**AUTOMOBILE PRUDENT SYSTEM**

**CLASS MODELING**

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**List of Domain Terms:**

Automobile, accident, safety, vehicle, two-wheeler, brake, four-wheeler, passengers, acquaintance, injury, seat-belt, helmet, maintenance, mobile safety application, speedometer, circuit, odometer, location, speed-breaker, pillion-rider, level detector, traffic-signal , driver, zebra crossing, ignition, Antilock breaking system, User, airbag system, tyre, Global Positioning System, Rear View Camera, alcohol sensor, road safety helpline, accelerator, insurance company, insurance, Ambulance, Heartbeat Sensor, Traffic Police, Service Provider, Central lock system, GSM module. Accident detector, Sensor

**Step 1: Finding Classes by extracting nouns from the list of domain terms as-well-as using a category list:**

Automobile, Vehicle, Two-wheeler, Brake, Four-wheeler, Passengers, Acquaintance, Seat-belt, Helmet, Speedometer, Mobile safety application, Circuit, Odometer, Speed breaker, Pillion rider, Level detector, Traffic signal, Driver, Ignition, Antilock breaking system, User, Airbag system, tyre, Global Positioning System, Rear View Camera, alcohol sensor, Accelerator, Insurance, Ambulance, Heartbeat sensor, Traffic Police, Service Provider, Central lock system, GSM module, Location. Accident detector, Sensor

**Step 2: Refining the above list by eliminating spurious classes:**

Automobile, Two-wheeler, Four-wheeler, Acquaintance, Helmet Sensor, Mobile safety application, Circuit, Level detector, Driver, Ignition, User, Airbag system, Alcohol Sensor, Heartbeat Sensor, Service Provider, GSM Module, Location. Accident detector, Sensor

**Step 3: Preparation of Data Dictionary:**

* **Automobile –** Consists of the technical specifications of the automobile. Has an in-built GSM module and a circuit. Driver can start the automobile and reach the destination.
* **Two-wheeler -** Consists of the technical specifications of the two-wheeler.
* **Four-wheeler -** Consists of the technical specifications of the four-wheeler.
* **Acquaintance –** Related to the driver. A user of the system.
* **Sensor -** Triggers the circuit to start/stop the ignition depending upon the situation.
* **Helmet Sensor –** Triggers the ignition of the two-wheeler. Gets activated/de-activated depending upon the state of the helmet.
* **Alcohol Sensor –** Triggers the stoppage of the vehicle in-case the driver is intoxicated. Gets activated/de-activated depending upon the state of the driver.
* **Heartbeat Sensor –** Trigger the ignition of the four-wheeler. Gets activated when the driver wears the seatbelt properly.
* **GSM Module –** Tracks the location of the vehicle. It is built-onto the automobile during the manufacturing process.
* **Ignition –** Holds the state of ignition of the vehicle. Can be triggered using the keys as-well-as the mobile safety application.
* **Level Detector –** Detects an accident. It triggers the circuit when the skid angle crosses the threshold, which in-turn informs the app to send a notification.
* **Airbag System –** Detects an accident. It triggers the circuit when the airbags get ejected, which in-turn informs the app to send a notification.
* **Accident Detector -** Detects an accident when the parameters of the vehicle cross the threshold
* **User –** Makes use of the functionalities provided by the system.
* **Circuit –** Stimulates the ignition of the vehicle depending upon the state of the sensors. Sends notification to the driver’s acquaintances depending upon the state of the level detector/ airbag system.
* **Service Provider –** A user of the system. Deals with the service of the vehicles whenever requested by the driver. Updates the status of the service and generates bill when its over.
* **Location –** Indicates the position of the vehicle.
* **Driver –** A user of the system. Has the ability to start/stop the vehicle.
* **Mobile safety application –** Integrates the entire system. Tracks the location of the vehicle. Driver/Acquaintances can send notifications to helpline workers in-case of an emergency. Driver can fix the date of service of his vehicle. Service Provider can update the service status as-well-as generate the bill when its over. Consists of a built-in payment system.

