Vehicle User Interface

(As of May 20, 2006)

San Diego State University
Sustainable Mobility Team

Table of Contents

Table of Figures

Overview

San Diego State's Sustainable Mobility Team has designed an in vehicle graphical user interface and data acquisition system. The programming has been done in Microsoft Visual Basic 6.0 with controls from National Instruments' Measurement Studio 6. All signals are transmitted and received via a Controller Area Network (CAN) serial data bus with a 500kps bit rate. When messages from the CAN bus are received they are converted into readable values and displayed to the user. A flow chart for hexadecimal signal conversion from the CAN hardware into decimal values is shown in Figure 1 below.

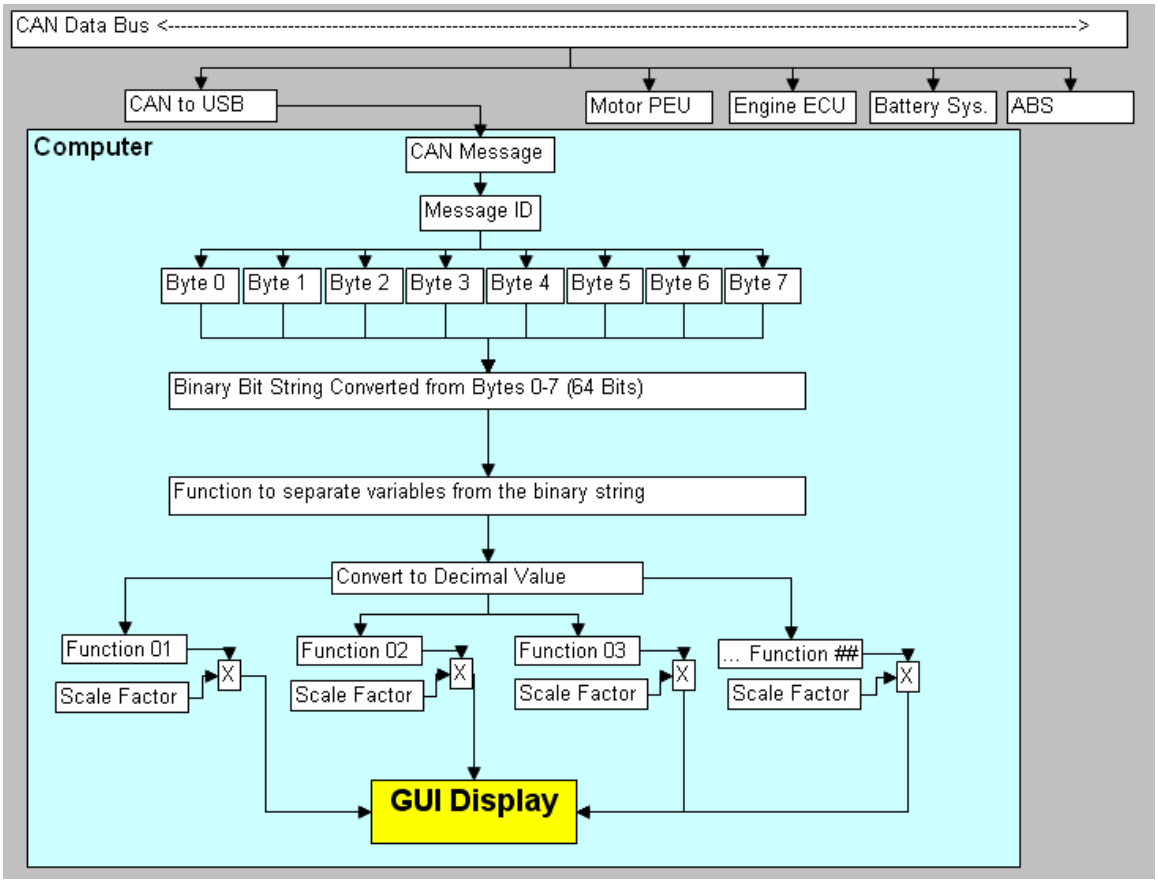

Figure 1 – CAN Message to GUI Display

A system is in place to give vehicle occupants a way to interface with vehicle system statistics. The vehicle user interface and display consists of a 12" LCD touch screen installed on a pivoting bracket and attached to the dash just above the vehicle's radio system. Display data is used to determine subsystem vitals and control strategy

functionality from a separate embedded vehicle controller. Anyone riding in the vehicle is able to select between different subsystems using a tab structure. These subsystems include the vehicle's engine, batteries, motor and motor controller. A main tab also displays vehicle subsystems in a summarized view as shown in Figure 2.

