Ubiquitous and Mobile Computing CS 403x: *Mobile Phone Based Drunk Driving Detection*

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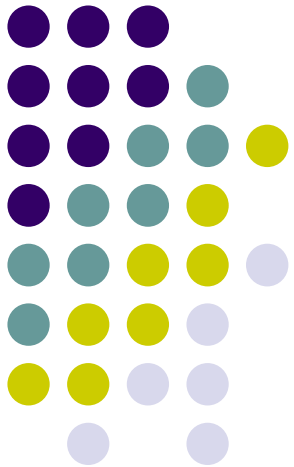
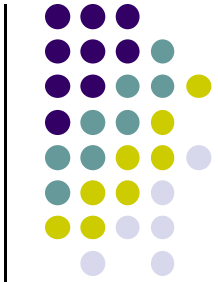
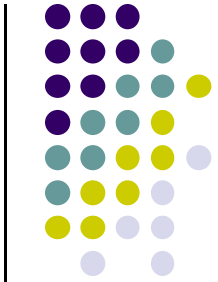


Motivation



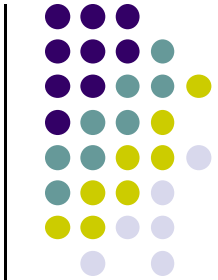
- Drunk driving accounted for 32% of fatalities in 2007 and 2008
- The cost of drunk driving incidents totaled more than $51 billion in 2008
- Officer patrols are insufficient to stop drunk driving
- Hard to notice cars exhibiting drunk driving behaviors
- Need a way to recognize drunk driving as soon as possible

Vision



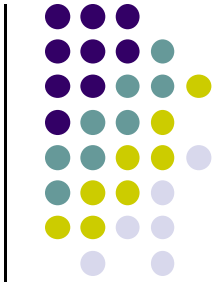
- Use mobile phones for drunk driving detection
  - 120 million copies sold in 2008
  - Highly portable and equipped with the necessary sensors
- Using a drunk driving algorithm, extract the necessary information in real time using accelerometer data
- Reliable, lightweight, non-intrusive, and power-efficient system

Related Work



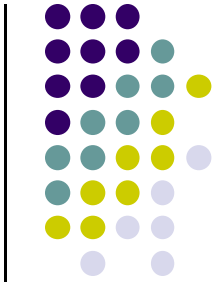
- This research is the first of its kind involving a mobile phone in drunk driving detection
- Technology has been used to attempt to recognize fatigue in drivers and promote alertness
  - Uses eye-gaze monitors, pupil detectors, and head movement trackers
- Proposed driver information system using GPS and specific sensors to monitor the acceleration of the car
  - Not yet reached the stage of implementation
  - System is very specific and not conveniently compatible

How is this different?



- This research is the first of its kind using a mobile phone.
- It is non-intrusive and requires no extra work from the user
- Utilizes sensors that come standard to nearly every smartphone
- Requires no additional hardware within the car or service
- Conducted real driving tests with the system to increase accuracy and prove legitimacy of detection system

System Design



- Uses accelerometer data to detect cues of drunk driving
  - Lane position maintenance problems: 50.75%
  - Speed control problems: 45.70%
  - Judgement and vigilance problems: 40.00%.
- Combining cues increases probability of drunk driving detection
  - i.e. weaving plus swerving increases probability to 65%
- Researchers focus on lane position maintenance and speed control problems

System Design

- Lateral Acceleration
  - Abnormal curvilinear movements
- Longitudinal Acceleration
  - Abrupt acceleration and deceleration
  - Erratic braking and jerky stops

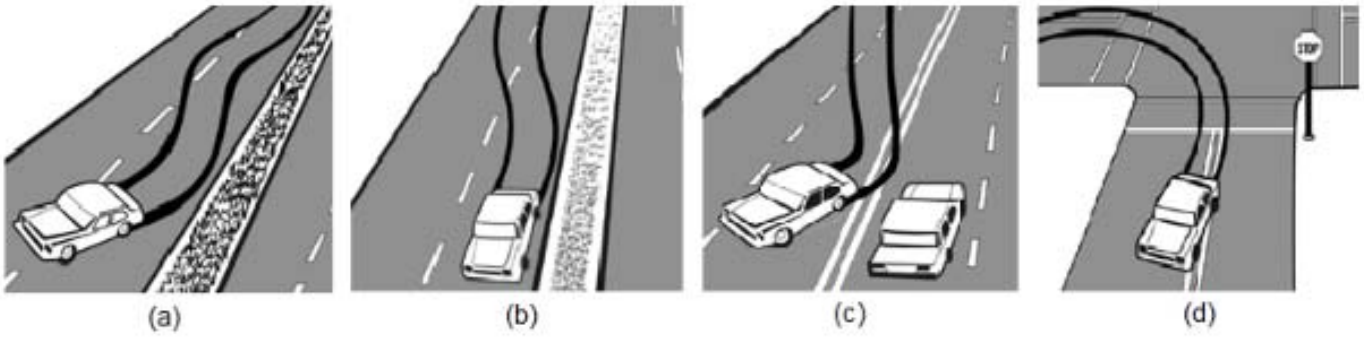


Fig. 1. Problems in maintaining the lane position : (a) weaving, (b) drifting, (c) swerving, (d) turning with a wide radius [5].

