Project Title

"AcciTrack: IoT based Accident Detection and Alert System"

Course name: Technical Answers for Real World Problems (TARP)

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<u>Methodology of Accident Detection and Alert System:</u>

1. System Power-On and Initialization:

   The switch is turned ON, which powers up the following things:

   - **The motor,** simulating vehicle movement like if the vehicle is moving in real time.
   - **The Arduino board,** which controls the entire system, code part for the functionality and the code for the predefined contact numbers are stored here.
   - **The GSM module,** which remains in standby mode, and it is initialised once the system is turned on.

2. Accident Simulation and Detection:

   - While the motor is revolving or rounding, the vibration sensor monitors a stronger vibration, indicating an impact of an accident.
   - A manual tap on the vibration sensor simulates a collision to perform like a real time simulation is made.
   - If the Impact crosses a predefined threshold, the Arduino registers it as an "accident event."

3. Immediate Post-Accident Actions:

   - The motor stops, simulating the vehicle coming to a halt.
   - Second, a long buzzer sound is triggered to alert nearby vehicles and pedestrians.

4. Emergency Alert via GSM module:

   - The GSM module performs **two actions.**
   - One, it immediately sends an SMS to predefined emergency contacts (E.g., family, ambulance, police) with a message like: "ALERT!!! ACCIDENT DETECTED!!!". Two, it makes an automated all to the said emergency contacts for immediate attention.

Run-down of the Scenario:

The switch first is made ON and motor starts revolving, indicating a car in motion. The Arduino and GSM are turned on and they will be in standby. An impact is made manually with a tap on the vibration sensor, indication for a real time simulation of an accident. Then, the motor stops and long buzzer is made to alert the nearest vehicles or people and at the same time, the GSM module with the help of Arduino, sends the alert message and calls to the predefined contact.

AcciTrack can be a life-saving solution for road safety for road safety. The alert of the accident notified to the said people is almost instinctive. This rapid response can significantly reduce the time taken for medical assistance, improving the chances of survival. Such a system is highly beneficial for vehicles, bikers, and remote travellers, ensuring that accidents do not go unnoticed, even in remote, isolated areas.
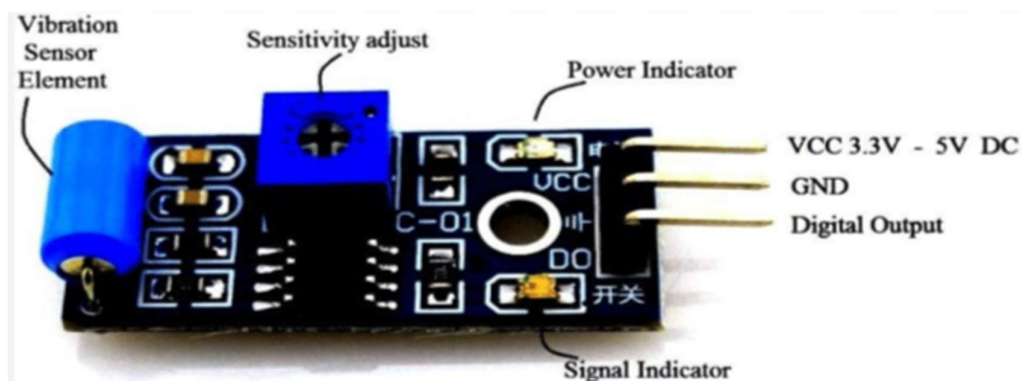
Components Used:

1) **Vibration Sensor:** Vibration sensor helps to detect the vibration caused by the impact, indicating an accident.
   ➔ Functionality: It continuously monitors for abrupt changes in movement. As soon as the vibration exceeds a predefined threshold, it triggers an accident alert. It works as an "input signal to the Arduino UNO" for accident detection
   ➔ Example: SW-420 Vibration Sensor Module.

2) **Power Switch:** The switch is used to turn the setup ON and OFF.

➔ Functionality: It powers up all components, mainly the motor, Arduino UNO and GSM module. It mainly ensures that the accident detection is active only when the vehicle (motor) is in operation.

➔ Example: Push-button, or a simple toggle switch

3) **Arduino UNO:** a microcontroller board that processes the input from the sensors and controls other components. The entire coding part of the system is stored in the board.

➔ Functionality: It receives input from the vibration sensor and determines if an accident has occurred. If an accident is detected, it stops the motor and activates the buzzer. Also, it sends a signal to the GSM module to send the SMS alerts and make emergency calls.