Main Vehicle Display

The "Frequinox" tab displays many different vehicles subsystem statistics in a summarized snapshot type view. A tachometer control is used to show both engine (Blue) and motor (Red) speeds in revolutions per minute. To either side of the tachometer are temperature gauges for the engine (Blue) and motor (Red). Motor, battery and engine system vitals are also displayed in different frames on this tab. These vehicle subsystems are displayed in more detail on their associated tabs.

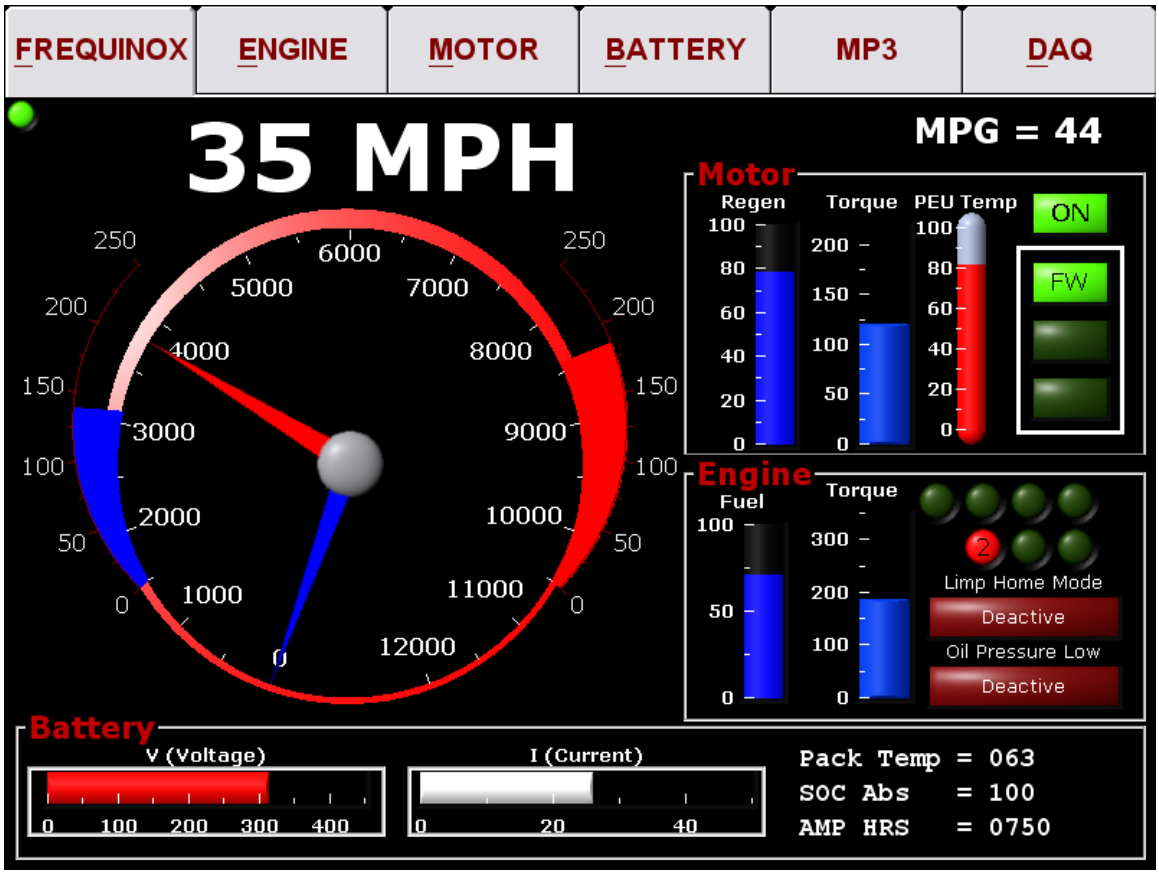

Figure 2 – All Vehicle System Display

Engine System Monitoring

Engine monitoring is done on the "Engine" tab shown in Figure 3 below. Since the converted Equinox has a six speed manual transmission for the engine the driver must determine when the best time to shift may be. To help the driver determine when to shift at an efficient time a theoretical hot efficiency plot as a function of engine torque and speed