

# SCORPION: SMART WEIGHBRIDGE

SUMMER INTERNSHIP PROJECT (SEM V)

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# Introduction

During my internship at LCS Controls Private Limited, Chennai, I had the opportunity to contribute to an innovative project titled Scorpion: Smart Weighbridge. This project focused on developing an automation solution to streamline the weighing process for heavy vehicles, enhancing efficiency and accuracy. Throughout the internship, I gained hands-on experience with various software tools, including PyQt5 and Qt Designer, which were instrumental in designing and implementing user-friendly interfaces. This experience not only expanded my technical skill set but also deepened my understanding of real-world automation solutions in the industry.

# Problem Definition

The current system of weighing heavy vehicles presents several challenges that affect the efficiency and reliability of tracking goods during transportation. These weighments are critical for monitoring goods, preventing transit delays, and minimizing product loss. However, the conventional process, which often relies on handwritten weighment slips or minimal technology, increases the time required for weighing and poses several risks. Customers are prone to misplacing manual bills, and there is a potential security threat since the accuracy of the weighment cannot be easily verified. Vendors might manipulate the recorded weight, leading to overcharging and disputes. These issues underscore the need for an automated solution to enhance accuracy, security, and efficiency in the weighment process.

# Objective

The objective of Scorpion: Smart Weighbridge is to provide an automated solution for seamless and efficient heavy vehicle weighment. The system features a user-friendly touchscreen interface, allowing vendors to quickly record vehicle entries and re-entries, generate weighment bills, and securely store these records on the company's database. Equipped with security cameras, Scorpion ensures transparency by monitoring the weighment process, thereby reducing the risk of malpractices such as weight manipulation. The system is also paired with load sensors for high weighment accuracy. This solution aims to improve the speed, accuracy, and security of the weighment process while minimizing human error and fraud.

# Survey

Following the survey, many weighment vendors reported significant concerns regarding the current weighment processes. Key issues identified included the time-consuming nature of weighments, accuracy which often leads to delays and customer disputes. Vendors also highlighted the manipulation of weighment data, resulting in increased costs due to fraudulent activities. Security emerged as a critical concern, as the existing systems do not adequately prevent malpractices. Additionally, the risk of misplacing weighment bills further complicates the process, creating challenges in record-keeping and customer satisfaction. These insights underscore the urgent need for an automated solution like Scorpion: Smart Weighbridge to streamline operations, enhance accuracy, and mitigate risks associated with weighment practices.

# System Architecture

The Scorpion: Smart Weighbridge system consists of several integrated components designed to ensure seamless, secure, and efficient heavy vehicle weighments.

## **1. Touchscreen Interface (Raspberry pi4)**

A user-friendly interface where vendors can quickly input vehicle entries and re-entries, initiate weighment, and generate bills. This interface is connected to the central system for real-time processing and data storage.

## **2. Weighbridge Sensors:**

Sensors integrated with the weighbridge capture the weight of vehicles in real time and transmit the data for processing.

### **3. Database Management:**

A secure database stores all weighment records, including vehicle entries, re-entries, and billing information, ensuring that data is preserved for both operational and audit purposes.

### **4. Security Cameras:**

Cameras installed around the weighbridge monitor the entire process to ensure transparency and reduce the risk of fraud or manipulation. The footage is linked to the system for real-time analysis and stored for security audits. It also captures images of the truck during time of weighment.

## **5. Bill Generation & Storage:**

The system automatically generates a digital bill once the weighment is complete. A copy of the bill is stored on the company's server, reducing the risk of misplaced bills.

