Software Requirements Specification for Vehicle Hybrid Monitor

Version 3

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Version History

Version	Data	Comments	Author
1.0	21/06/2018	Initial Draft	Yashasvi Karnena

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1. Introduction

This section gives a scope description and overview of everything included in this SRS document. Also, the purpose for this document is described and a list of abbreviations and definitions is provided.

1.1. Purpose

The Purpose of this document is to provide a detailed description of requirements for "Vehicle Hybrid Monitor" Firmware. It will illustrate the purpose and complete declaration for the development of the system. It will also explain the system constraints, interfaces and interactions with various other components on thee vehicle. This document is primarily intended for an Embedded Software developer as a reference for development of the device. This document is prepared according to Std. IEEE 830 - 1998 – IEEE Recommended practices for software requirements specifications.

1.2. Scope

The "Vehicle Hybrid Monitor" is a device used by all APL Hybrid Vehicles for recording data and fault information from vehicle and transmitting the data to APL's Server for further analysis of vehicle parameters and use them for fault analysis and development. Also, the device should be capable of connecting with the vehicle user's mobile phone.

The Hybrid components of the vehicle provide information about their states and their parameters via CAN-Bus and the Vehicle's Power Train components information is obtained from OBD by the vehicle hybrid monitor. The system broadcasts this information via internet to the server for data logging and processing.

Furthermore, the firmware should also acquire GPS data and broadcast the information correlated with the acquired data from OBD and CAN Bus and transmit to the server via GSM Module.

1.3. Definitions and Abbreviations

Term	Description
VHM	Vehicle Hybrid Monitor
CAN	Controller Area Network
GPS	Global Positioning System
GSM	Global System for Mobile Communications
OBD	Onboard Diagnostics
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
INT	Interrupt
PCM	Powertrain Control Module
BMS	Battery Management System

1.4. References

1.5. Overview

The remainder of this document contains two chapters apart from appendices. The next chapter shall provide an over all idea of the whole system and its tasks and an insight of interaction between various systems. The third chapter provides various requirements of the whole system.

2. Overall Description

This section will give an overview of the whole system. The system will be explained in its context to show how the system interacts with other systems and introduce the basic functionality of it. It will also describe what type of stakeholders that will use the system and what functionality is available for each type. At last, the constraints and assumptions for the system will be presented.

2.1. Product Perspective

The system consists of three main parts, The hardware, mobile application and the web application. The hardware is the key interface for mobile and web applications. The mobile application interfaces with the hardware and displays the data real time. Web application receives information from VHM and stores it for processing and display.

The Hardware communicates with the PCM of the vehicle and the Hybrid systems such as BMS and Inverter/Charger via communication interfaces such as OBD and CAN to acquire all the parameters of the vehicle such as Engine Speed, Charge levels, Temperatures etc. It has its own internal memory to store the data for a period. It uses interfaces such as USB and GPRS for transmitting data to their respective applications.

The Mobile application receives the real time data via OTG and displays all that data in graphical format for the driver's usage. The web application uses a web-server that listens to the requests from the VHM and stores all that data in text file for further processing. The web application parses all the data in text files for display in graphical format.

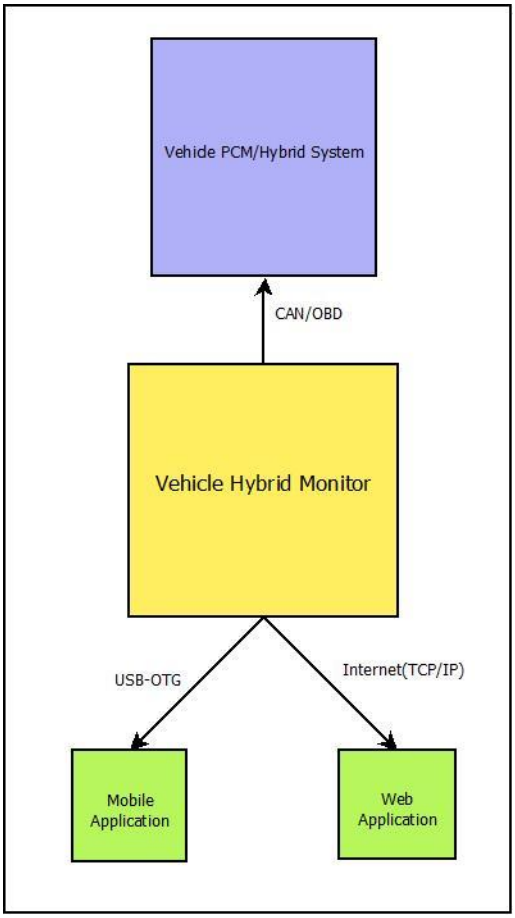

Figure 1. Block diagram of the system and the interfaces

2.2. Product Functions

The main features of VHM are as follows:

2.2.1. Data Acquisition

The Inverter/Charger and BMS broadcast parameters such as Battery SoC, Currents, Faults etc. on CAN bus of the vehicle. This data is stored in the Flash memory onboard VHM.