System Implementation

- Monitoring Daemon Module
- Calibration Module
- Data Processing and Pattern Matching Module
- Alert Module

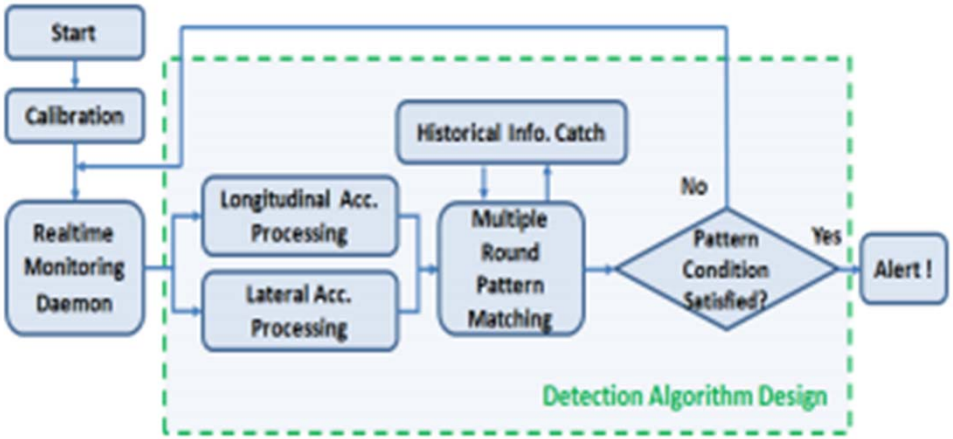
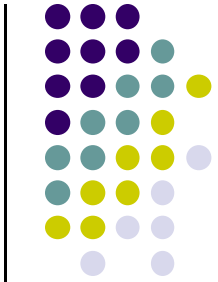


Fig. 2. Working procedure of the drunk driving detection system. The components in the dashed box show the data processing and pattern matching part, reflecting the algorithm design.

Results

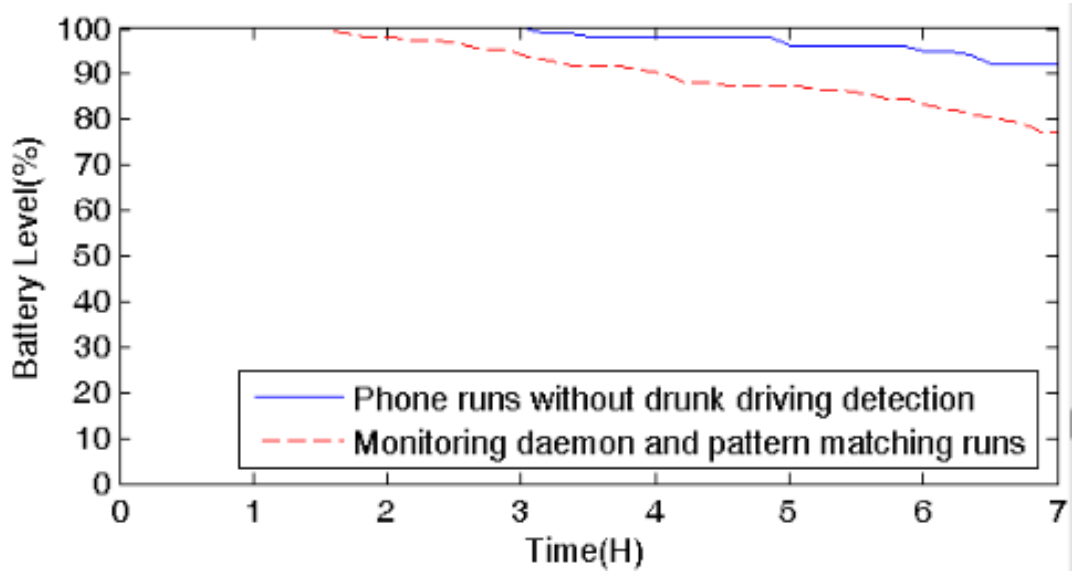


- Tested situations both where phone was stationary inside car and was allowed to slide around
- Detection algorithm performs fairly well
- Phone sliding increases false negative rate for abnormal curvilinear movements significantly

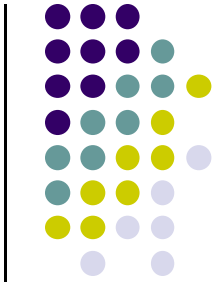
	Abnormal Curvilinear Movements	Problems of Speed Control
FN Rate (%)	0	0
FP Rate (%)	0.49	2.39
FN Rate (%) (Phone Slides)	14.28	0
FP Rate (%) (Phone Slides)	1.09	2.72

Power Consumption

- Ran phone with and without monitoring daemon on for 7 hours
- Phone running with detection system continuously will last for roughly 34 hours



Conclusion



- Effective drunk driving detection using mobile phones
- Reasonable energy consumption
- Actively identifies drunk driving behavior
- Future considerations
  - Improve the accuracy of detection
  - Integrate additional sensors such as GPS and camera to collect more data

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