



Lane Departure Warning System

Saving lives, one alert at a time

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Overview

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Background

- Run-Off-Road (ROR) accidents are a leading cause of deaths on US roads and highways (1,550 fatalities, 71,000 injuries a year)₍₁₎
- Need for a system that monitors car movement and provides a quick and effective alert to the driver to take a corrective action when car drifts unintentionally
- Proposed solution: Design and build a Lane Departure Warning System (LDWS)

(1) - National Highway Traffic Safety Administration

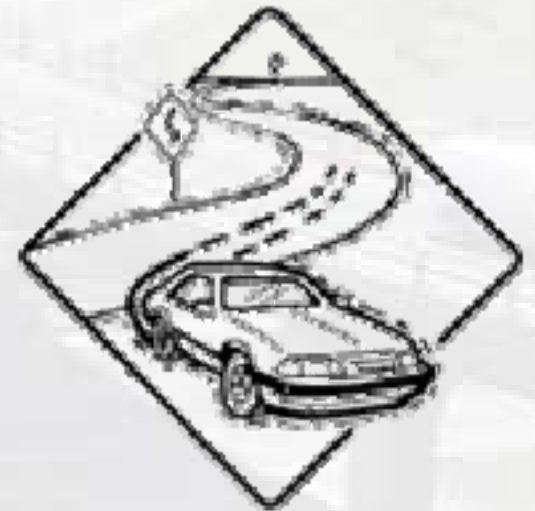
Problem Formulation

- Main design components:
 - Input: Monitoring system
 - Control unit: Interpret the data from monitoring
 - Output: Alert system for the driver in the event of a lane drift



Problem Formulation

- Performance
 - Track lane boundaries and issue warnings within ± 0.1 meter from the warning thresholds
 - Issue directional warning within 1 second
 - Detect vehicle position relative to visible lane boundaries using an input data stream from 8 infrared sensors
- Safety
 - Perform a self-test within 30 seconds of starting the vehicle
 - Adhere to all NHTSA ⁽¹⁾ safety standards



Problem Formulation

- Constraints
 - Initial set up cost less than \$500
 - Maintenance cost less than \$150 per year
- Regulations
 - Meet the electrical requirements as stated in SAE standards—J1455, J1113

Current Status of Art

Available Technology

- Image processing technology (e.g. Autovue[®], AURORA)
- Utilizes a camera or a video as its input provider
- Interprets the input data through an algorithm



Weakness

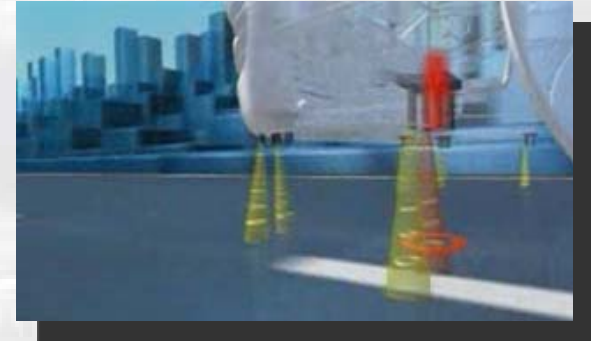
- Depend on a moderate to high quality image as input
- LDWS is not functional in poor visibility scenarios (low quality input image)



Solution Approaches

Input Component: Infra-red technology

- Constant bombardment of road with IR rays
- To leverage wavelength difference in reflected beam based on color of material hit (road or lane mark)
- Sensors (4 per side) to receive reflected beam
- Processing unit to decipher lane drift or not
- Multiple sensors help determine extent of drift