is used. These values change in real time as torque and speed values change and are displayed with crosshairs over the plot. Data is also continually being acquired to compare true to theoretical efficiency. Warning lights and indicators are also used in engine and transmission fault diagnostics as seen on the left side of Figure 3.

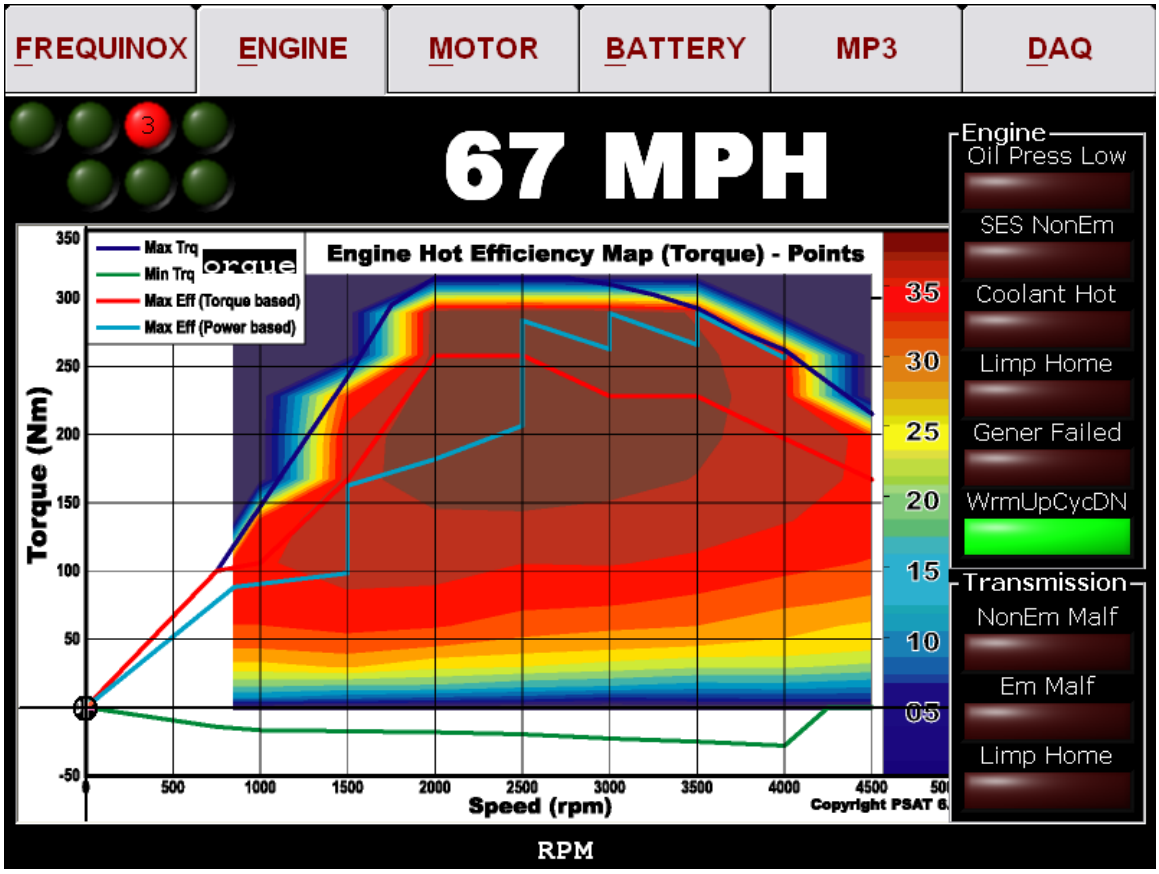

Figure 3 – Engine Tab

Motor System Monitoring

Motor display data is displayed on the "Motor" tab (Figure 4). This tab displays all the motor statistics to the driver. The Power Electronics Unit (PEU) and motor temperature is displayed to the sides of the tachometer. An efficiency map is also displayed for control verification purposes. Voltage and current to the motor from the PEU, which acts as the motor controller and power management system, is used to determine how well our system is working and what our power consumption is. Motor fault flags are also displayed as LEDs.