## **6. Printer:**

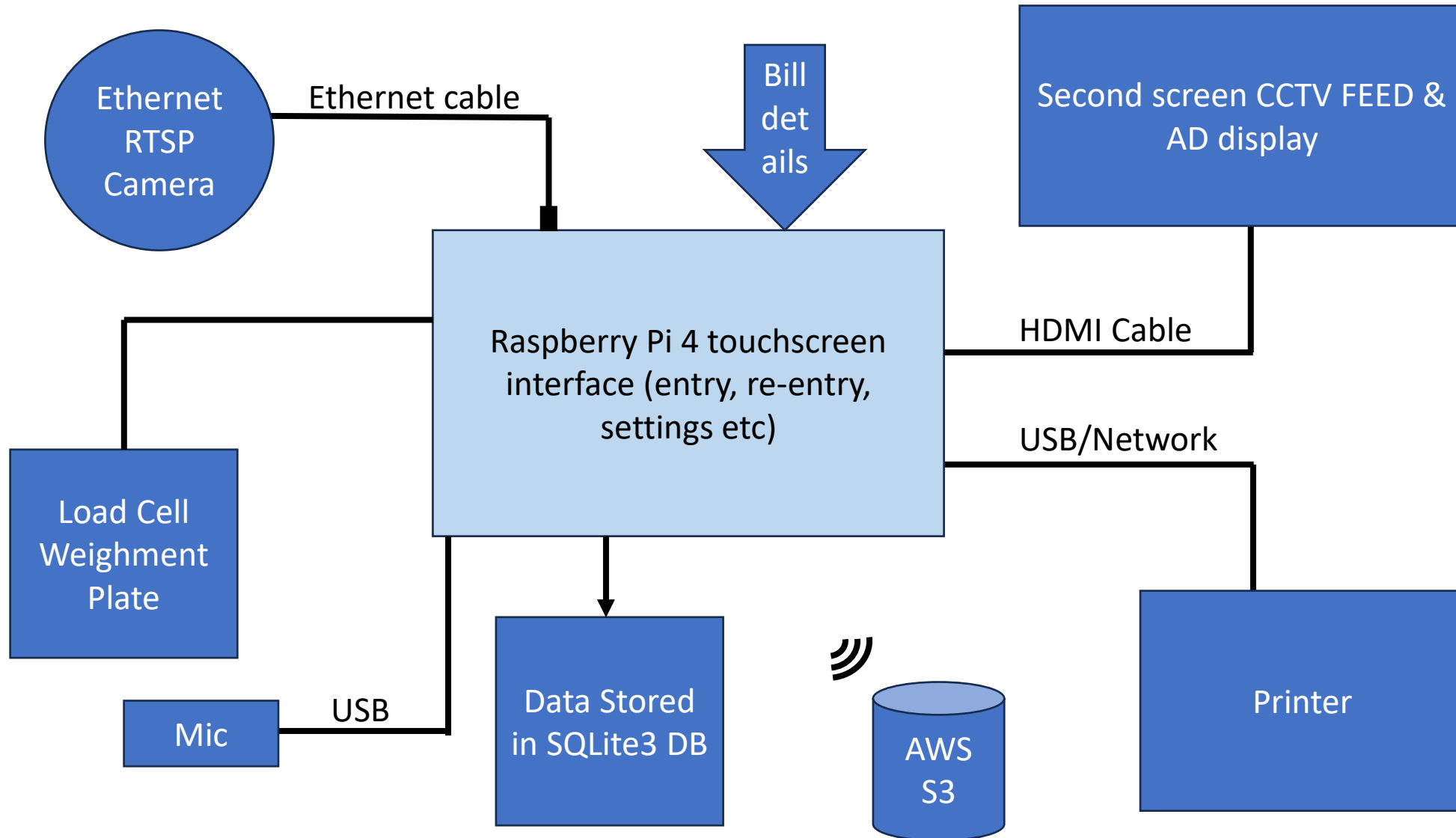
The system quickly establishes a connection with either a USB or network printer to print the generated bill efficiently.

