Viking Motorsports
Digital Dash
Project Proposal
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Objective

The objective of this unit is to provide the operator of the Viking Motorsports Formula SAE electric vehicle with information about the vehicles operation. The information will be gathered from the onboard vehicle control unit (VCU), deciphered by a main processing unit and displayed on a liquid crystal display (LCD) mounted in the operators view. Mission critical information, such as warnings about battery management systems (BMS), insulation-monitoring devices (IMD) and system temperatures will be displayed on the digital dash.

Motivation

The Viking Motorsports team has an internal combustion engine vehicle for Formula SAE races and their new electric car intended for the same purpose was modeled closely to it. With the addition of complex electrical systems it is the desire of the Viking Motorsports team to have this reflected in the aesthetics of the vehicle. The digital dash will integrate with the vehicles systems to display relevant information to the driver and will look good doing so.
Another motivation for the digital dash is to guide the future of electric cars created for the purpose of Formula SAE. It is the desire of the Viking Motorsports team to have the digital dash be open source so they can share it with other teams that show interest. Perhaps if enough teams adapt to a digital dash the product can evolve over time to support new features outside the scope of this proposal.

Description

The complete package will be made up of a single enclosed unit. The unit will consist of a mainboard (comprised of a microcontroller and power supply), an LCD screen, and an enclosure. The complete unit will have an input that gathers data from the CAN busses on the vehicle and an output that displays the information on a display. The digital dash system will be readable in sunlight, waterproof and robust against racecar conditions.

Components

Mainboard

The mainboard will be designed to house the microcontroller, power supply and other necessary components for their functionality. The final mainboard will be a printed circuit board.

Microcontroller

The microcontroller will be the brains of the digital dash. It will acquire messages sent across the CAN bus and decide what information is needed to be displayed on the dash. The microcontroller will connect to the CAN bus and the display. The microcontroller used will be an ATSAM3X. The ATSAM3X is a 32-bit, 84-MHz microcontroller that will operate quick enough to handle the messages being transmitted on the CAN bus. The ATSAM3X is also the microcontroller found in the Arduino Due, which is planned to be used on the electric vehicle. The microcontroller will be located on the mainboard.

CAN Transceiver

The CAN transceiver that will be used is a MCP2551. The CAN transceivers job is to merge two CAN busses together. The electric vehicle has two CAN busses, one from the vehicle control unit (VCU) and one from the battery management system (BMS). These CAN busses have different baud rates and cannot be simply connected to each other. The job of the CAN transceiver is to take the two busses and merge them onto a single bus. The device comes in either a through hole or surface mount package. The CAN transceiver will be located on the mainboard.

Power Supply

The power supply will deliver power to the display and the microcontroller. The power supply will draw power from the 12V rail that is supplying the VCU and will be stepped down through voltage regulators to 5V. There will be plenty of bypass capacitors in order to reduce voltage spikes seen across the components. The power supply will be located on the mainboard.

Voltage Regulator

The voltage regulator that will be used is an LM7805 or a variation of it. The voltage regulator has an input that ranges from a steady 6-12V and an output of 5V. The device comes in either a through hole or surface mount package. The voltage regulator will be located on the mainboard.

Display

The display will visually output the information that is passed to it from the microcontroller. It will be capable of displaying color and will be visible in direct sunlight. The display must be large enough to see from the drivers viewpoint but also small enough to fit on the dash. The display will be a 4D Systems' uLCD-35DT-AR. A polarizing shield will be placed over the screen to ensure that it can be read in sunlight.

GUI Design

The graphical user interface (GUI) will be the selling point of the digital dashboard that the customer will interact with and remember. It will be the visual output on the display and will be as simple as possible. The GUI will use a black background to minimize clutter and will have three large icons indicating BMS status, IMD status, and system temperatures. The battery voltage will be displayed in a simple manner with blocks dedicated to percentages of battery life.

Enclosure

The entire system will be a self-contained unit in the form of small black box. The enclosure will be constructed of a robust material. The screen will be visible on the front. The back of the digital dash unit will have a plug for power and the CAN bus. The unit will be able to survive the 2-minute rain test that the Viking Motorsports team must stress the car with according to the Formula SAE rules. That is, the device must adhere to IP65.

Location

The digital dash will be designed for mounting on the right hand portion of the Viking Motorsports Formula SAE electric car. The unit will be positioned in the dash for an optimal viewing angle for the driver.

Timeline

The first prototype iteration of the digital dash will be completed in early March to allow the Viking Motorsports team to familiarize themselves with the functionality and usage of the unit. Based off the feedback from the electric vehicles' driver some changes may be made and features may be implemented for a second final iteration of the digital dash, which will be complete no later than the end of May.

Glossary

BMS – Battery Management System
CAN – Controller Area Network
GUI – Graphical User Interface
IMD – Insulation Monitoring Device
IP – Ingress Protection
LCD – Liquid Crystal Display
SAE – Society of Automotive Engineers
VCU – Vehicle Control Unit

References

Digital Dash Github Repository
https://github.com/noahterickson/DigitalDash/wiki

Viking Motorsports Webpage
http://vms.groups.pdx.edu/