**(8223) INTRODUCTION TO COMPUTER ENGINEERING**

**ASSIGNMENT 1**

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**STEP 7:**

**TESTING AND REFINEMENT**

A number of test cases are created based on every possible combination of the three input conditions—train approaching, train passed, and vehicle on track—in order to confirm the effectiveness and reliability of the proposed system. There are eight potential scenarios to assess with three binary inputs.

Each test case specifies the expected system response, which will then be compared to the actual output during testing. This process ensures the control logic functions correctly under all possible operating conditions and helps identify any refinements needed for maximum safety and reliability.

Here is a table of all the possible combinations of the test cases:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **INPUTS** | | | **OUTPUTS** | | |
|  | **Train Approaching** | **Train Cleared** | **Vehicle on Track** | **Gate Status** | **Signal for Vehicles** | **Signal for Trains** |
| 1. | No | No | No | Raised | Green | Yellow |
| 2. | No | No | Yes | Raised | Green | Yellow |
| 3. | No | Yes | No | Raised | Green | Yellow |
| 4. | No | Yes | Yes | Raised | Green | Yellow |
| 5. | Yes | No | No | Lowered | Red | Green |
| 6. | Yes | No | Yes | Lowered | Red | Red |
| 7. | Yes | Yes | No | Lowered | Red | Green |
| 8. | Yes | Yes | Yes | Lowered | Red | Red |

**EXPECTED OUTPUTS VS ACTUAL OUTPUTS**

For this process, we write the same test cases as the above, and add two additional columns for expected output and the actual ones.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **INPUTS** | | | **EXPECTED OUTPUTS** | | | **ACTUAL OUTPUTS** | | |
|  | **Train Approaching** | **Train Cleared** | **Vehicle on Track** | **Gate Status** | **Signal for Vehicles** | **Signal for Trains** | **Gate Status** | **Signal for Vehicles** | **Signal for Trains** |
| 1. | No | No | No | Raised | Green | Yellow | Raised | Green | Yellow |
| 2. | No | No | Yes | Raised | Green | Yellow | Lowered | Red | Yellow |
| 3. | No | Yes | No | Raised | Green | Yellow | Raised | Green | Yellow |
| 4. | No | Yes | Yes | Raised | Green | Yellow | Lowered | Red | Yellow |
| 5. | Yes | No | No | Lowered | Red | Green | Lowered | Red | Green |
| 6. | Yes | No | Yes | Lowered | Red | Red | Lowered | Red | Red |
| 7. | Yes | Yes | No | Lowered | Red | Green | Lowered | Red | Green |
| 8. | Yes | Yes | Yes | Lowered | Red | Red | Lowered | Red | Red |

The logic's dependability in practical settings was demonstrated by the fact that every test case matched the theoretical outputs. These sensible modifications, motivated by safety concerns, improve overall security without sacrificing the system's intended dependability and simplicity.

**IMPROVEMENTS AND REFINEMENTS**

Based on the testing outcomes, certain refinements can be made to improve the system’s safety and efficiency.

* A speed regulation system should be implemented for trains approaching such crossings. Maintaining a consistent, controlled speed ensures that the timing for vehicle signals turning yellow, then red, and for the gates lowering, remains accurate and in line with the design calculations.
* The motion detection cameras should be optimised to identify only vehicles or human beings, ignoring irrelevant movements such as animals, debris, or weather effects to prevent false triggers.
* Lastly, a short delay mechanism could be added before raising the gates after the train has passed, allowing for an additional safety buffer in case of late-detected hazards.