Introduction

The Wireless Data Acquisition System is intended to be used with the Bradley University SAE Formula Car. This system will gather data from the SAE car and display important information to the driver through a LCD screen mounted in the car. Data will also be wirelessly transmitted to an off-track laptop where the data can be displayed and recorded. Transmitted data will include information such as car velocity, engine speed, acceleration, engine coolant and air temperatures, oil level, and suspension travel. The in-car display used will be an Amulet Technologies LCD touch screen. A pair of Aerocomm transceivers will be used for wireless transmission.

System Block Diagram

An overall high level system block diagram is shown in Figure 1.1. The diagram shows the microprocessor or programmable logic device link necessary between the ECU and sensors and the RF transmitter and LCD.

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![Figure 1.1 High Level System Block Diagram](image-url)
Interfaces

The formula car ECU and/or sensors will be sampled using a microcontroller. Sampled data will be conditioned in software and prepared for transmission over RS232 serial connections to both the Amulet LCD and Aerocomm transmitting transceiver. The previously stored data is transmitted and the most recent data is temporarily stored in memory.

The final stage of the system involves the RF receiver and the remote laptop PC. Data transmitted over the RF link is sent to the laptop through another RS232 serial connection. Matlab and Simulink will be used to record and display the transmitted data.

Wireless Communication

The conditioned data will be sent and received by the respective Aerocomm transceivers. A laptop PC connected to the receiving transceiver will collect data through a RS232 serial connection. Figure 2.1 shows the relationship between the communicating transceivers.

![Figure 2.1 AC4790-200 Transceiver Communications](image)

Data received from wireless transmission will be saved and displayed on the remote laptop PC through the use of Matlab and Simulink software. This will create real time diagnostic ability as well as the ability using the graphical displays in addition to viewing the data log recording at a later time.
Software Structure

Three main routines will be the core of operation. One routine can be used to sample sensor data at the appropriate times. The other two will be set up to send data to the LCD display and also the Aerocomm transmitter. The two transmission routines will vary slightly due to the characteristics of the different receiving components. Figure 3.1 shows high level software flowcharts for this project.

Figure 3.1 High Level Software Flowcharts
Functional Requirements and Performance Specifications

Hardware

- Protection circuitry shall be used to ensure that sampled sensor signals are within the range of -0.3V to 5.0V for the microcontroller’s analog-to-digital converter.

- Voltage level conversions of TTL to RS232 and RS232 to TTL shall be accomplished through the use of MC1488 and MC1489 integrated circuits respectively. This conversion is necessary for the operation of the Aerocomm transceivers.

- The system shall be robust enough to operate successfully amongst the EMI created by the electrical and mechanical components of the formula car, without interfering with those same components.

Software

- Critical data shall be sampled every 10 milliseconds. Critical data includes car velocity, engine speed, acceleration, and suspension travel.

- Less critical data shall be sampled every 500 milliseconds. Less critical data includes engine coolant and air temperatures as well as oil pressure.

- Software execution shall happen in the following order:
  1) transmission of previously stored data to transmitter
  2) sampling of the necessary sensors
  3) storing sampled data in memory

- Total software execution time shall take fewer than 10 milliseconds. This will ensure that data can be transmitted, sampled, and stored without interfering with the 10 millisecond sampling time requirement for critical data.

Project History and Preliminary Work

In the past, senior projects involved with the Bradley SAE Formula car made significant progress, but were never fully implemented. In 2006 Dave Pavlik created a microcontroller driven LCD touch screen display to be mounted inside the formula car as an instrument panel. The display gathered information from the sensors on the car and displayed it on the screen. This project was successfully tested at the end of the year on a lab test bench, but was never integrated into the formula car. In 2007 JP Haberkorn and Jon Trainer attempted to create a wireless data acquisition system. At the end of the year, they were able to setup the Aerocomm transceivers and communicate wirelessly, but they did not have time to implement the proper software in order to use the system with the formula car.

The goal of this 2008 senior project is to fully integrate the two previous projects into one system that will be installed on the Bradley SAE Formula car. The first stage of the project consists mainly of research for the hardware components being used and becoming familiar with the previous two projects. Fully understanding the operation of the previous projects will aide in developing the primary system from the previously mentioned subsystems.
Preliminary Tasks
Research possible SiLabs microcontroller board
Review 2006 Microcontroller Driven LCD project by Dave Pavlik
Review 2007 Wireless Data Acquisition project by JP Haberkorn and Jon Trainer
Matlab and Simulink tutorials and research for data acquisition and display possibilities

Schedule
Break
24-Jan
31-Jan
7-Feb
14-Feb
21-Feb
28-Feb
7-Mar
14-Mar
21-Mar
28-Mar
4-Apr
11-Apr
18-Apr
25-Apr
2-May

Equipment
Aerocom AC4790-200 Transcievers (2)
Si Labs microcontroller (?)
Touch Screen LCD
Amulet Technologies Touchscreen Starter Kit IC board STK-AOB3202405
MC1488 – TTL to RS232 conversion IC
MC1489 – RS232 to TTL conversion IC

Sources
Aerocom – “AC4790 900 MHz OEM Transceivers User’s Manual”

Amulet Technologies
http://www.amulettechnologies.com