Solution Approaches

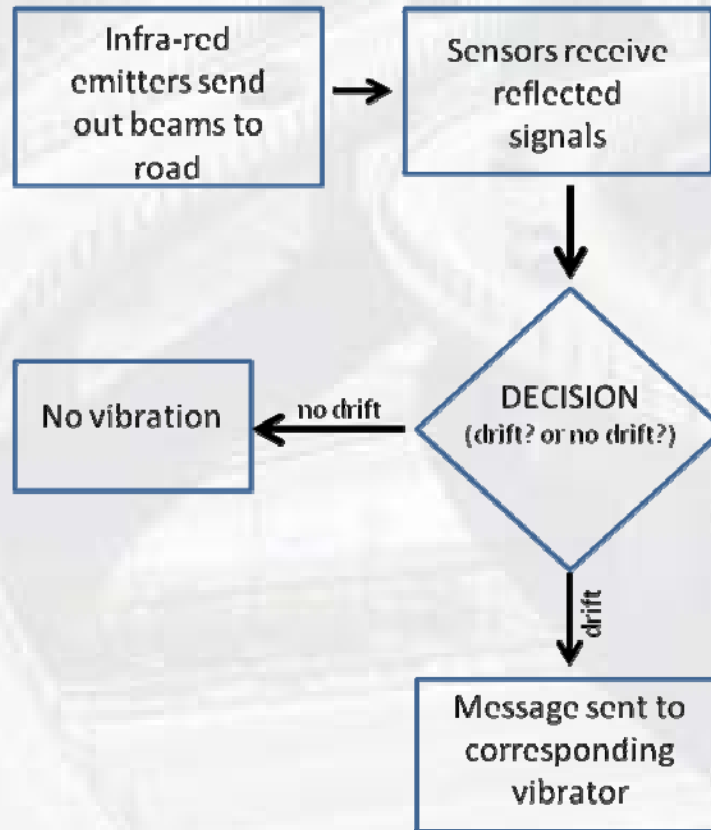
Output Component: Seat Vibrator

- Two sets of vibrators built into driver's seat (one set on each side—left and right)
- Processing unit sends signal to vibrators in the case of lane drift
- Only the vibrators on the side of drift will go off
- Intensity of vibration (number of vibrators set off in each set) dependent on level of drift