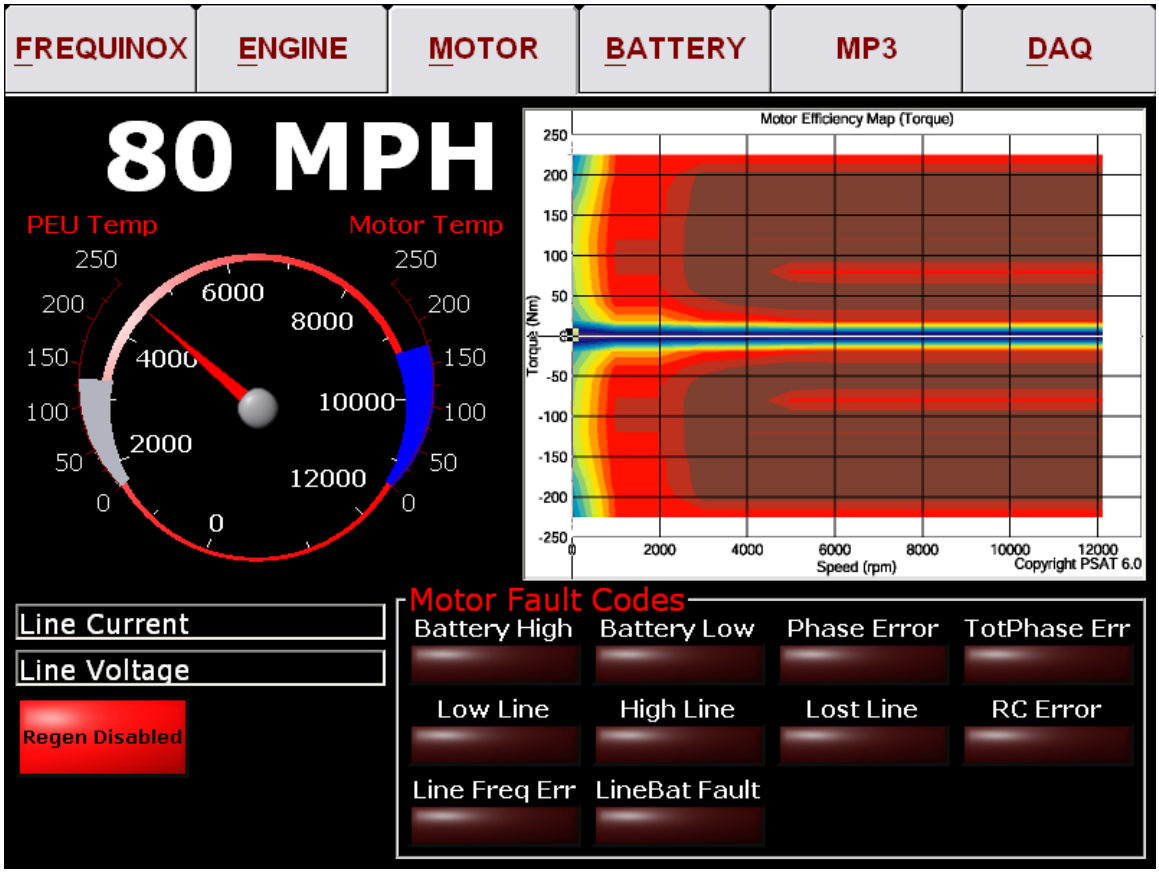

Figure 4 – Motor Tab

Power Management

A battery tab was created to charge the battery pack and display information concerning the battery system. The battery system needs to be charged through the motor controller by controls that have been added to the tab in Figure 5. While in charge mode the vehicle is turned and plugged into a standard wall socket. The individual controlling battery charging needs to keep in mind breaker currents and use the breaker limits so as not to blow a fuse. Once the breaker current has been selected the voltage is also. With these two values selected the power going into charging is determined and set limits are instituted.