2.2.2. Diagnostic Indication

The VHM shall provide diagnostic visual and audio indications of the vehicle state and the hybrid system of any existing faults that need to be taken care of.

2.2.3. Telemetry

All acquired parameters by VHM should be broadcasted to a centrally located server for analysis at APL. Also, the data must be transmitted to mobile devices via USB-OTG protocol for display on APL applications.

2.3. User Characteristics

2.4. Constraints

2.4.1. Hardware Limitations

2.4.2. Software Limitations

2.5. Regulatory Policies

- The System should not contain any Operating System(OS) as a part of the executing Firmware.
- The firmware should comply with MISRA C:2012 guidelines

2.5.1. Higher Order Language Requirements

Firmware shall be written in C Language with usage of #pragma directives and inline assembly codes where ever necessary.

2.5.2. Criticality of the System

2.6. Assumptions and Dependencies

No assumptions and dependencies are envisaged for the system.

3. Specific Requirements

This section contains all the functional and quality requirements of the system. It gives a detailed description of the system and all its features.

3.1. External Requirements

The following components are necessary for development of the VHM firmware:

3.1.1. GPS Module

A UART based GPS module shall be used for receiving GPS data.

3.1.2. GSM Module

A UART Based GSM module shall be used for transmission of acquired data to the web-server via TCP/IP protocol

3.1.3. CAN Transceiver

A CAN Transceiver shall be used to interface the microcontroller with the CAN bus of the vehicle.

3.1.4. OBD-II Converter

A UART Based OBD-II data converter shall be used to sniff the PCM data. The OBD-II Converter shall be able to convert the following protocols:

- SAE J1850 PWM
- SAE J1850 VPWM
- ISO 9141-2
- ISO 14230 KWP2000
- ISO 15765 CAN

3.1.5. Flash Memory

A SPI based Flash Memory shall be used for storage of information acquired. The memory size must be 64MB and of NOR Flash type.

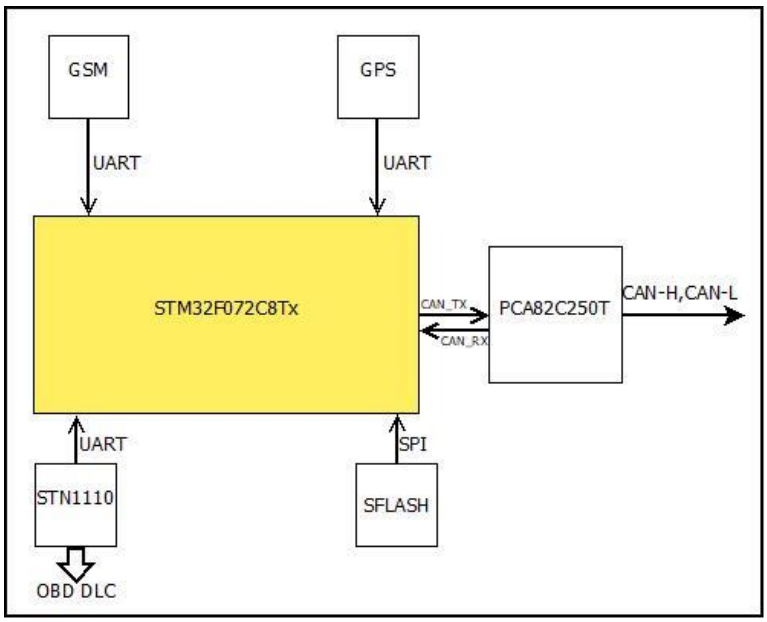

Figure 2. System Architecture of VHM

3.2. Microcontroller Requirements

The microcontroller should have the following requirements:

3.2.1. Watchdog Timer

A watchdog timer shall be used for ensuring proper execution of the firmware. The watchdog timer refreshing rate shall be set at 700mS

3.2.2. CAN Controller

A CAN Controller with CAN Message Filter and Mailbox shall be present on the microcontroller. The CAN Bus should operate at a Bus Speed of 250Kbits/Sec

3.2.3. USART

At least 3 USART/UART channels shall be present on the microcontroller with individual baud rate control shall be present on the microcontroller to interface GPS, GSM Modules and ODB Controller IC

3.2.4. SPI

At least 1 configurable SPI Channel shall be present on the microcontroller to interface the SPI NOR Flash memory.

3.2.5. GPIO

At least 14 configurable GPIOs must be present apart from all the peripherals mentioned in this section for control of various components and diagnostic indicators onboard VHM.

3.2.6. RTC

Real Time Clock with battery support shall be present on the microcontroller for generating timestamps for the stored/transmitted data.

3.2.7. USB Interface

The microcontroller shall have a USB interface with OTG support, for interfacing mobile application with the firmware.

3.2.8. JTAG Support

The microcontroller shall support JTAG probes for debugging purposes.

3.3. Calibration

3.4. Performance Requirements

- CAN Messages shall not be missed at any instant
- If the firmware hangs in a state at any instant, then the microcontroller shall be reset instantly

3.5. Portability