**Step 4: Finding associations-using relationships that are verbs**

* Application **Tracks** Automobile
* Application **Tracks** Two-wheeler
* Application **Tracks** four-wheeler
* Circuit **Stimulates** Ignition
* Circuit **Monitors** GSM Module
* Sensor **Triggers** Circuit
* GSM Module **Pings** Driver’s Acquaintance
* Driver **Drives** Automobile
* User **Utilizes** Application
* Driver **Utilizes** Application
* Service Provider **Utilizes** Application
* Driver’s Acquaintance **Utilizes** Application
* Service Provider **Assists** Driver
* Driver **ContactedBy** Driver’s Acquaintance
* Service Provider **Services** Automobile
* Level Detector **Signals** Circuit
* Airbag System **Signals** Circuit
* GSM Module **Locates** Location
* Level Detector **Reports** GSM Module
* Airbag System **Reports** GSM Module
* Driver’s Acquaintance **Receives** Location
* Sensor **Activates/Deactivates** Ignition
* Automobile **ConsistsOf** Ignition **(Composition)**
* Circuit **Notifies** Driver’s Acquaintance
* Level Detector **Informs** Ignition
* Airbag System **Informs** Ignition

**Step 5: Refining associations by eliminating spurious associations:**

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| **ASSOCIATION** | **DESCRIPTION** |
| Application **Tracks** Automobile | Application tracks the state of the automobile at each and every instant of time. |
| Circuit **Stimulates** Ignition | Circuit stimulates the ignition depending on the state of the sensors and detectors. |
| Sensor **Triggers** Circuit | Sensors trigger the circuit depending on whether they are activated or deactivated. |
| GSM Module **Pings** Driver’s Acquaintance | In case of an accident GSM Module pings the driver’s acquaintances. |
| User **Utilizes** Application | User makes use of the functionalities provided by the system with the help of the application. |
| Service Provider **Assists** Driver | When driver’s vehicle is in need of service, the service provider assists him. |
| Driver **ContactedBy** Driver’s Acquaintance | In case of an accident the driver’s acquaintances get notified as they are related to the driver. |
| Airbag System **Signals** Circuit | Airbag System Signals Circuit depending upon its state. |
| Level Detector **Signals** Circuit | Level Detector Signals Circuit depending upon its state. |
| Level Detector **Reports** GSM Module | Level Detector Reports GSM Module when the parameters of the vehicle cross the threshold. |
| Airbag System **Reports** GSM Module | Airbag System Reports GSM Module when the parameters of the vehicle cross the threshold. |
| Automobile **ConsistsOf** Ignition | Ignition is a part of the automobile and it can’t independently exist without it. |
| GSM Module **Locates** Location | GSM Module Locates Location at every instant of time and notifies the driver’s acquaintance in case of an accident. |

**Reasons for eliminating spurious associations:**

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| **ASSOCIATION** | **REASON** |
| Application **Tracks** Two-wheeler  Application **Tracks** four-wheeler | Removed as Two-wheeler and Four-wheeler classes can be generalized to an Automobile class. |
| Circuit **Monitors** GSM Module | Redundant as the circuit indirectly achieves this functionality by signalling the accident detector, which in turn reports to the GSM Module. |
| Driver **Drives** Automobile | Redundant as it doesn’t specify any functionality of the system. |
| Service Provider **Services** Automobile | Redundant as it doesn’t specify any functionality of the system. |
| Driver’s Acquaintance **Receives** Location | Redundant as the driver’s acquaintance indirectly receives the location of the vehicle when the GSM Module pings him/her after detecting the location. |
| Driver **Utilizes** Application  Service Provider **Utilizes** Application  Driver’s Acquaintance **Utilizes** Application | Removed as Driver, Service Provider and Driver’s Acquaintance classes can be generalized to a User class. |
| Sensor **Activates/Deactivates** Ignition | Redundant as the sensor indirectly activates/deactivates the ignition by triggering the circuit, which in turn stimulates the ignition. |
| Circuit **Notifies** Driver’s Acquaintance | Redundant as the driver’s acquaintance receives a notification  when the accident detector reports to the GSM Module in case of an accident, which in turn pings the driver’s acquaintance. |
| Level Detector **Informs** Ignition  Airbag System **Informs** Ignition | Level Detector/ Airbag System classes are generalized to an accident detector class which signals the circuit to stimulate an ignition. |