When not in charge mode the "Battery" tab is used to view the battery temperatures, voltages, and power consumption. The state of charge (SOC) is calculated by the vehicle controller and displayed with a vertical progress bar on the left and numeric value. The power consumption in "AMP Hours" is also displayed. Battery temperatures are estimated per battery with multiple RTD devices. Voltage per battery is also to be displayed at a latter time.

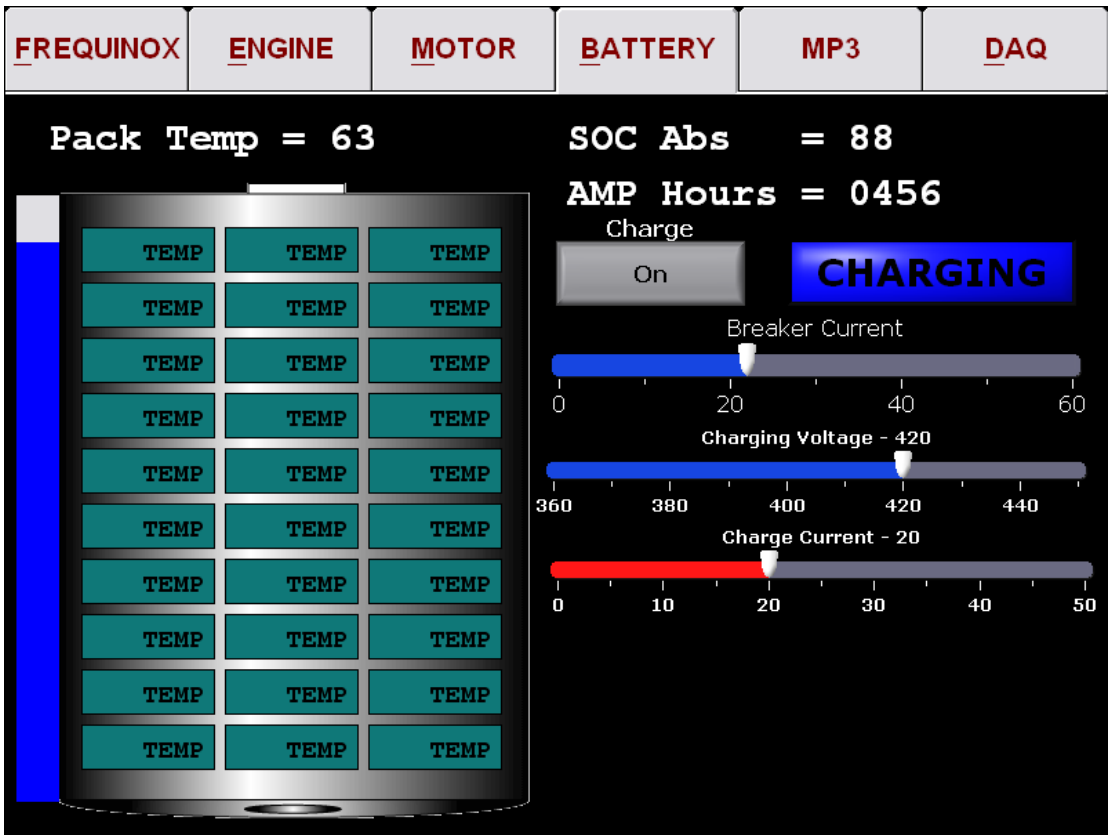

Figure 5 – Battery Tab

Vehicle Music Entertainment

For vehicle entertainment an MP3 player was also created. Music files in the upper list box may be selected via touch screen. Once selected the files are added into a play list below the selection list box in Figure 6. Artist statistics are determined from the MP3 tag and shown. The Windows Media Player component is used for visualizations, which turn off when this tab is not selected, as well as for playback.

Figure 6 – MP3 Music Tab

Data Acquisition

For competition requirements and general data logging the "DAQ" tab has been created, Figure 7. This makes it easy to select different signals from sensors around the vehicle and log them. The "Start Logging" button is to be clicked once all the functions desired are selected. This initiates the data logging.

