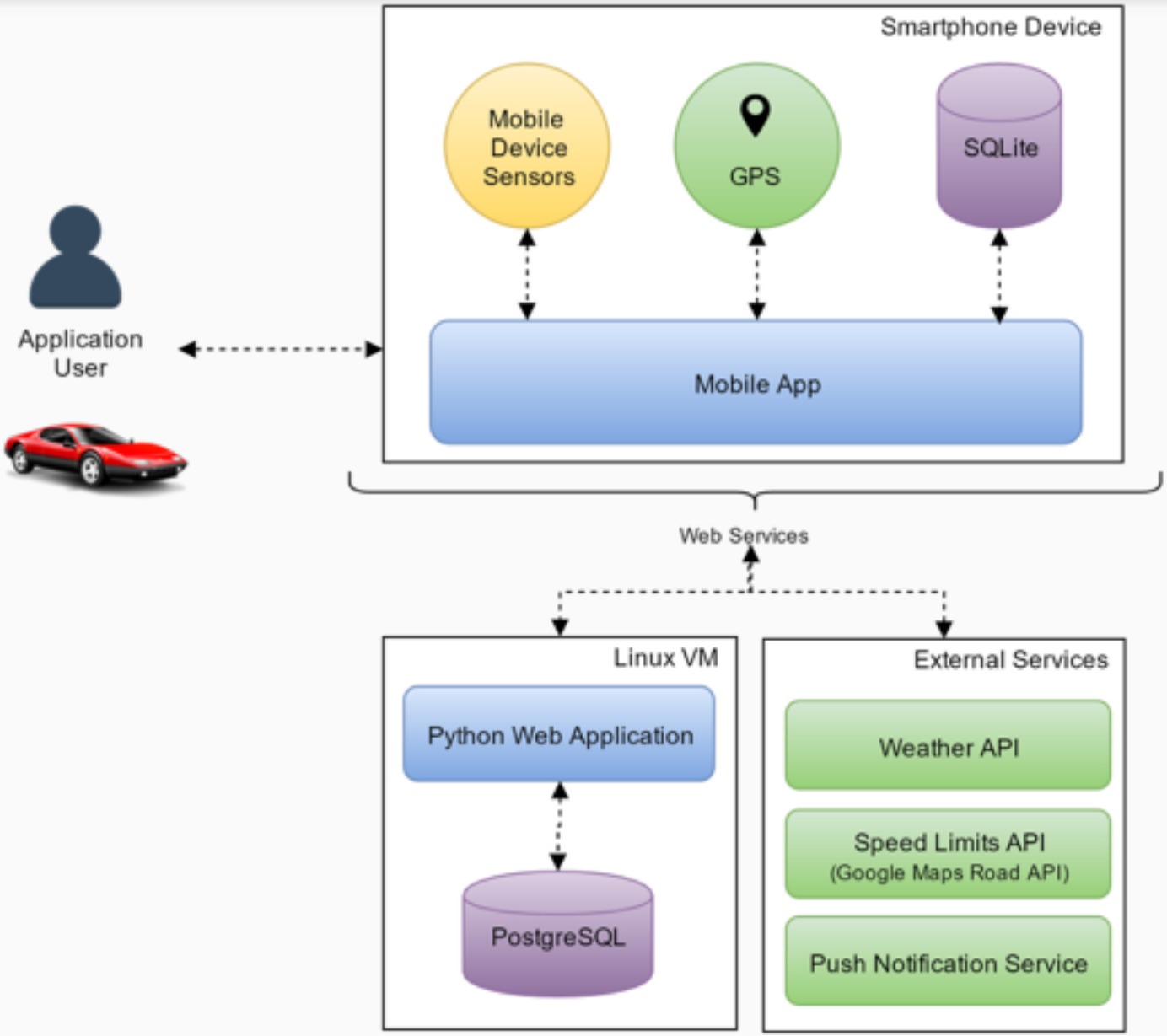
Statistical Anomaly Detection

Using data captured from all users, statistical analysis can be employed to detect anomalies

