**Body Control Module I4 BMW**

**Project Requirements**

**General project information**

1. The project shall follow the AUTOSAR standard.
2. The project shall follow the C coding style rules.
3. The project shall use hardware components that satisfies the requirements needed in order to execute the defined functionality.
4. The project shall use NUCLEO-F411RE development board as a main controller for the functionality.
5. The NUCLEO-F411RE with the microcontroller STM32F411RE shall have enough processing power and memory capacity to satisfy the needs of the project.
6. The components that need to be used are HC-05 for bluetooth communication, light sensor, vibration sensor, HC-SR04 ultrasonic sensors, jumper wires, resistors, LEDs, toy RC car, buzzers.
7. The power supply of the project shall be given by external power supply such as laptop, PC, external battery devices.

**Concepts defined**

1. **Wireless control**
   1. Project shall implement wireless control of functionality through bluetooth communication.
   2. Project shall use the HC-05 bluetooth module as a gateway for bluetooth communication.
   3. Project shall use an Android mobile phone to connect to the HC-05 bluetooth modules.
   4. Project shall use any available bluetooth serial terminal application for Android mobile phones.
   5. Project shall defined series of messages that need to be sent to the bluetooth module from the Android mobile phone to the development board through serial communication.
   6. Project shall check the data validity of the data received from the bluetooth communication.
   7. Project shall implement system diagnostic for the components that are feasible to check.
   8. Project shall display diagnostic information to the mobile phone terminal application.
2. **Central locking**
   1. Project shall implement the functionality of central locking.
   2. Project shall display the functionality of central locking by turning on a buzzer at a defined period of time and frequency.
   3. Project shall display the functionality of central locking by turning on the exterior and interior lights at a defined period of time and frequency.
   4. Project shall have a check in place for when the central locking is active.
   5. Project shall control a LED to indicate that the central locking is active.
   6. Project shall turn on the LED that indicates the central locking is active at a defined period of time and frequency.
3. **Follow Me Home**
   1. Project shall implement the Follow Me Home concept.
   2. Project shall, upon central locking being set active or inactive, turn on the exterior lights, low beam and rear position lights, and the interior lights for 20 seconds.
   3. Project shall refresh the 20 seconds period each time the state of the central locking changes.
   4. Project shall turn on the respective lights at a defined brightness.
   5. Project shall interrupt the Follow Me Home sequence if the central locking is set to active and any light command is set active.
4. **Exterior Lightning**
   1. Project shall implement the exterior ligthning.
   2. Project shall implement low beam, high beam, turn signals, front fog lights, rear fog lights, reverse lights, rear position lights and brake lights.
   3. Project shall implement automatic exterior lightning which uses the light sensor and turns on and off the low beam and rear position lights at a defined level of brightness.
   4. Project shall control individually the fog lights, turn signals, reverse lights and brake lights with a defined level of brightness.
   5. Project shall turn on the turn signals at a defined level of brightness, frequency and period.
   6. Project shall implement four different states for the exterior lightning that simulate the rotary light switch, and the states shall be lights off, position lights on, night time lights on and automatic lights on.
5. **Interior Lightning**
   1. Project shall control the interior lights independently of the Follow Me Home concept.
   2. Project shall allow for the interior lights to be controlled by Follow Me Home concepts.
   3. Project shall turn on the interior lightning at a desired level of brightness.
6. **Security Alarm**
   1. Project shall implement the functionality of a security alarm.
   2. Project shall use a vibration sensor to use as an input for the security alarm.
   3. Project shall turn on a buzzer at a defined frequency and period to alert and demonstrate the security alarm.
   4. Project shall turn on the exterior lightning at a defined frequency, period and brightness to alert and demonstrate the security alarm.
   5. Project shall interrupt the alarm after a defined period of time.
   6. Project shall be able to trigger the alarm any time the input is calculated to be enough for a trigger.
   7. Project shall allow for alarm interruption upon setting the central locking inactive.
7. **Parking Distance Sensors**
   1. Project shall implement parking distance sensors.
   2. Project shall use ultrasonic HC-SR04 sensors that measure the distance between them and another object by emitting sound and calculating the distance the sound has travelled.
   3. Project shall implement the functionality of the ultrasonic sensors.
   4. Project shall calculate precisely the distance obtained as input from the ultrasonic sensors.
   5. Project shall activate the sensors upon triggering the reverse light command.
   6. Project shall turn on a buzzer at a defined period and frequency when the sensors detect an object is approaching.
8. **System Control**
   1. Project shall implement mechanisms of controlling the inputs of sensors and route them to the specific part where the inputs are needed.
   2. Project shall implement mechanisms of performing diagnostic tests and routing the obtained results to the Android mobile phone bluetooth terminal application when requested.
   3. Project shall implement system integrity checks, error checks and timing checks which assure that the system is always in safe running condition.
   4. Project shall implement mechanisms of measuring the inputs from sensors.
   5. Project shall implement mechanisms of error detection.
   6. Project shall implement communication protocols.
   7. Project shall implement mechanisms of timing.