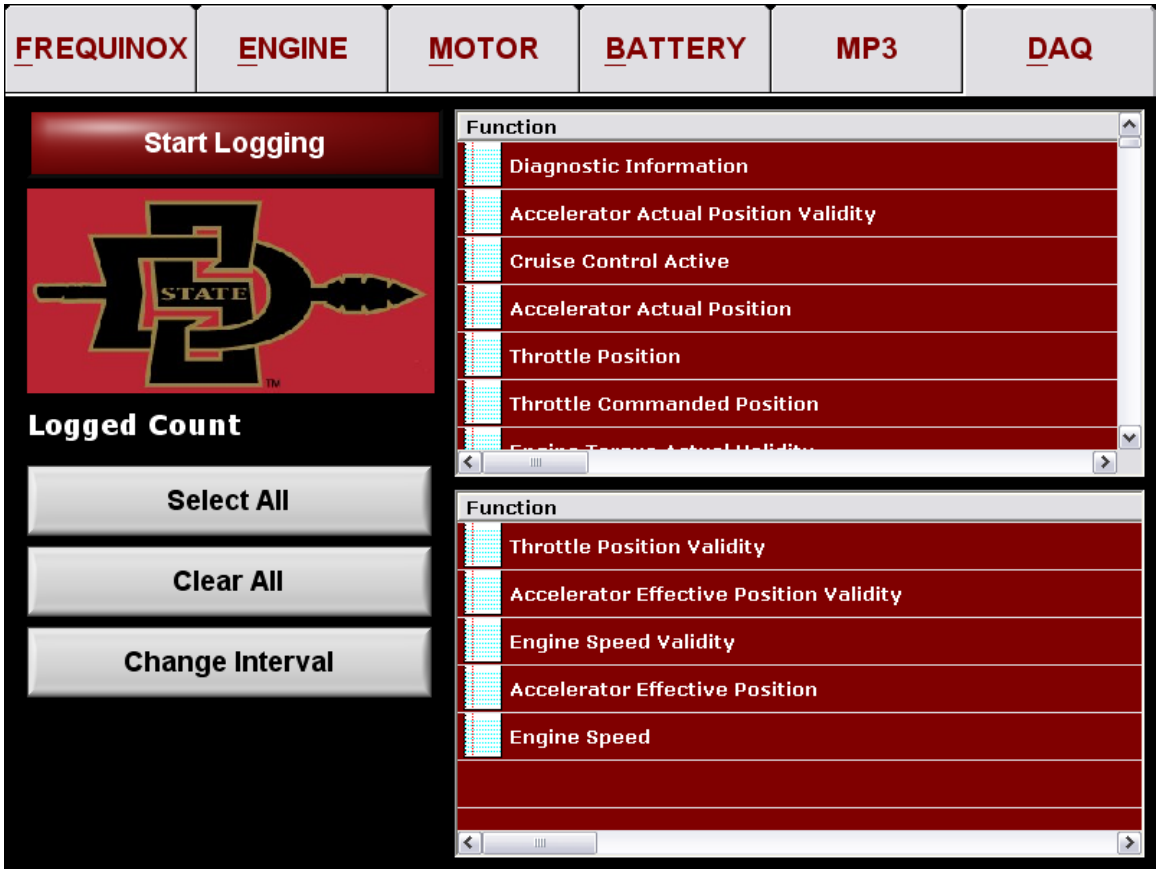

Figure 7 – Data Acquisition Tab

Additional Considerations

The vehicle user interface (VUI) has been designed to only run pertinent code when their associated tabs are selected by disabling timer controls. This means controls on other tabs will not change until the tab is again selected. Only the “MP3” and “DAQ” tabs may be running timer control code when not selected. Timer controls are disabled to increase performance and lower processing time. It should be noted processing/system power and speed has not been an issue, by any means, and this design is only implemented for practical reasons.

A VUI has been instituted for display purposes only and does not run vehicle control algorithms. Battery charging is, however, controlled when all other systems are powered down or in sleep modes and is merely an interface for communication with the true battery charging controller. This is the only control done by the computer system used for display.