➔ Some advantages of Arduino UNO are that it is easy to program using the **Arduino IDE.** It supports multiple sensor connections, also, its power consumption is low and it is cost-effective.
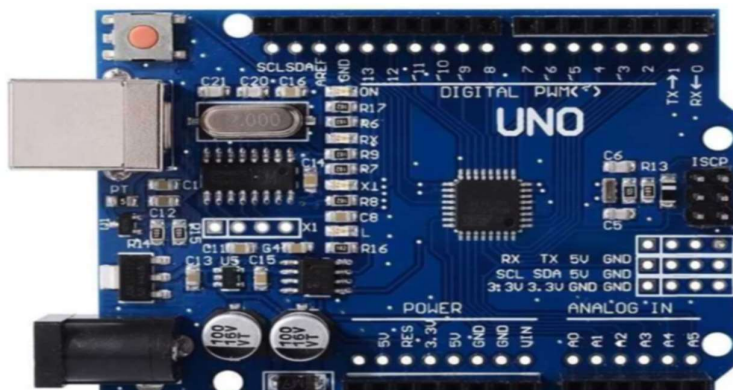
4) **Motor:** Simulates vehicle operation and helps with the impact analysis.

➔ Functionality: It runs when the system is powered ON, indicating a vehicle in motion. The running stops immediately when an accident is detected, i.e., when the vibration sensor pick up the impact.

➔ Example: DC motor or a small stepper motor.
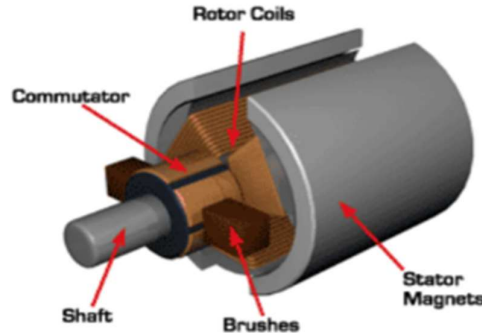
5) **GSM Module:** Sends an alert message and call to predefined contacts upon detecting an accident.

➔ Functionality: Operates via a small SIM card to communicate over a mobile network. Upon receiving a trigger from Arduino, it sends an alert text message, something like: "ALERT! ACCIDENT DETECTED!! PLEASE RESPOND AND GET HELP IMMEDIATELY!!!". Then, initiates an automated emergency call to the predefined contact, it can be to a family member, ambulance services, or police.

➔ Example: SIM800L or SIM900A GSM module. SIM800L is used in this system.
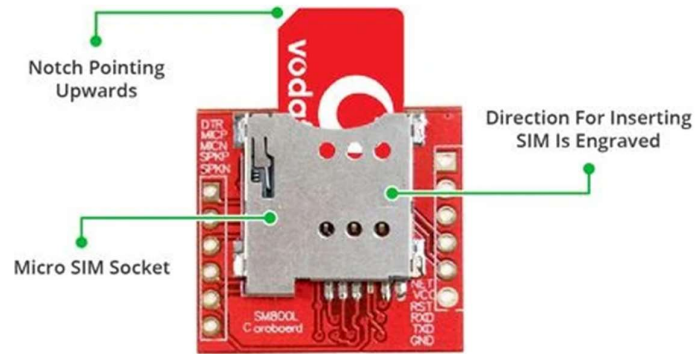
6) **Buzzer:** It emits a long buzzer sound to alert nearby people and vehicles to get help when an accident is detected.

➔ Functionality: It is controlled by the Arduino UNO. It is activated when the Arduino sends the signal of an accident. It helps in immediate local attention to the accident scene.

➔ Example: Piezoelectric buzzer module.

7) **Battery:** Provides power to all components for standalone operation.

➔ Functionality: Supplies power to the Arduino, motor, vibration sensor, and GSM module. It should have enough capacity to support continuous operations.

➔ Example: 9V or 12V rechargeable battery with a voltage regulator. These will be used in the battery slots.

8) **Connecting Wires and PCB:** Used for circuit integration, it ensures proper electrical connections between all components.