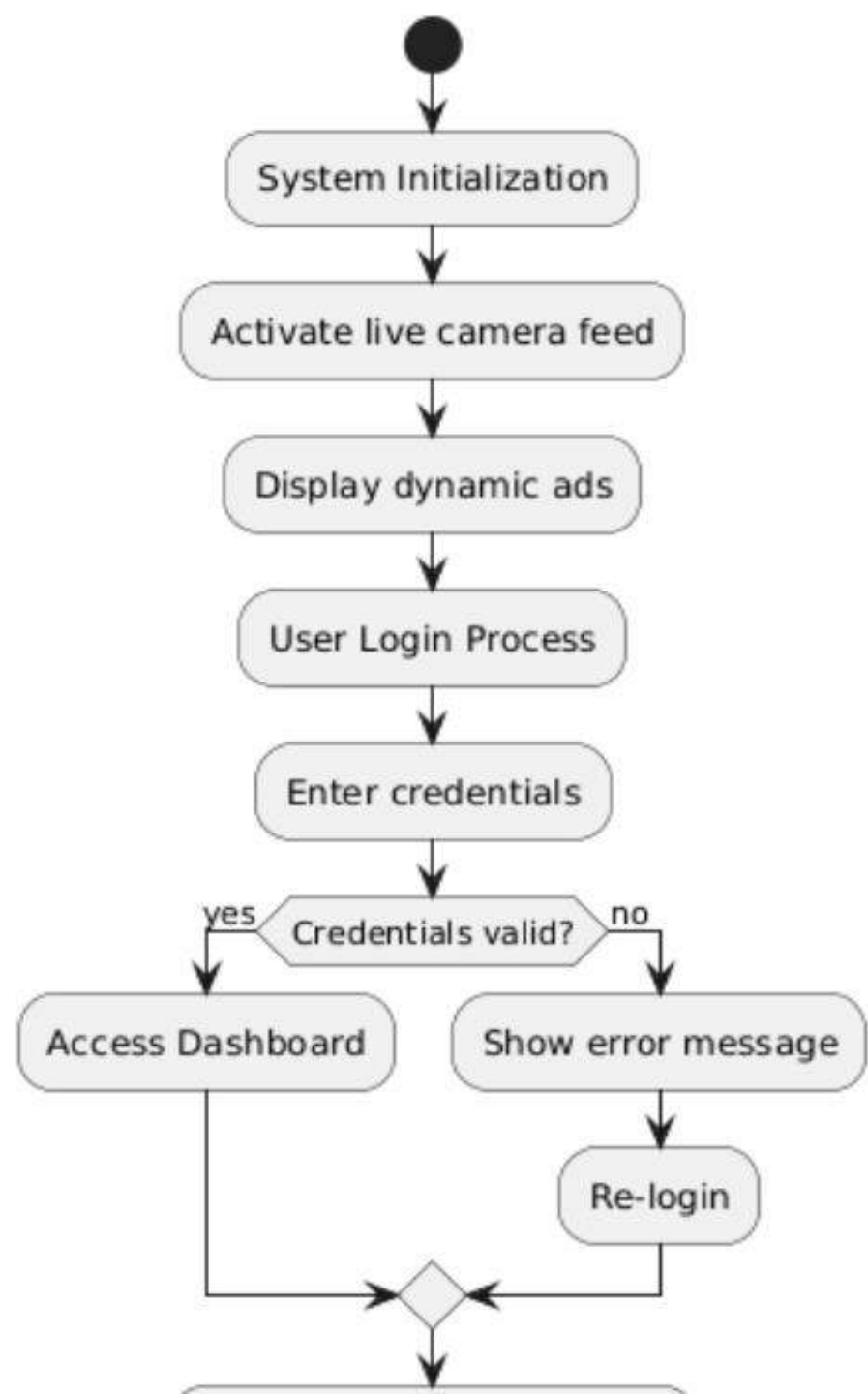
## **7. HDMI Second Screen:**

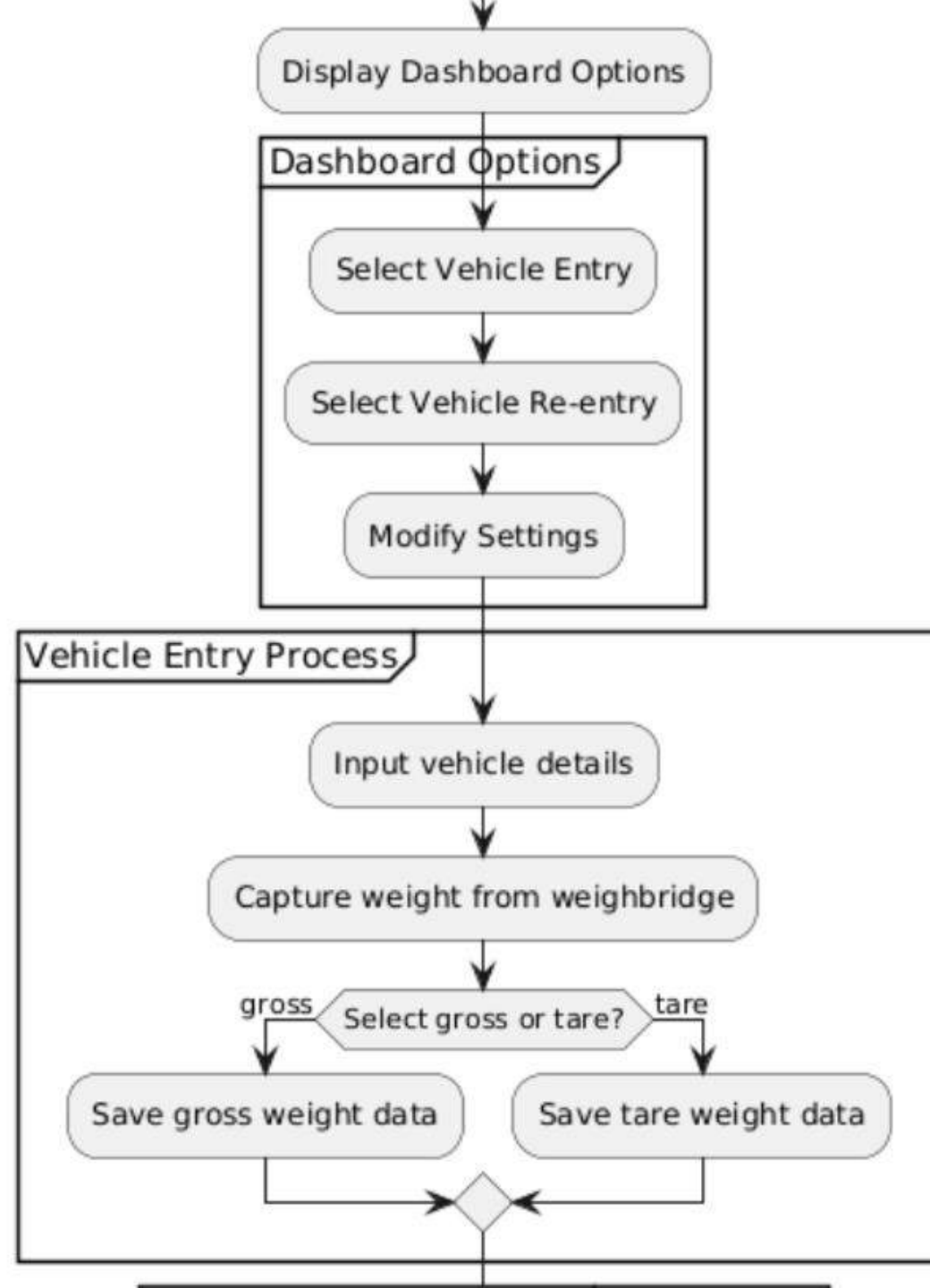
The system is also linked with a second screen (HD TV) via HDMI cable. It displays live camera feed along with promotional advertisements.

