HSB
Hochschule Bremen
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Master 2017

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Development of Automated Test Environment for Rain-Light Sensor.

ABSTRACT - Masterthesis

The Rain Light Humidity solar sensor is used for various functionalities in the automotive industry. Valeo's Sensor offers various automated features like Rain, Light, Temperature, Humidity, solar etc.The Rain functionality works based on the intensity of the rain(i.e., raindrops falling on the sensitive area of the sensor). The sensor triggers the wiper system to control the wiper speed. The Light Functionality is based on the output of the photodiodes (Ambient Light, Infra-red, and Forward Light). It controls the vehicle Headlamps ON/OFF based on the detected light values. Based on the temperature and Humidity output of the Humidity Temperature-module, climate control is done. The bus communication between the Valeo's sensor and the vehicle is LIN (Local Interconnect Network). The sensor is a LIN slave device and is connected to the BCM which acts as a LIN Master.
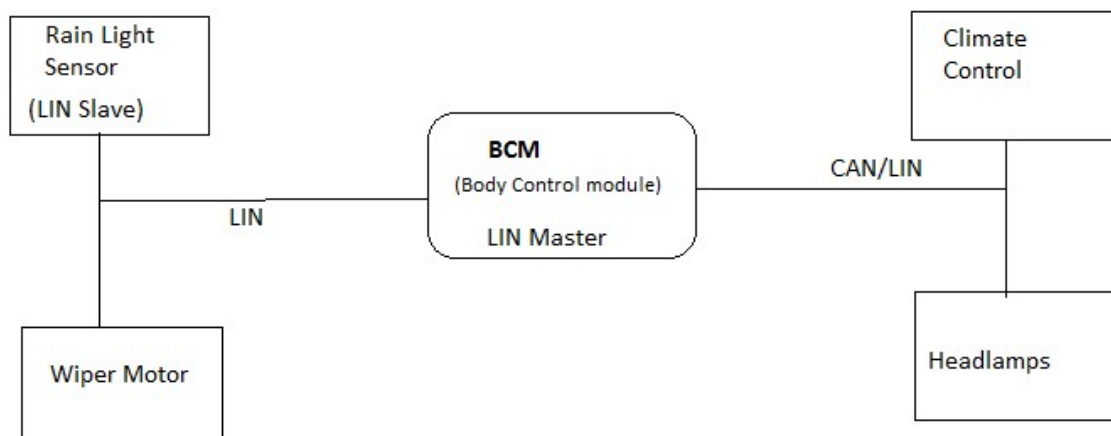
The Sensor measures the rain, light, humidity, temperature and solar and provides these values via LIN to BCM. The hardware of the sensor is built with ASIC chip, Microcontroller, LIN SBC (System Basis Chip) with watchdog and temperature & Humidity module.
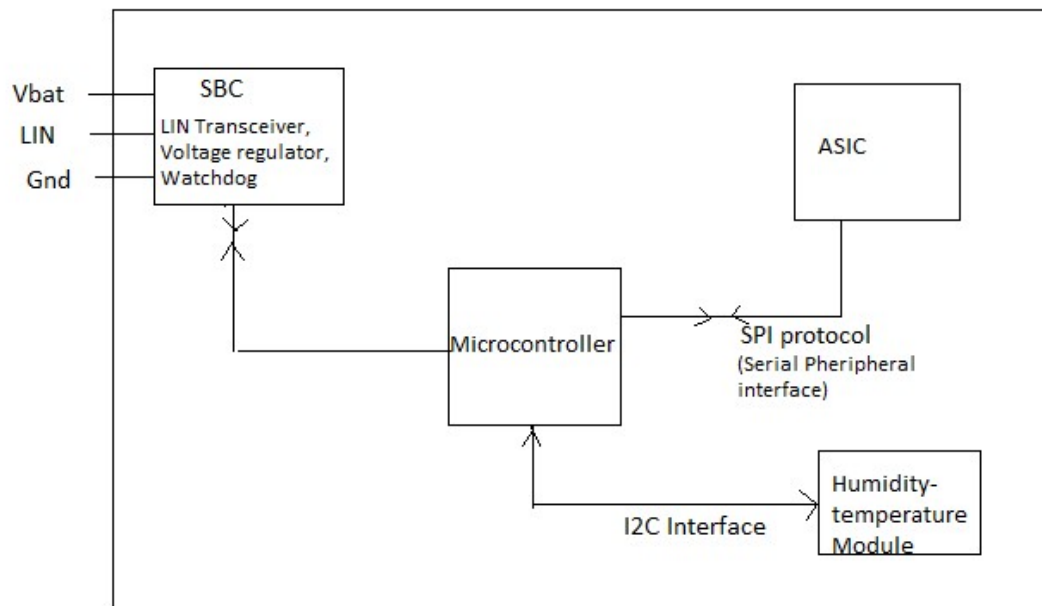
Currently, Valeo Produces sensors for various customers (Variants) like VW, Chrysler, and Fiat etc. Each customer requires specific functionalities and the sensor is adapted according to it and delivered.

The scope of the Project is to create automated Test environment which manipulates input Light, rain, Temperature, Humidity, Voltage and current values to the sensor. The manipulation of these different inputs to the sensor requires implementation of the hardware interface. Thus the sensor' behaviour for different inputs are tested and evaluated. The output of the sensor is analysed through test scripts written in vTESTstudio tool and the pass/fail behaviour for various inputs of the sensor is validated. Though the basic functionalities for all the customers remain the same, the way of adaptation of LIN database differs from one variant to another. The challenging task is to create the test environment that should be compatible with all the customers. The developed test scripts should be customer independent so that it can be used by all the variants. The future extension should not involve the changes in test scripts as it should be efficient fitted to all the variants. So the plan to solve this issue is to create separate interface files which should act as an interface between the test scripts and the LIN database (distinct for each customer). This file should be extendable and capable of making the test scripts to run according to the specific customer requirements. Any changes in the future should be done only in this and shouldn't affect or change the test scripts. The change from one customer to another shouldn't lead to new development of test cases. It should be reusable and more automated.