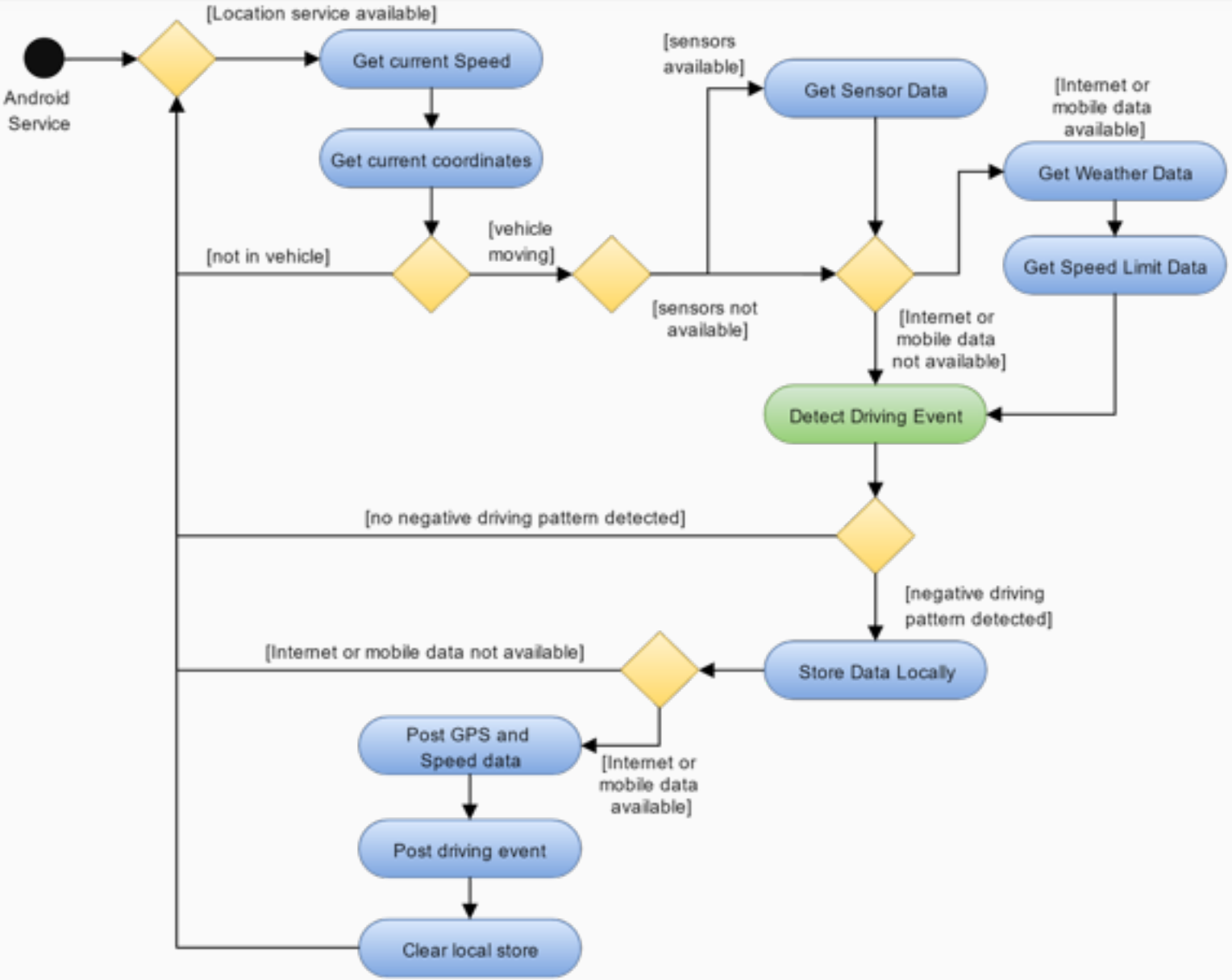
- Anomalies using gaussian / normal distributions
- Cluster based (Eg. *K-means clustering*)