**Step 6: Identifying the attributes of the associations.**

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| **ASSOCIATION** | **ATTRIBUTES** |
| Application **Tracks** Automobile | 1 **TO** 1..\* |
| Circuit **Stimulates** Ignition | 1 **TO** 1 |
| Sensor **Triggers** Circuit | 1..\* **TO** 1 |
| GSM Module **Pings** Driver’s Acquaintance | 1 **TO** 1..\* |
| User **Utilizes** Application | 1 **TO** 1..\* |
| Service Provider **Assists** Driver | 1 **TO** 1..\* |
| Driver **ContactedBy** Driver’s Acquaintance | 1..\* **TO** 1..\* |
| Level Detector **Signals** Circuit | 1 **TO** 1 |
| Airbag System **Signals** Circuit | 1 **TO** 1 |
| Level Detector **Reports** GSM Module | 1 **TO** 1 |
| Airbag System **Reports** GSM Module | 1 **TO** 1 |
| Automobile **ConsistsOf** Ignition | 1 **TO** 1  It’s a **composition** relationship. |
| GSM Module **Locates** Location | 1 **TO** 1 |

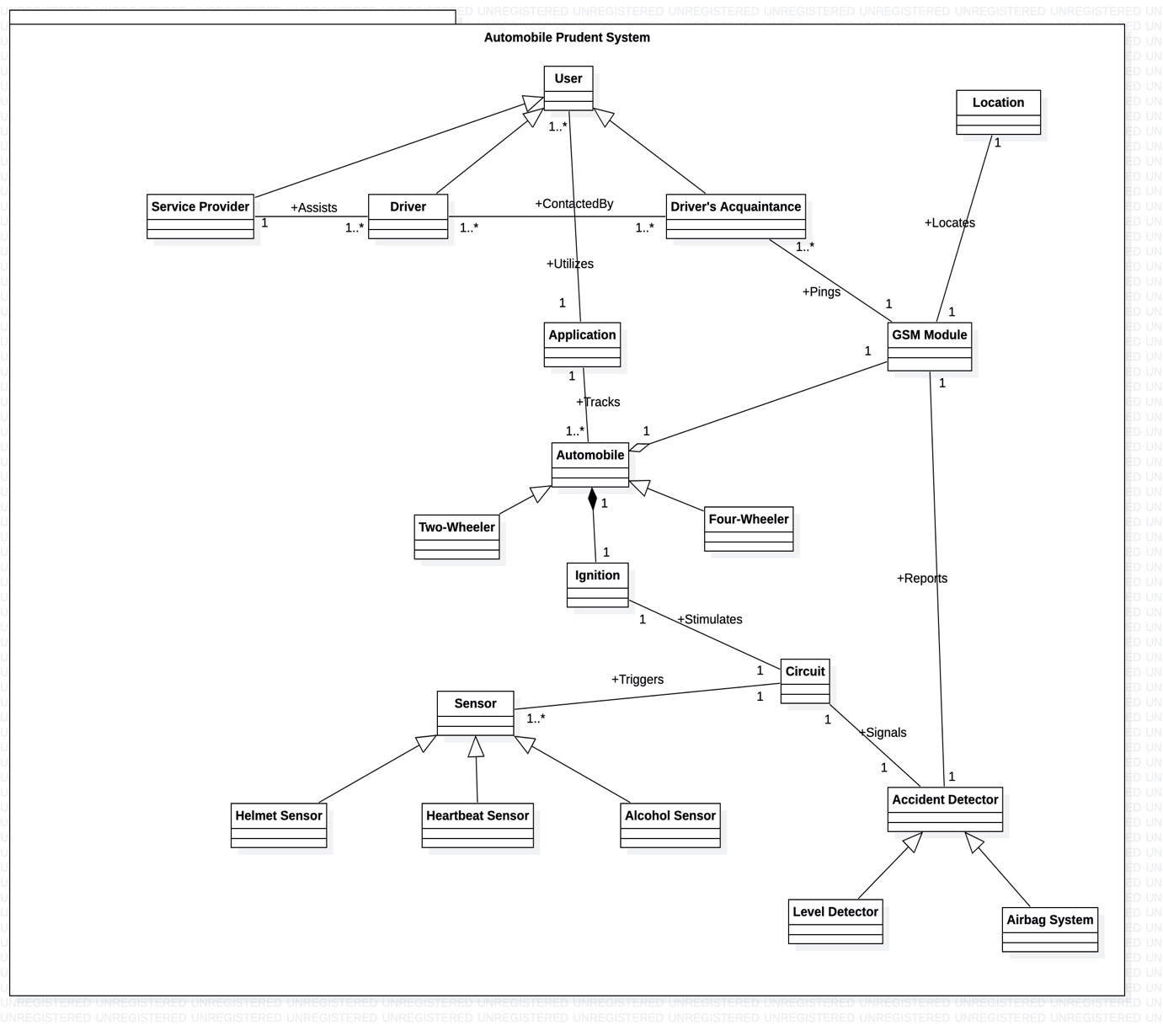
**Step 7: Identifying the attributes of the classes.**

