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Learning Report – Automotive systems and overview

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|  | 19-03-21 | ShivaKumar Naga Vankadhara |  |  |  |
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**Document History**

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[In the cruise control feature I am building, I have taken a Level 1 cruise control. Here, there are 4 inputs and 1 output. The model I am taking for reference is the GMC SIERRA DENALI 2020 model. 6](#_Toc67300559)

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# INTRODUCTION:

## 1.1 HATCH OPENING FEATURE:

In automotive electronics, **body control module** or 'body computer' is a generic term for an electronic control unit responsible for monitoring and controlling various electronic accessories in a vehicle's body. Typically, in a car the BCM controls the power windows, power mirrors, air conditioning, immobilizer system, central locking, etc. The BCM communicates with other on-board computers via the car's vehicle bus, and its main application is controlling load drivers – actuating relays that in turn perform actions in the vehicle such as locking the doors or dimming the interior lighting. The distinguishing feature of a hatchback is a rear door that opens upwards and is hinged at roof level (as opposed to the boot/trunk lid of a saloon/sedan, which is hinged below the rear window). Most hatchbacks use a two-box design body style, where the cargo area (trunk/boot) and passenger areas are a single volume. The rear seats can often be folded down to increase the available cargo area. Hatchbacks may have a removable rigid parcel shelf,or flexible roll-up cover to cover the cargo space behind the rear seats.

## 1.2 RESEARCH & LITERATURE SURVEY:

* + 1. LITERATURE SURVEY:

STEP1:

Car brand chosen Mercedes BENZ

STEP2:

Interface of the feature has a button on the door and 2 buttons on the back door.

Working:

It opens or closes if the user presses the button on the driver door and can hold the position of it by pressing the pause kind of button on the back of door and can resume the operation by pressing the stop button on the door which is present down the door and works with the sensor when the user places his leg near the sensor.

* + 1. INPUTS:

1.2.2.1 USER INPUT:

* Hatch opening on/off: Press to open/close Hatch control on or off.
* Lock Key: To stop or resume the operation of the Hatch opening on the back-door bottom.
* Back door handle button: Hatch can be opened even by pressing this button.

This user input is achieved using push buttons.

Datasheet for push button: <https://cdn.dealereprocess.org/cdn/servicemanuals/gmc/2020-sierra1500.pdf>

Ex: Waytek push button switch 44102

Characteristics:

* Supply voltage: 14VDC
* Supply current: 20A
* IP65

1.2.2.2 SENSOR INPUT:

For the sensor input we will place the proximity sensor under the car backside which will be accessible for a person with his leg when he places his leg the sensor sends the information to the ECU to open the Hatch the below table give the information about the sensors which are feasible for the detection and working.

Input types: Sensor input

Characteristics:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Proximity Sensors | range | I/P range | O/P response | O/P current |
| Capacitive | 7.2mm-8.8mm(<1cm) | <=200mA | <35ms | <0.3mA |
| Optical | 50mm-100mm(1cm-10cm) | (2.3 V to 3.6 V)  Response(200ms) | <35ms | <0.3mA |
| Inductive | 30mm | <10ms&(10v-36v) | <=0.3mss | <0.3mA |

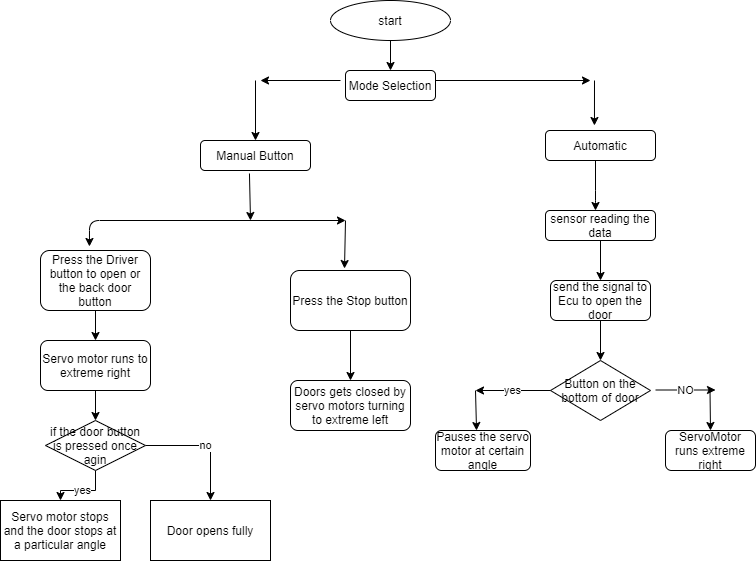
REFERRENCES:

* <https://www.onsemi.cn/pdf/datasheet/noa3302-d.pdf>
* <https://www.gavazzionline.com/pdf/CA12CLC0.pdf>
* <https://docs.rs-online.com/e8de/0900766b80274a6e.pdf>

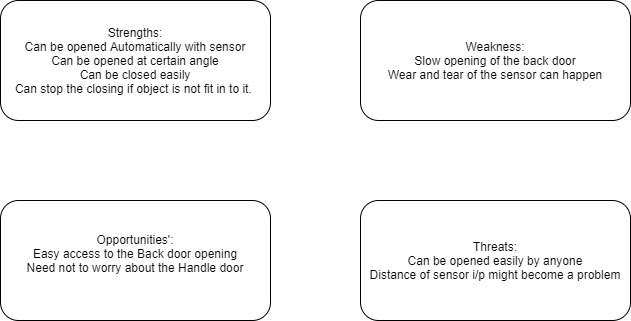
Sensor chosen is Optical proximity sensor NOA3302 because the other sensors do need metal objects to get detection and the other sensors work only for short range of distance.

A servo motor is used to open the door and works with 3 different pulse widths to 3 different ranges 0to90degrees, 90to180degrees, in between 0 to 180 with milliseconds duration.

1.2.3 ALGORITHM (Flow Chart):



1.2.5 SWOT ANALYSIS:



## 1.2.6 DETAILED REQUIREMNETS:

## 1.2.6.1 HIGH LEVEL REQUIREMENTS:

Opening of the Back door through Physical switch and through Proximity sensor.

## 1.2.6.2 LOW LEVEL REQUIREMENTS:

* Stopping of the door opening through a button located on the bottom such that the door servo motor stops at certain angle with the pulse width.
* Servomotor should go extreme right when there is no handle door button pressed. (i.e. Door will open)
* Servomotor should go extreme left when the user presses the stop button on the bottom of the door. (i.e. Door will close)
* Driver can open and close the back door from the door switch which is next to him.

1. TEST PLAN:
   1. HIGH LEVEL TEST PLAN:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test ID | Description | Input given | Output expected | Actual output |
| HLT\_HD\_1 | A Button in the driver door and the sensor input should open the hatch at the back |  |  |  |

* 1. LOW LEVEL TEST PLAN:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test ID | Description | Input given | Output expected | Actual output |
| LLT\_HD\_01 | A Button on the back-door handle is pressed |  | Hatch door should open |  |
| LLT\_HD\_02 | A Stop button on the bottom of the door should be pressed. |  | Door opening should be closed |  |
| LLT\_HD\_03 | A button on the back-door handle is pressed |  | Door operation should pause |  |
| LLT\_HD\_04 | A Button on the bottom of the door should be pressed after pressing the back-door handle button |  | Door operation should resume |  |