New hardware Setup
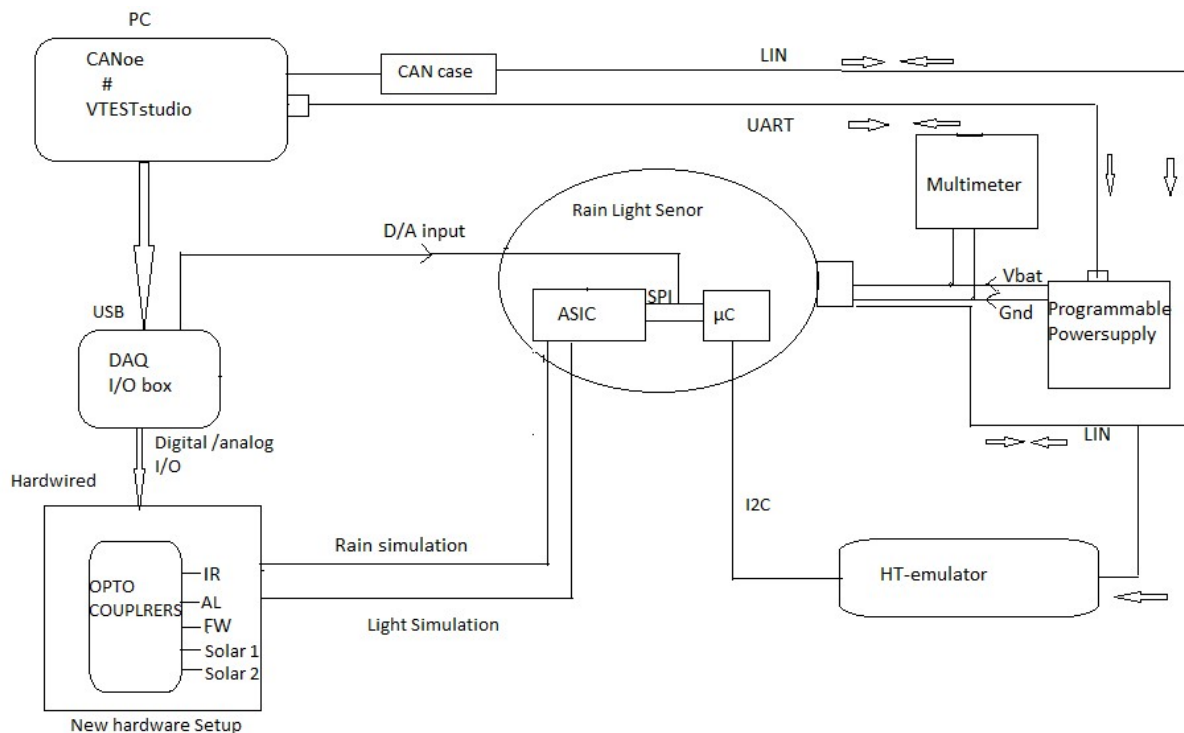
The evaluation of sensor for all functionalities is done entirely by verifying the testscripts. So the selecting tool to write the testscripts should support simulation and testing facilities in CANoe. It shouldn't depend on any specific Variant and the scripting language should be compatible to run in CANoe and it should be reusable. Thus the vTESTstudio provides various graphics and programming editors in one tool. This tool can support different programming languages, the CAPL (CAN access Programming Language) is a scripting language used here which can be easily imported into CANoe and reports can be generated.

The other challenging part is to choose DAQ device for the required application. Proper Analysis and selection of right device should be done by calculating the number of analog/digital pins needed for the Hardware. It should also support in providing inputs and outputs to the hardware interface and to the sensor also. This may require different signal types both Analog/Digital and it should be capable of reading input from CANoe and providing output. The hardware part includes the optocouplers for light simulation and the circuit with LEDs to simulate rain with the help of ASIC chip and to interrupt the SPI protocol etc.

The important scope is to design hardware architecture in such a way that it uses DAQ device to read the input from the testscripts and provide it to the optocouplers and finally feed it to the ASIC chip of the sensor. The hardware interface comprises of Optocouplers for light simulation and a circuit with LEDs for rain simulation. The implementation can be done by replacing the photodiodes with an optocoupler that is used to simulate different use cases for the light measurement. So input values to the optocouplers can be manipulated based on comparing it with the real time values and it is given through testscripts.Planning to use four optocouplers for light functionalities forward light, Solar 1, solar 2 and Ambient light. Except for IR light all other optocouplers are hardwired to the ASIC of the sensor.

For IR light, the values are read from the output of the LED's in the Sensor. The LED in the circuit combined with the Asic of the sensor is used for simulating rain. Thus different light values are manipulated for verifying light functionalities of the sensor.

HT-emulator setup which exists already can simulate different humidity and temperature values. The task is to create test scripts and inputs are given via LIN to the HT-emulator and the output of the sensor is validated.

The Behaviour of the sensor at extreme conditions should also be verified. There comes the need to perform voltage and current tests. The present electrical tests require continuous monitoring and also consume much time. So the idea is to perform the automated tests by providing input voltage and current variations. These are done by Programmable Power supply and mutimeter which is controlled by CANoe and is connected to the PC via RS 232. The task is to develop and execute various test cases based on the requirements of electrical tests given by the customer and to observe the behaviour of the sensor.

The aim of my thesis is to make a generic implementation that can be adapted to different OEM's for HIL(Hardware-in-loop) testing.