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| **CLASSES** | **ATTRIBUTES** |
| Automobile | Manufacturing Company  Fuel tank capacity  Mileage  Fuel type  Colour  Model  Engine Number |
| Two-wheeler | Threshold Angle  Chassis Number |
| Four-wheeler | Number of Airbag modules  Number of Crash Sensors  Number of cylinders |
| Driver’s Acquaintance | Relation  Blood Group |
| Helmet Sensor | Dimensions  Arduino Microcontroller Version |
| Mobile safety application | Name  Version |
| Circuit | RF Transmitter  RF Receiver |
| Level detector | Dimension  Skid Angle |
| Driver | Driving License ID  Vehicle Registration No  Insurance ID  Blood Group |
| Ignition | State  Threshold electrical pulse |
| User | Username  Password  Name  Aadhar Number  Contact Number |
| Airbag system | Threshold Torque  Response Time |
| Alcohol Sensor | Output Voltage  Active Temperature  Optimum Power |
| Heartbeat Sensor | Pulse Rate  Scale |
| Service Provider | Automobile Company  Company Identification Number  Server Centre Location |
| GSM Module | Standard  Fixed Dialling Number  Embedded AT commands |
| Location | Latitude  Longitude |
| Accident Detector | State  Manufacturing Company  Model No. |
| Sensor | State  Model No.  Manufacturing Company  Sensitivity  Range |