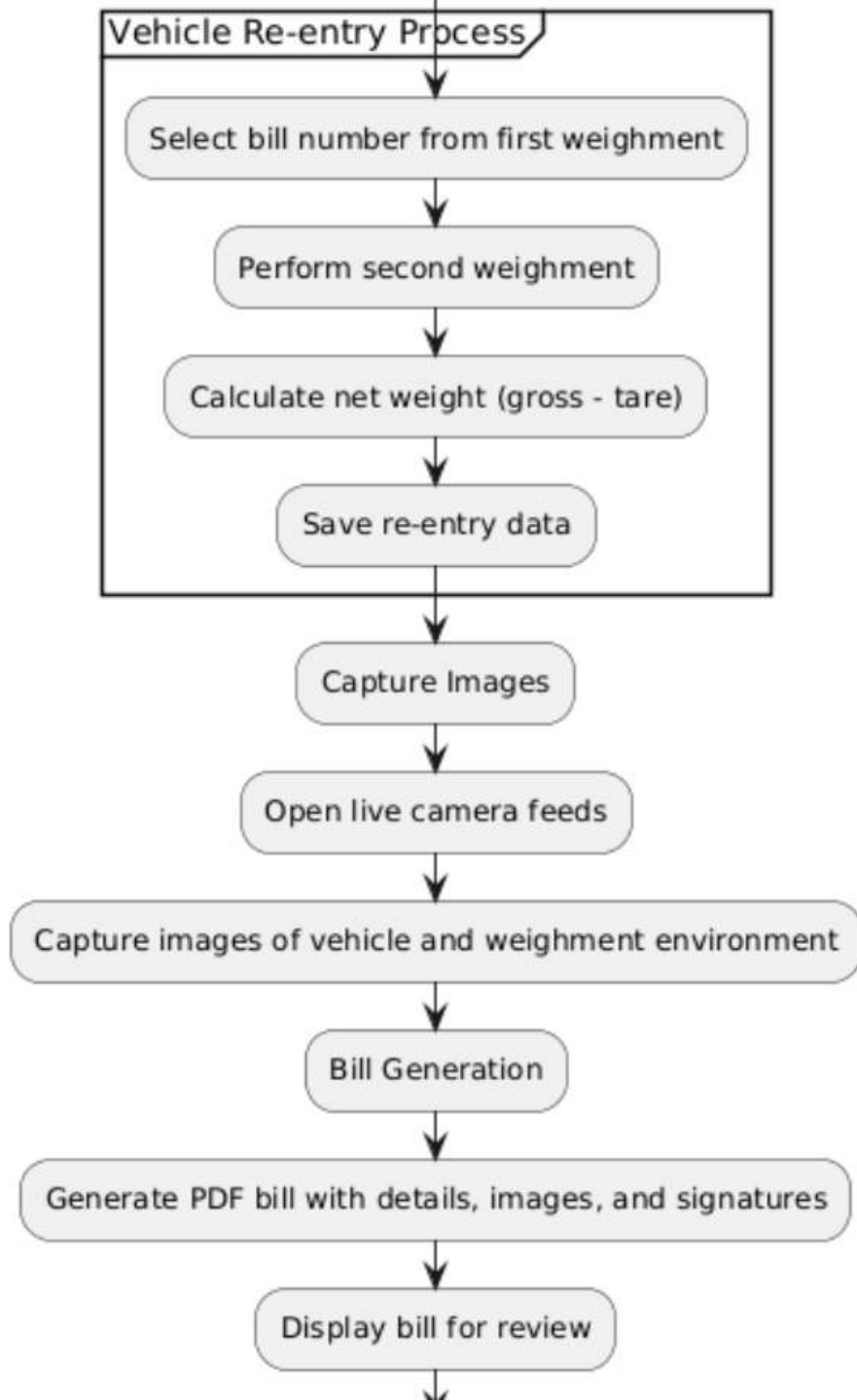


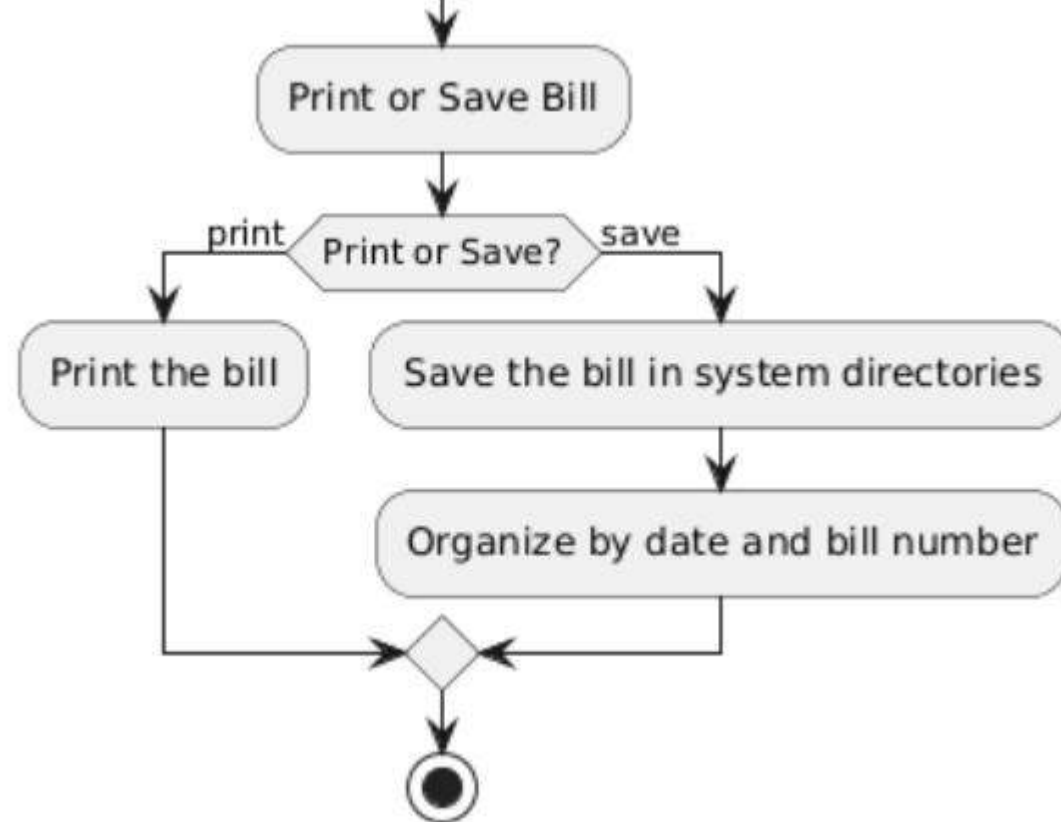
# Architecture Diagram











# Design

## 1. System Initialization:

- When the system starts, it automatically initiates the live camera feed on the primary screen to monitor the weighment environment.
- Simultaneously, the second screen (via HDMI) displays dynamic advertisements or relevant content, functioning as a digital signage display.

## 2. Touchscreen Dashboard:

- The touchscreen interface opens with a dashboard consisting of several buttons, including options like *Vehicle Entry*, *Vehicle Re-entry*, and access to *Recent Billings*.
- The user is required to log in before accessing the functionalities to ensure data security and user tracking.

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### 3. Vehicle Entry (First Weighment):

- After logging in, the user selects the *Vehicle Entry* option for the first weighment (either gross or tare).
- The user fills in all the necessary details, including vehicle number, supplier name, product type, and other headers required for the weighment process.
- The weighbridge sensors capture the weight, and the user selects whether it's a *gross* or *tare* weight.
- After filling in the required details, the user saves the information, storing it in the database for future reference.



#### 4. Vehicle Re-entry (Second Weighment):

- For the second weighment, the user selects the *Vehicle Re-entry* option from the dashboard.
- A dropdown list allows the user to select the bill number generated during the first weighment (from the *Vehicle Entry*).
- The user performs the second weighment (either *gross* or *tare*), and the system automatically calculates the *net weight* as the difference between the two weighments (gross - tare).
- Once all details are verified, the user clicks the *Save* button to proceed.

## 5. Capture Images and Bill Generation:

- After the second weighment is saved, the system opens a split-screen view showing two live camera feeds. One camera captures the vehicle, and the other captures the weighment environment for security and verification purposes.
- The user clicks *Capture*, taking the images, which are then automatically added to the bill.

## **6. Bill Generation and PDF Display:**

- Once the images are captured, the system automatically generates a PDF of the bill. This bill contains :

Time and date of weighment

Supplier name and vehicle number

Gross and tare weights

Net weight (gross - tare)

Captured images of the vehicle and the weighment environment

Digital signatures

- The PDF is automatically then displayed in a viewer for the user to review.

