**Cruise Control HUD: Team 1**

*Place picture of project with team members here.*

*Complete the caption, below.*

*Delete this text box before pasting in your photo!*

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| *Team Members (left-to-right on picture, above)* | *Class No.* | *Lab Div* |
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| *Report/Functionality Grading Criteria* | *Points* |
| Originality, creativity, level of project difficulty | 20 |
| Technical content, succinctness of report | 10 |
| Writing style, professionalism, references/citations | 10 |
| Project functionality demonstration | 20 |
| Overall quality/integration of finished product | 10 |
| Effective utilization of microcontroller resources | 10 |
| Significance of individual contributions\* | 20 |
| *Bonus Credit Opportunities* | *Bonus* |
| Early completion | 0.5% |
| PCB for interface logic | 2% |
| Poster (required for Design Showcase participation) | 1% |
| Demo video (required for Design Showcase participation) | 1% |
| Design Showcase participation (attendance required)\* | 1% |

##### \**scores assigned to individual team members may vary*

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| *Grading Rubric for all Criteria (Including Bonus)* | *Multiplier* |
| *Excellent* – among the very best projects/reports completed this semester | 1.0 - 1.1 |
| *Good* – all requirements were amply satisfied | 0.8 - 0.9 |
| *Average* – some areas for improvement, but all basic requirements were satisfied | 0.6 - 0.7 |
| *Below average* – some basic requirements were not satisfied | 0.4 - 0.5 |
| *Poor* – very few of the project requirements were satisfied | 0.1 - 0.3 |

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1. **Introduction**

The purpose of this project was to create an adaptive cruise control HUD (heads-up display) to be used in an automobile that would display its current speed as well as distance relative to whatever object happens to be in front it. For this project, the HC9S12C microcontroller has two main functions: to interface with said automobile’s ECU (engine control unit) to get its speedometer reading, and to communicate with a LIDAR distance sensor to determine the distance between the automobile and whatever happens to be directly in front of it.

Interfacing with a car’s ECU allows the connected computer (or, in this case, microcontroller) to access a wealth of diagnostic information. Though it certainly would have been possible to try and measure the car’s velocity through other means, interfacing with the ECU is both a simple and reliable method that doesn’t require the use of an external sensor in addition to the LIDAR already being used. As an added bonus, the board can be powered through the OBD-2 port that is used to communicate with the ECU, thereby removing the need for some sort of power adapter due to the absence of a wall outlet in automobiles. To retrieve information, such as current speed, a request must be sent and then a response received via the chip’s onboard SCI peripheral.

The LIDAR sensor measures distance, so it can be used to determine how far an object is from whatever is in front of it. In addition, these measurements can be used to approximate relative velocity if two measurements are taken in quick succession. If mounted on the front of a car, then, it could calculate the distance between the user’s automobile and the one in front of it. Assuming the car in front is maintaining a consistent speed, the microcontroller could then be used to set cruise control such that the distance between the user’s car and the one in front of it stays constant. There are three small LEDs (connected to PWM outputs) included to indicate if the user should speed up, slow down, or maintain velocity to match the car in front of them.

Patrick was in charge of designing the PCB in Eagle. He wrote the SCI drivers,

and designed the additional hardware required for the serial communication; namely, a

circuit to go between RS232 logic levels and the five-volt logic that our HC9S12C

microcontroller uses. Pat had a part in programming the final LIDAR driver, and also helped

implement the voltage regulator to protect the microcontroller from the twelve volts supplied

from the OBD-2 port. Additionally, he had a part in creating the 3-D printed case and lid for the

project.

Will wrote a large chunk of the software, including the main loop and the preliminary version of the LIDAR driver. He also designed and built the LIDAR enclosure and created the poster board for the SPARK challenge, as well as creating the YouTube video that was put online.

Tyler programmed the three PWM LEDs and helped write the final version of the LIDAR driver. He and Pat got the voltage regulator working, and he also assisted in creating the case as well as largely designing the lid and building a prototype out of paper.

1. **Interface Design**

## *Describe any external interfaces utilized (e.g., switches, LEDs, sensors). Include your Eagle or OrCAD schematic as Appendix B.*

*Length should be about* *one page.*

This project makes use of three LEDs, two four by seven segment displays, two shift registers, a LIDAR distance sensor, and a serial to OBD connection.

The three LEDs are there to indicate that the user’s automobile is either going too fast, too slow, or about the right speed based on the car in front of it. These LEDs are fairly simple to interface, in this case, they are driven by PWM in order to vary the intensity based on how much faster or slower the user needs to go to match the speed of the object in front of him/her.

The four by seven segment displays are used to show the driver’s speed and distance from the object in front of them by reflecting off of their windshield. The displays

# **Microcontroller Resource Utilization**

*Describe how the microcontroller’s peripherals (ATD, SCI, SPI, TIM, PWM) as well as its other on-chip resources (RTI, SRAM, flash memory, etc.) were utilized, including the mode(s) in which they were programmed to operate. Provide rationale for the choices made.*

*Length should be about one page.*

1. **Software Narrative**

*Describe what the software does and how it is organized/structured (i.e., event-driven, state machine, etc.). Submit your complete software listing on-line separately. Include a flowchart to document program structure in Appendix C.*

*Length should be about one page.*

1. **Packaging Design**

*Describe the packaging design for your project; include drawings/photos in Appendix D.*

*Length should be about one page.*

1. **Summary and Conclusions**

*Describe what you learned from completing the project and what you might do to improve your design if you had more time.*

*Length should be about one page.*

1. **References**

*List any references (e.g., data sheets, application notes, web sites) used in formulating your solutions.* ***Be sure to cite these references in your report.***

*NOTE: Use IEEE format.*

**Appendix A:**

**Individual Contributions**

**and**

**Activity Logs**

**Activity Log for:** <name-1> **Role:** <role on team>

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**Written Summary of Technical Contributions:** <name-1>

*Provide a concise but sufficiently detailed description of your technical contributions to the project.*

*Length should be about one page.***Activity Log for:** <name-2> **Role:** <role on team>

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**Written Summary of Technical Contributions:** <name-2>

*Provide a concise but sufficiently detailed description of your technical contributions to the project.*

*Length should be about one page.***Activity Log for:** <name-3> **Role:** <role on team>

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**Written Summary of Technical Contributions:** <name-3>

*Provide a concise but sufficiently detailed description of your technical contributions to the project.*

*Length should be about one page.***Activity Log for:** <name-4> **Role:** <role on team>

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**Written Summary of Technical Contributions:** <name-4>

*Provide a concise but sufficiently detailed description of your technical contributions to the project.*

*Length should be about one page.*

**Appendix B:**

**Interface Schematic**

**and**

**PCB Layout Design**

*Paste a copy of your Eagle or OrCAD interface schematic here and (optionally) PCB layout.*

*Be sure to clearly identify the team member(s) responsible for producing this documentation.*

**Appendix C:**

**Software Flowcharts**

*Include software flow diagrams and/or pseudo code here.*

*Be sure to clearly identify the team member(s) responsible for producing this documentation.*

*NOTE: Software source listing file must be submitted on-line and should NOT be included here.*

**Appendix D:**

**Packaging Design**

*Paste illustrations/pictures of your project packaging here.*

*Be sure to clearly identify the team member(s) responsible for producing this documentation.*