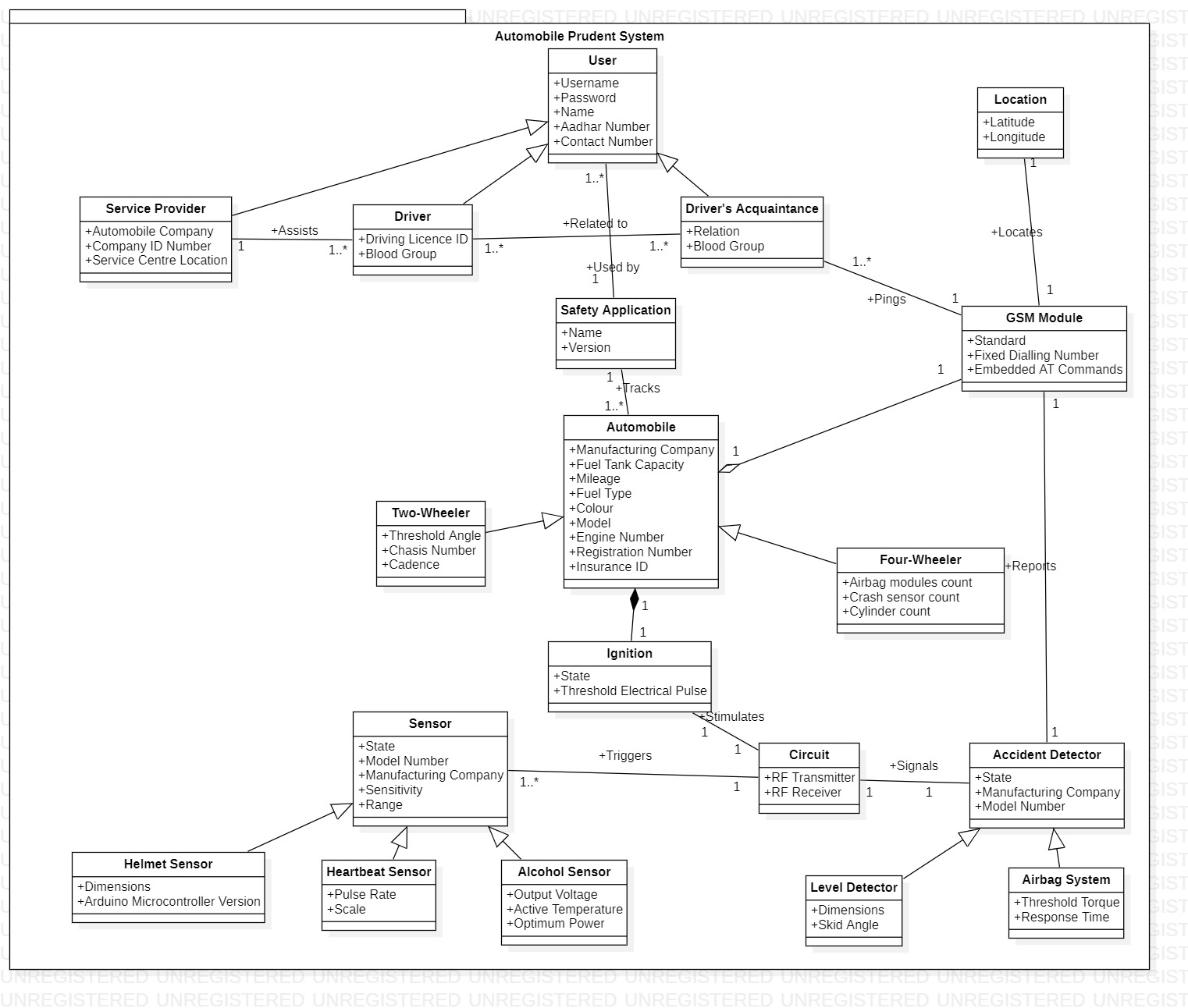
**Step 8: Organizing and Simplifying classes using inheritance.**

* **User** – Generalized Version of Driver, Service Provider and Driver’s Acquaintance
* **Sensor** - Generalized Version of Helmet Sensor, Heartbeat Sensor and Alcohol Sensor
* **Accident** **Detector** - Generalized Version of Level Detector and Airbag System.