## 7. Printing and Saving Data:

- The user has the option to print the generated bill using a local or network printer by simply clicking the *Print* button.
- The PDF, along with the images, is also automatically saved in designated directories on the system for future reference or audits. These directories are organized by date and bill number to ensure easy retrieval.

## 8. Storage and Future Reference:

- All weighment details, including bill information and captured images, are stored securely in the system's database and file directories.
- The saved files can be accessed later from the *Recent Billings* section in the dashboard, or retrieved by bill number for customer inquiries or audits.

# Tech Stack

## **Python**

Python is a high-level programming language known for its simplicity and readability. It supports multiple programming paradigms and offers extensive libraries, making it ideal for developing a wide range of applications quickly.

## **Raspberry pi 4**

The Raspberry Pi 4 with a touchscreen is a powerful, compact tool for automation projects.

## **PyQt5: UI/UX**

PyQt5 is a set of Python bindings for the Qt framework, enabling the creation of cross- platform desktop applications with rich, interactive user interfaces. It provides tools for designing and managing graphical elements and user interactions.

## **Qt Designer: Instant UI Creation**

Qt Designer is a visual tool for designing user interfaces. It allows developers to create UI layouts using a drag-and-drop approach, saving designs as .ui files that can be integrated into PyQt5 applications.

## **Ethernet Cameras: Real-Time Monitoring**

Ethernet cameras provide live video streaming over a network, enabling real-time monitoring and surveillance. They are used for continuous video capture and remote access.

## **OpenCV: Capturing Images from Camera Feed**

OpenCV is a library for computer vision and image processing. It allows for capturing video streams, processing images, and performing tasks like object detection and image analysis.

## **SQLite3: Database**

SQLite3 is a lightweight, serverless database engine. It provides a simple SQL interface for managing data, making it suitable for applications requiring embedded databases or small-scale data storage.

## **Pixmap: Placing Images on the PDF Canvas**

In ReportLab, Pixmap represents an image that can be placed on a PDF canvas. It is used to include images like logos or photos within generated PDF documents.

