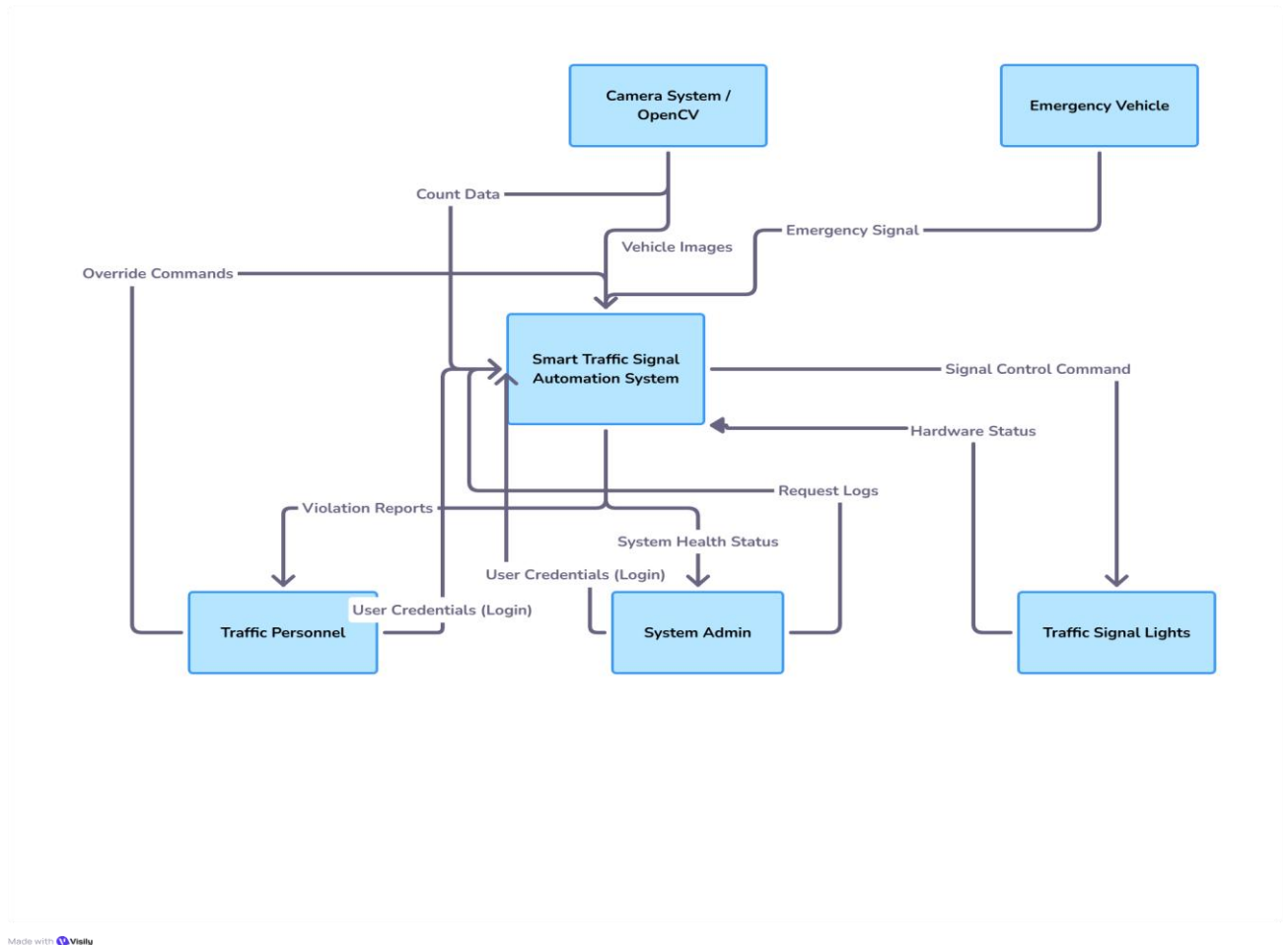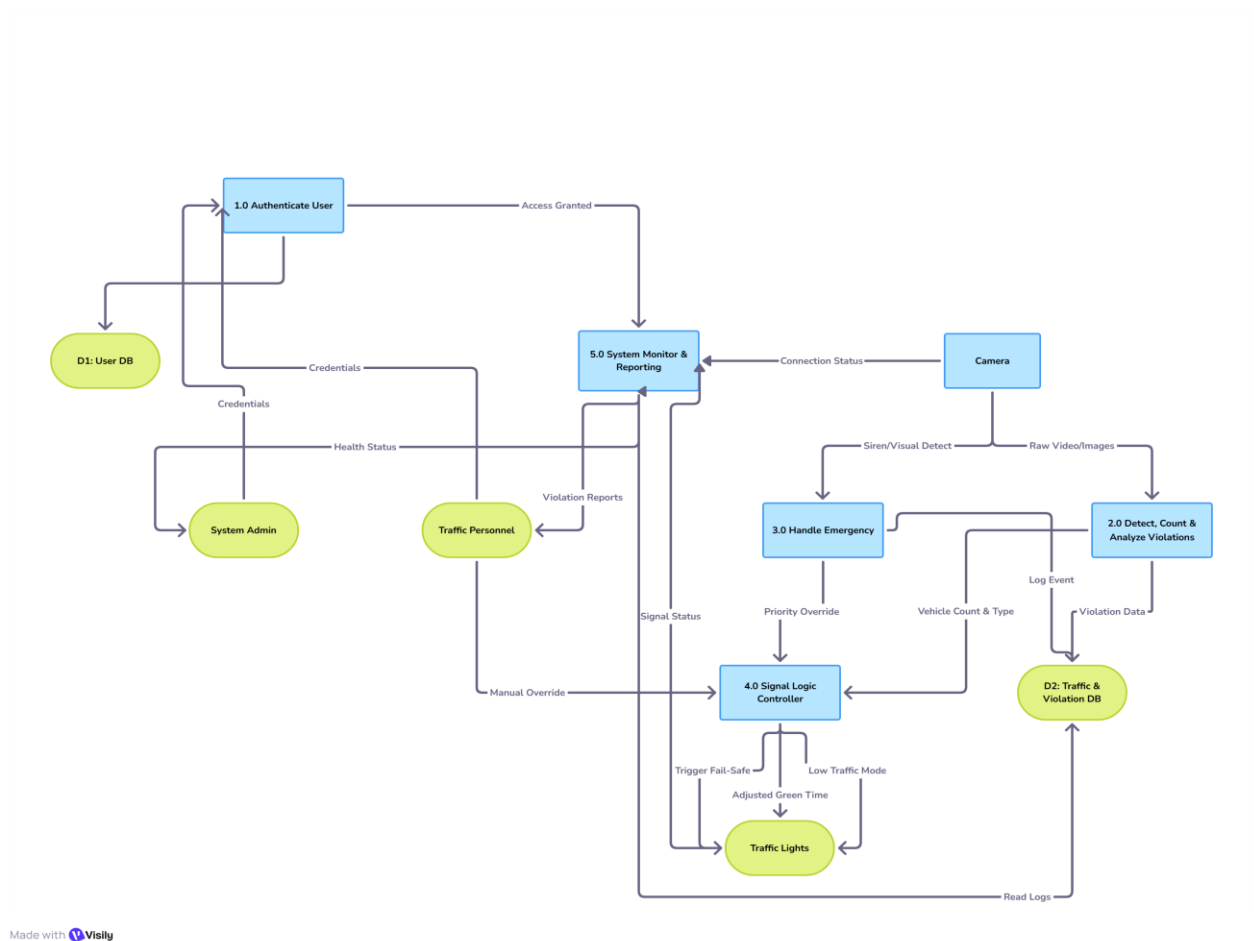**PART A:**