**Step 9: Partial Class Model**

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**Step 9: Partial Class Model – Version 2**

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**CLASS RESPONSIBILITY COLLABORATION CARDS**

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| **SAFETY APPLICATION** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Login(),Update\_Details(),**  **Change\_password(), Make\_payment()** | **User, Automobile** |

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| **AUTOMOBILE** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Start(), Stop()** | **Safety Application, Ignition, GSM Module** |

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| **DRIVER** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Fix\_service\_date(), Check\_service\_status(), Send\_emergency\_notification()** | **ServiceProvider, Driver’s Acquaintance** |

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| **DRIVER’S ACQUAINTANCE** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Detect\_driver\_location(),**  **Send\_notification()** | **Driver, GSM Module** |

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| **SERVICE PROVIDER** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Update\_service\_status(), Generate\_bill()** | **Driver** |

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| **USER** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Plan\_trip()** | **Safety application** |

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| **IGNITION** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Find\_state(), Check\_condition()** | **Automobile, Circuit** |

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| **CIRCUIT** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Convert\_to\_state()** | **Sensor, Accident detector, Ignition** |

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| **SENSOR** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Trigger\_circuit(), Activate(), Deactivate()** | **Circuit** |

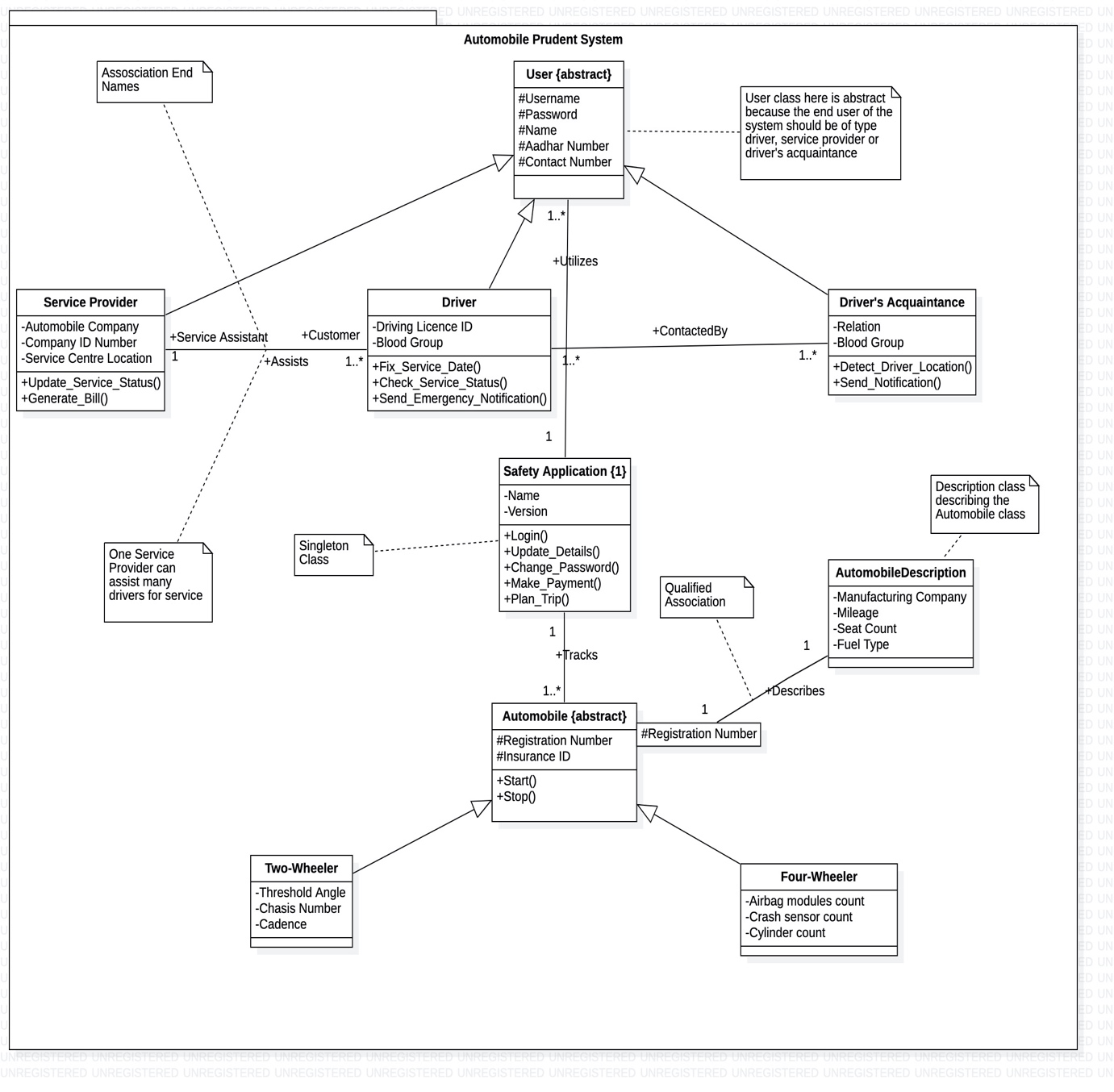
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| **LEVEL DETECTOR** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Detect\_state(), Signal\_circuit(), Report\_GSM\_Module()** | **Circuit, GSM Module** |
| **AIRBAG SYSTEM** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Detect\_state(), Signal\_circuit(), Report\_GSM\_Module()** | **Circuit, GSM Module** |