➔ Functionality: It is used with Breadboard, for prototyping the circuit before final assembly. PCB (Printed Circuit Board) are used for stable and reliable connection in the final system.
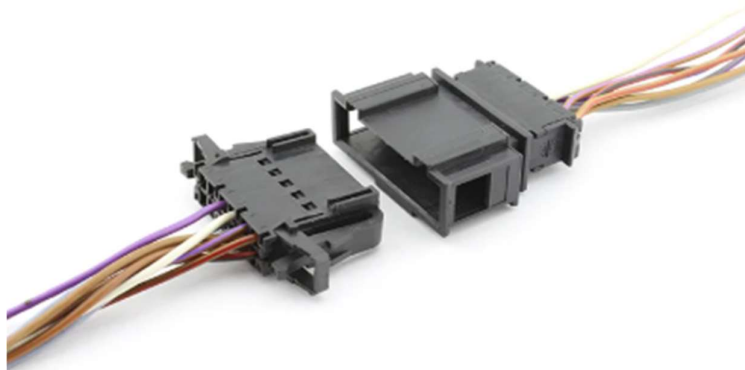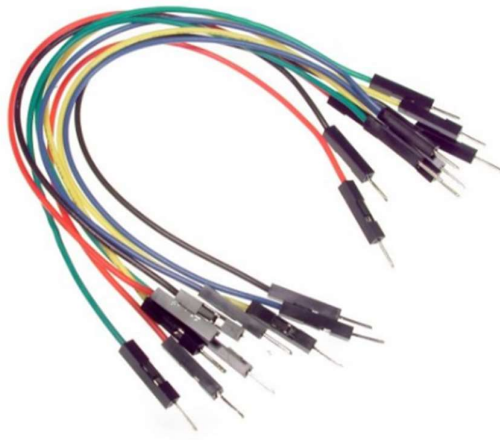
9) **3.3V Buck Convertor:** Used to decrease the voltage coming from the battery for the GSM module to work.

➜ Functionality: It converts a higher DC voltage (E.g., 5V or 12V) to a stable 3.3V output efficiently. This 3.3V output is used for the functioning of the GSM module since it supports only 3.3V. It generates less heat compared to linear regulators, making it ideal for low-power electronics.


10) **Motor Driver:** It is used to control the motor that performs the specific actions upon detecting the accident. It is the main part for the working of the motor. It acts as an interface between the Arduino and the motor.

➔ Functionality:

- When the system is turned on, the motor driver starts up the motor to run, while simultaneously being on standby from the Arduino UNO for further instructions.
- If an accident is detected, the Arduino UNO sends a signal to the motor driver, and the motor driver can stop the vehicle, i.e., stopping the running of the motor.

➔ Example: L298N Motor Driver, L293D Motor Driver, and TB6612FNG Motor Driver.
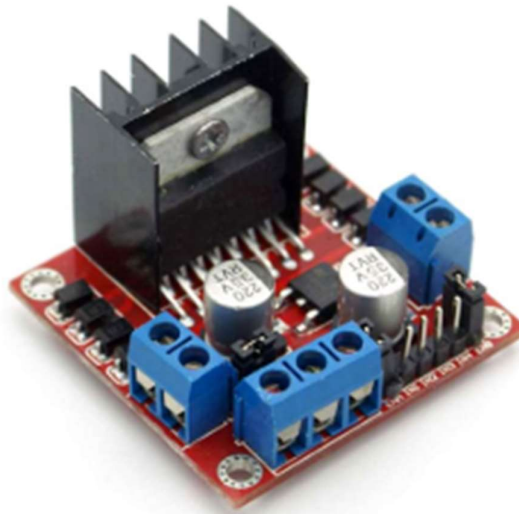
11) **Reset Switch:** Reset switch is used to reset the entire system.

➔ Functionality:

- For the reset switch to work, the whole system has to be powered by the power switch.
- The reset switch is used to reset all the operations and makes every component to their initial stages, Arduino, GSM going back to standby mode, and the Motor Driver starts the motor again to run

➔ Example: A push button or a toggle switch. Push button is used in this setup.

Communication Network for AcciTrack:

The system relies on a wired communication network between the component and a wireless communication network to send accident alerts quickly and efficiently.

The Networks used in this network would be:

i)   GSM module: It is used to send SMS alerts to the emergency predefined contacts. A SIM800L GSM module is used in our system for the said communication and alert sending methods.

ii) Buzzer Communication: A buzzer is used for short-range communication, caused by the triggering buzzer sound, notifying nearby pedestrians and vehicles that an accident has occurred.

iii) Sensor Integration: Vibration sensor integration with the system acts as an internal communication between the components. It detects sudden impact or crash.