# Project Gallery



Img. 1: Project setup



Img. 2: Vehicle entry screen





Img. 3: Vehicle re-entry screen



# SCORPION



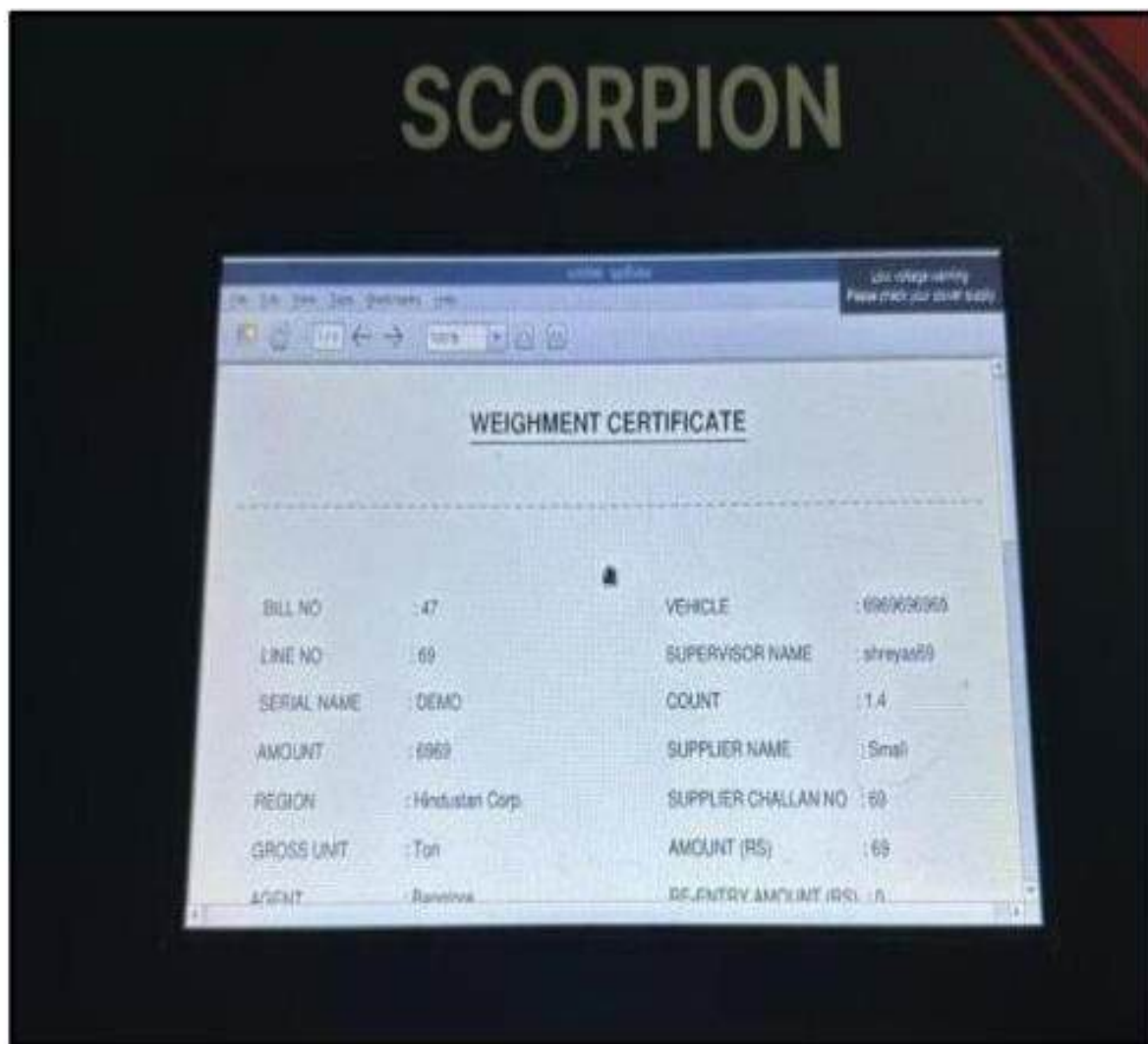
LCS

WB-50SP-IT

PowerDirector

# Results

The result gives a fully automated weighment and billing system that streamlines the entire process. From the initial vehicle entry to the final bill generation, the system ensures accurate, efficient, and secure weighments. By automating tasks like weight capture, vehicle re-entry, and bill generation, it minimizes human errors, prevents data manipulation, and reduces delays. The integration of security cameras adds transparency, capturing images of the vehicle and weighment environment. The system also generates detailed bills, including all weighment data and images, which are saved digitally for easy access and printed via a connected printer. This automated solution improves operational efficiency, enhances security, and provides a seamless experience for both vendors and customers.



Img. 7: report in PDF viewer

**WEIGHMENT CERTIFICATE**

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BILL NO	: 55	VEHICLE	: AP288K7542
LINE NO	: 7	SUPERVISOR NAME	: SHREYAS
SERIAL NAME	: DEMO	COUNT	: 1.4
AMOUNT	: 500	SUPPLIER NAME	: Small
REGION	: Hindustan Corp	SUPPLIER CHALLAN NO	: 45
GROSS UNIT	: Ton	AMOUNT (RS)	: 100
AGENT	: Bangalore	RE-ENTRY AMOUNT (RS)	: 650
GROSS Wt (Kg)	: 1561.0	FIRST ENTRY	: Tare
TARE Wt (Kg)	: 1004.5	GROSS DATE	: 17-07-2024 16:43:37
NETT Wt (Kg)	: 556.5	TARE DATE	: 17-07-2024 16:42:45

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LCS - For All Your Weighing Needs

Camera 1

Camera 2

Signature of the Operator

Signature of the Supervisor

Img. 8: sample printed report





Img. 9: Second screen dynamic ad display

# References

- [i] Scorpion: Smart Weighbridge user manual by LCS Controls Pvt Ltd.
- [ii] <https://stackoverflow.com/questions/40875846/capturing-rtsp-camera-usingopencv-python>
- [iii] <https://www.geeksforgeeks.org/python-sqlite/>
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- [vii] <https://www.investopedia.com/terms/s/second-screen-advertising.asp>