Solution Approaches

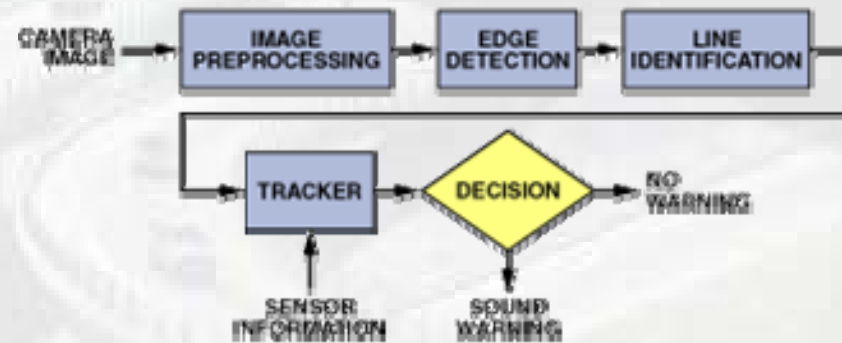
System Schematic



Solution Alternatives

Input Component: Camera Technology

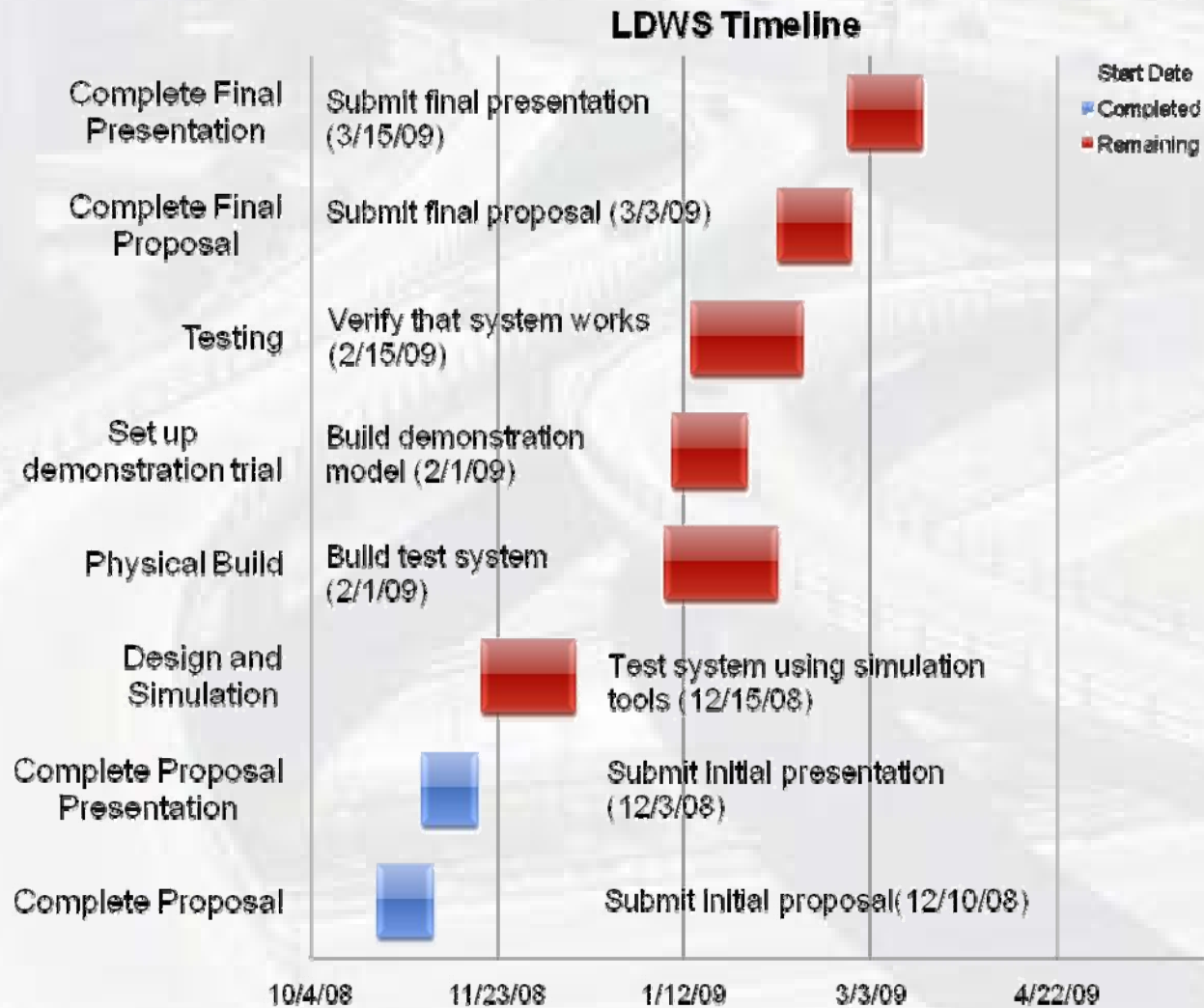
- Image processing
- Edge detection
- Line identification
- Sensor information



Output Component: Audio and LED Notification

- Processing unit triggers audio response or LED (visual) in the event of a lane drift

Project Management



Verification Plan and Deliverables

- Lane Departure Warning System
 - Input: Infrared sensors
 - Control Unit: Microprocessor
 - Output: Vibrational, audio, and visual systems
- Simulation Trials
 - Comprehensive testing
- Demonstration Environment
 - Miniature remote controlled car
 - Driving surface with lane markings
 - Driver's seat model to mimic driver's experience



Costs and Resources

Item	Description	Cost	Number	Total Cost
Sharp IR Range Finder	Infrared Sensor	\$20.00	8	\$160.00
RC Car	Miniature car	\$50.00	1	\$50.00
Paint	White and yellow paint	\$3.00	2	\$6.00
Roll of black paper	Black paper	\$5.00	3	\$15.00
Control board	FPGA Board	\$150.00	1	\$150.00
Seat vibrator	Alert indicator	\$50.00	2	\$100.00
Miscellaneous	Additional costs	\$50.00	1	\$50.00
				\$531.00

Conclusion

- Run-Off-Road (ROR) accidents are a leading cause of accidents and fatalities on US highways
- LDWS that provides a quick and effective alert to the driver if he/she drifts across lanes
- Proposed solutions:
 - Input: Infrared Sensor System
 - Output: Vibrational System
 - Added Value: Functional in poor visibility environments; Increased response time to vibrational stimulus

Questions