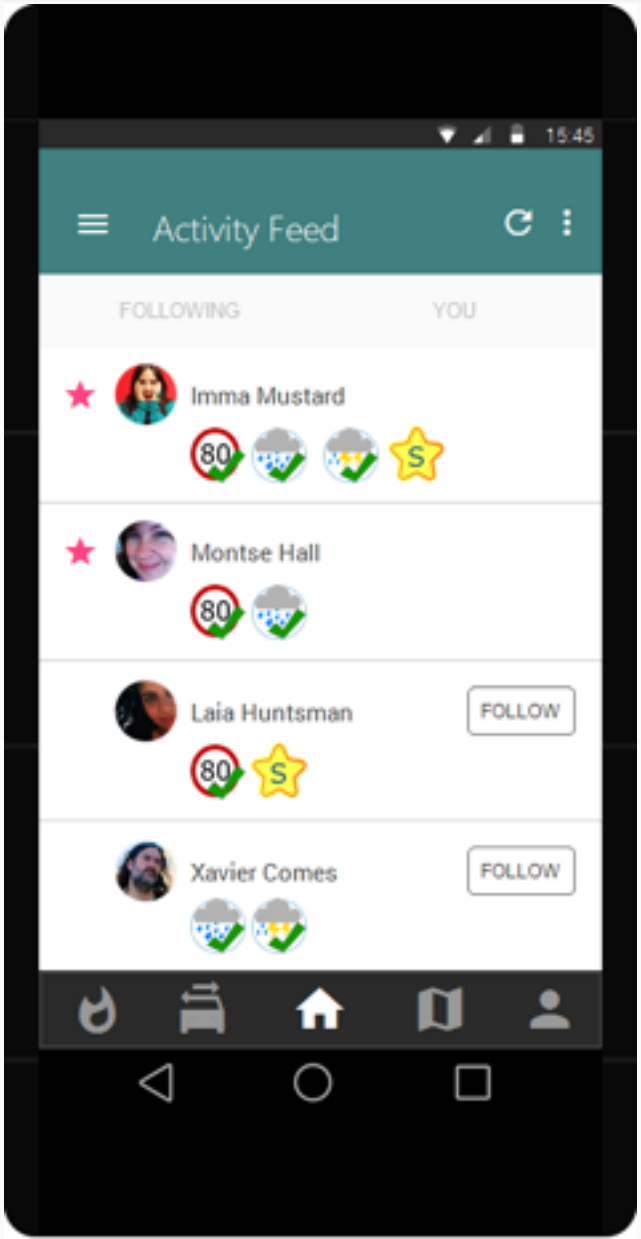
Architecture and Design



Architecture and Design

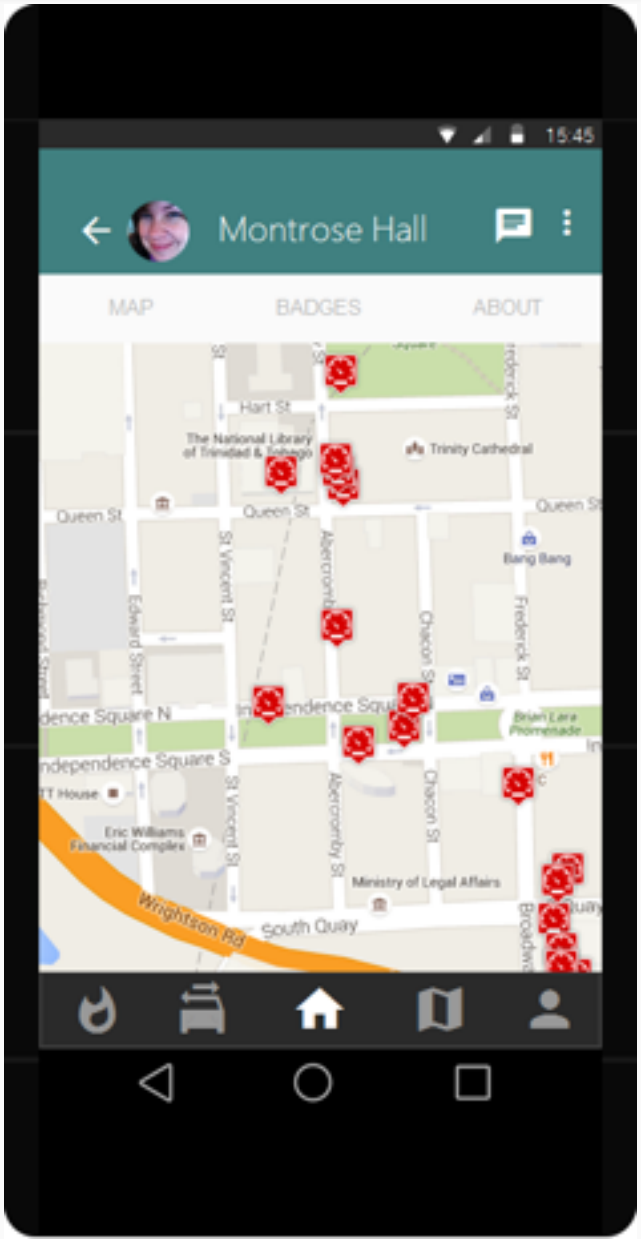


Future Work : User Facing Application



- **User Management / Social networking**
  - User sign up / login
  - Activity feed
  - Add and Follow other drivers

Future Work : User Facing Application



- **User Management / Social networking**
  - “Driving Buddy” feature
    - Allows user to monitor the driving behavior of persons on his contact list, upon request.