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| **GSM MODULE** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Send\_location()** | **Level detector, Airbag System, Automobile, Location,**  **Driver’s Acquaintance** |

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| **LOCATION** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Get\_Location()** | **GSM Module** |

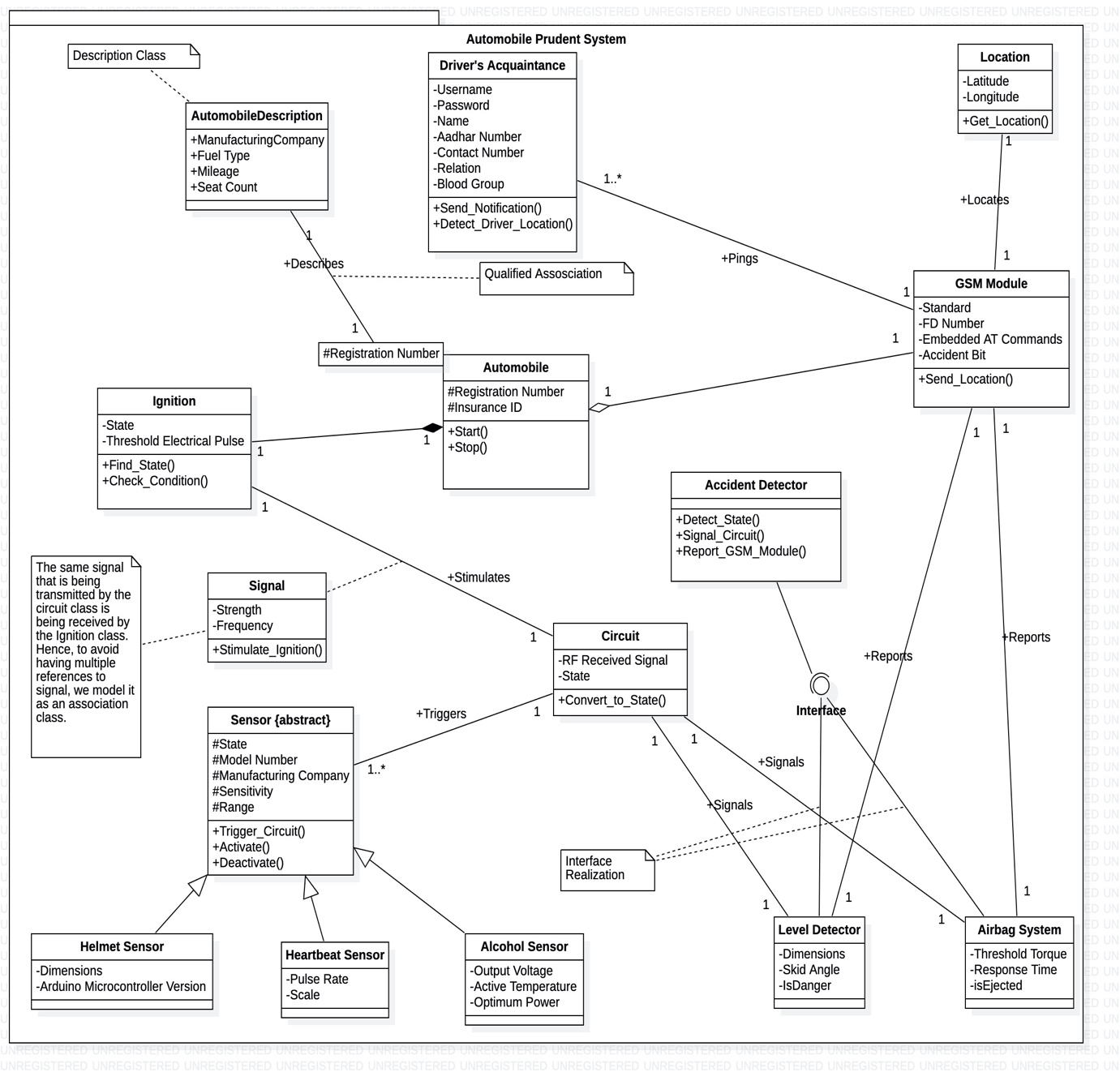
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| **SIGNAL** | |
| **RESPONSIBILITY** | **COLLABORATION** |
| **Stimulate\_ignition()** | **Ignition, Circuit** |

