**(8223) INTRODUCTION TO COMPUTER ENGINEERING**

**ASSIGNMENT 1**

**SHOMIT BASU**

**STUDENT ID: 3294488**

**STEP 1:**

**1. Restating the Problem:**

I am part of a transportation infrastructure team responsible for creating a logic-driven safety mechanism to manage the opening and closing of gates at a railway level crossing. My goal is to design a system that ensures safe and efficient gate operation based on specific conditions and inputs.

The original problem in the question provided to us had a minor default. It said that the system must ensure that gates are lowered when a train is approaching or a vehicle is still on the tracks and only raised when it is completely safe. So, if the vehicle remains on the tracks and the gates closes, then the car will get stuck within the gates which will result in a serious accident.

Thus, I will be designing a system where the gates are lowered when a train is approaching, gates will be lifted when the train has passed by and if any car gets damaged/immobile on the track (still on track, when the train arrives), the train signal will become red so that the trains stops, and the car can be safely removed from the track.

Additionally, my design should be based purely on straightforward, intuitive logic. I will not need to use Boolean logic, digital logic gates, or truth tables for this assignment, as those concepts will be introduced later. Instead, I’ll must create and describe the system using a plain English algorithm.

**2. Identifying and describing all the inputs and outputs of the System:**

The following are inputs and outputs of the system that I will be planning and building.

**Inputs:**

**i. Train Approaching (Yes/No or True/False)**

This Input is to check whether the train is arriving or not. The sensors will be the instrument to detect when the train is approaching. (More about the process regarding the sensors in the upcoming steps)

**ii. Train Cleared (Yes/No or True/False)**

This input is to check whether the train has cleared off or not. If cleared, that would mean that the vehicles are now safe to cross the track.

**iii. Vehicle on Track (Yes/No or True/False)**

This input is to check whether a vehicle has gotten stuck on the track or not. The camera motion detection will identify this input, and act accordingly so that the vehicle is safe (More on the camera motion detection in the upcoming steps).

**Outputs:**

**i. Gate Status (Lower/Raised)**

This output results in the lowering of gates when a train is approaching and the uplifts them when it safe for the vehicles to cross the track.

**ii. Signal for Vehicles (Red/Yellow/Green)**

This output results in conveying the appropriate message to the vehicles when to stop (while the train is approaching) and when to start moving.

**iii. Signal for Trains (Red/Yellow/Green)**

This output shows the appropriate signals to the train. When no train is approaching it remains yellow as a warning sign. It becomes green when the gates are lowered and only becomes red when a vehicle is detected to be stuck on the track.

**3. Describing the Context, Constraints and Stakeholders involved**

**Context:**

Railway level crossings are critical points where road and rail traffic intersect. Without proper safety mechanisms, they pose significant risks of collisions between trains, vehicles, and pedestrians.

Before building the system, the following contexts must be kept in mind:

* **Vehicle traffic** can include cars, trucks, motorcycles, bicycles, and possibly farm equipment.
* **Pedestrian traffic** may also be present.
* The location could be **urban, suburban, or rural**, each having different patterns of train and vehicle movement.
* The system must operate **autonomously** without constant human supervision.

**Constraints:**

Constraints limit how the system can be designed and implemented. They can be grouped into categories:-

**1. Technological Constraints:**

The system must function using basic logic without relying on advanced electronics, and it should accurately detect the presence of both trains and vehicles. A quick response time is essential to prevent accidents, and the power supply can come from grid electricity, battery backup, or solar energy, especially in remote locations.

**2. Economic Constraints:**

The system must be cost-effective to install and maintain, utilizing affordable and widely available sensors and mechanical components. It should be designed for minimal ongoing operating costs, with low power consumption and inexpensive maintenance to ensure long-term sustainability and practicality.

**3. Social Constraints:**

The system must be easy to understand and trusted by drivers, pedestrians, and train operators, while minimizing unnecessary delays for road users when no trains are present. It should also be designed with accessibility in mind, ensuring usability for individuals with disabilities such as visual or hearing impairments.

**4. Environmental Constraints:**

The system must be durable enough to withstand extreme temperatures, heavy rain, dust, and strong winds, while being environmentally friendly by minimizing noise pollution and preventing harm to local wildlife. Its components should be built for longevity to reduce waste and support sustainable operation.

**5. Legal Constraints:**

From a legal standpoint, the system must comply with Australian railway and road safety regulations, including the **Rail Safety National Law (RSNL)** and **Australian Level Crossing Assessment Model (ALCAM)** guidelines. It should meet relevant Australian Standards such as **AS 7658 – Level Crossing Safety**, and follow state or territory transport signalling rules. Integration with existing rail signalling systems is required, and the design must ensure fail-safe operation to meet liability and duty-of-care obligations under Australian law.

**Stakeholders Involved:**

These are individuals or groups who are directly or indirectly affected by the system:

1. **Primary Stakeholders**
   * **Train operators**: Rely on the system for safe passage.
   * **Drivers and pedestrians**: Depend on the gates to protect them from collisions.
   * **Railway companies**: Own and maintain the railway infrastructure.
   * **Road authorities/local councils**: Responsible for public road safety.
2. **Secondary Stakeholders**
   * **Maintenance technicians**: Service and repair the system.
   * **Emergency services**: Need reliable crossings to respond quickly.
   * **Local residents**: Impacted by noise, safety, and traffic flow.
   * **Government regulators**: Enforce compliance with safety laws.
3. **Tertiary Stakeholders**
   * **Insurance providers**: Concerned with liability and accident prevention.
   * **Environmental groups**: Ensure the design is eco-friendly.
   * **Manufacturers**: Supply parts and technology for the system.