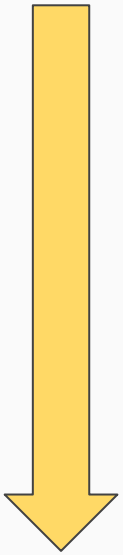
Future Work : Gamification

Gamification in a nutshell

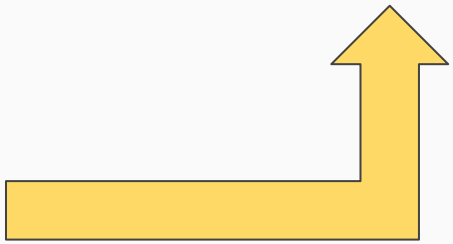
- ➔ Gamification engages users and changes behavior with the best ideas from games, loyalty programs and behavioral economics
- ➔ Gamification is not making everything a game
- ➔ *Examples*:
  - Point system on stackoverflow
  - Grocery Store Loyalty Cards
  - Credit Card Miles

Future Work : Gamification

Attainable Objectives



Unlock rewards and achievements



Share

Leaderboards
Progress

Conclusion

- Touched on the importance of negative driving detection as well as existing related works
- Overview of project in its current state
- Overview of future implementations and ideas

Questions & Answers

References

[1] Arrivealivett.com, "Statistics - Arrive Alive Trinidad and Tobago", 2015. [Online]. Available: http://www.arrivealivett.com/index.php?page=statistics. [Accessed: 15- Feb- 2016].

[2]C. Meier, "9 Elements That Will Make Gamification a Part of Your App Marketing Strategy - Appcase Blog", *Appcase Blog*, 2014. [Online]. Available: http://getappcase.com/blog/app-marketing/make-gamification-a-part-of-app-marketing-strategy. [Accessed: 15- Feb- 2016].

[3]R. Varshneya, "6 Techniques to Effectively Gamify a Mobile App", *Entrepreneur*, 2014. [Online]. Available: http://www.entrepreneur.com/article/237891. [Accessed: 15- Feb- 2016].

[4]T. Pholprasit, W. Choochaiwattana and C. Saiprasert, "A comparison of driving behaviour prediction algorithm using multi-sensory data on a smartphone", *2015 IEEE/ACIS 16th International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD)*, 2015.

[5]J. Dai, J. Teng, X. Bai, Z. Shen and D. Xuan, "Mobile phone based drunk driving detection",*Proceedings of the 4th International ICST Conference on Pervasive Computing Technologies for Healthcare*, 2010.

[6]D. Johnson and M. Trivedi, "Driving style recognition using a smartphone as a sensor platform",*2011 14th International IEEE Conference on Intelligent Transportation Systems (ITSC)*, 2011.

[7]P. Singh, N. Juneja and S. Kapoor, "Using mobile phone sensors to detect driving behavior",*Proceedings of the 3rd ACM Symposium on Computing for Development - ACM DEV '13*, 2013.

[8]J. Meseguer, C. Calafate, J. Cano and P. Manzoni, "DrivingStyles: A smartphone application to assess driver behavior", *2013 IEEE Symposium on Computers and Communications (ISCC)*, 2013.

[9]L. Bergasa, D. Almeria, J. Almazan, J. Yebes and R. Arroyo, "DriveSafe: An app for alerting inattentive drivers and scoring driving behaviors", *2014 IEEE Intelligent Vehicles Symposium Proceedings*, 2014.

[10]P. Chaovalit, C. Saiprasert and T. Pholprasit, "A method for driving event detection using SAX on smartphone sensors", *2013 13th International Conference on ITS Telecommunications (ITST)*, 2013.

[11] Trevorwhitney.com, "Trevor Whitney > Data Mining > Anomaly Detection", 2016. [Online]. Available: http://trevorwhitney.com/data_mining/anomaly_detection. [Accessed: 15- Feb- 2016].

Answers

I knew someone was going to ask that...

The problem of users competing for “bad driver”

- The system will be designed in a way to prevent users from competing to be a bad driver.
  - System will contain no benefit or (amusement) value for negative detections. The user will only gain badges, scores, achievements from positive driving.
  - Penalties can be established for (extreme) frequent negative patterns

Answers

I knew someone was going to ask that...

How is any data gathered for the project verified?

- Research is being done with OBDII (On-board diagnostics) devices. These devices can connect to the vehicle's onboard computer system, and provides an interface for gathering data.

Data includes vehicle speed, acceleration (in some cases), engine RPM, etc.