**CLASS DIAGRAM - 1**



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| **METHOD** | **DESCRIPTION** |
| **Plan\_Trip** | It returns the distance to the destination location from the current location when the user enters it. |
| **Update\_Service\_Status** | Service Provider updates the status of the service into the application. |
| **Generate\_bill** | Service Provider generates the final bill upon completion of the service |
| **Fix\_Service\_Date** | Driver chooses the required service date. |
| **Check\_Service\_Status** | Driver checks the current status of his automobile’s service. |
| **Send\_emergency\_notification** | Driver requests help from emergency workers in case of an accident. |
| **Detect\_driver\_location** | Used to detect the current location of the vehicle. |
| **Send\_notification** | Driver’s acquaintance requests help from emergency workers in case the driver undergoes an accident. |
| **Login** | User logs into the application using this functionality. |
| **Update\_details** | User updates his account details. |
| **Change\_password** | User updates his password upon entering his valid current password. |
| **Make\_payment** | Driver uses this functionality to pay for his service. |
| **Start** | Used by the driver to start the automobile. |
| **Stop** | Used by the driver to stop the automobile. |

**CLASS DIAGRAM - 2**

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| **METHOD** | **DESCRIPTION** |
| **Find\_state** | If Check\_condition() returns a true flag, state of the ignition is set to “active”. |
| **Check\_condition** | If the strength of the received signal crosses the threshold electrical pulse, it returns a true flag. |
| **Send\_location** | GSM Module sends the driver’s location to his acquaintances in the event of an accident. |
| **Trigger\_circuit** | If the state of the sensor is active, the circuit gets triggered. |
| **Activate** | It activates the sensor if the helmet/seatbelt is worn by the driver, or the level of intoxication is less than the threshold. |
| **Deactivate** | It de-activates the sensor if the helmet/seatbelt is not worn by the driver, or the level of intoxication crosses the threshold. |
| **Convert\_to\_state** | Converts the received RF signal into a boolean value that indicates the state of the circuit. |
| **Stimulate\_ignition** | If the state of the circuit is true, it sends an electrical pulse indicating the same to the ignition circuit. |
| **Detect\_state** | It activates the accident detector if the skid angle crosses the threshold or if the airbag system gets ejected. |
| **Signal\_circuit** | If the state of the accident detector is true, it sends a signal indicating the same to the circuit. |
| **Report\_GSM\_Module** | If the state of the accident detector is true, it reports the GSM Module to track the driver’s location and in-turn inform his acquaintance. |