Level 0 DFD :

 >> **Central Process:** The **Smart Traffic Signal Automation System** acts as the central hub, processing real-time data to control traffic flow dynamically.

>> **External Entities & Interactions:**

- **Camera System / OpenCV:** This is the primary data source. It streams **Vehicle Images** and numerical **Count Data** into the system for analysis.

- **Traffic Signal Lights:** The system sends **Signal Control Commands** (Green/Red/Yellow duration) to the hardware. Crucially, the lights send back **Hardware Status**, allowing the system to detect malfunctions and trigger fail-safe modes.

- **Traffic Personnel:** These users provide **User Credentials** for login and issue **Override Commands** to manually control signals. In return, they receive **Violation Reports**.

- **System Admin:** Provides **User Credentials** to access administrative functions. They receive **System Health Status** updates and can **Request Logs** for auditing.

- **Emergency Vehicle:** The presence of these vehicles acts as a trigger. Their visual signature (siren lights/shape) is processed as an **Emergency Signal**, initiating priority protocols.

**Level 1 DFD:**

### >> Process 1.0: Authenticate User

- Before accessing the system, both Admins and Traffic Personnel must provide credentials. This process verifies them against the **D1: User DB**. Upon success, "Access Granted" tokens allow interaction with monitoring and control modules.

### >> Process 2.0: Detect, Count & Analyze Violations

- Receives **Raw Video/Images** from the camera.
- It performs two key tasks:
    1. **Counting:** Outputs **Vehicle Count & Type** to the Signal Logic Controller.
    2. **Violation Detection:** Identifies wrong-way driving or overspeeding and saves this **Violation Data** directly to the **D2: Traffic & Violation DB**.

### >> Process 3.0: Handle Emergency

- Continuously scans for emergency vehicles. If detected, it sends a **Priority Override** signal to the Logic Controller and logs the event in **D2**.

>> **Process 4.0: Signal Logic Controller**

- The core "brain" of the system. It calculates the **Adjusted Green Time** based on vehicle counts from Process 2.0.

- It accepts **Manual Override** commands from Traffic Personnel.

- It triggers **Low Traffic Mode** or **Fail-Safe Mode** if specific conditions (like low density or hardware errors) are met.

>> **Process 5.0: System Monitor & Reporting**

- This module ensures reliability (Uptime Target: 99.9%).

- It receives **Connection Status** from Cameras and **Signal Status** from Lights. If a critical component fails, it alerts the Admin via **Health Status**.

- It also retrieves historical data (**Read Logs**) from **D2** to generate reports for Admins and Personnel.

>> **Data Stores:**

- **D1: User DB:** Stores encrypted login credentials and access levels.

- **D2: Traffic & Violation DB:** A MySQL database storing vehicle logs, violation evidence, and system event history.