

# **SCORPION: SMART WEIGHBRIDGE**

## **SUMMER INTERNSHIP REPORT**

*Submitted by*

**Phavankumar R.L 2022115054**

*in partial fulfillment for the award of the degree*

*of*

**BACHELOR OF TECHNOLOGY**

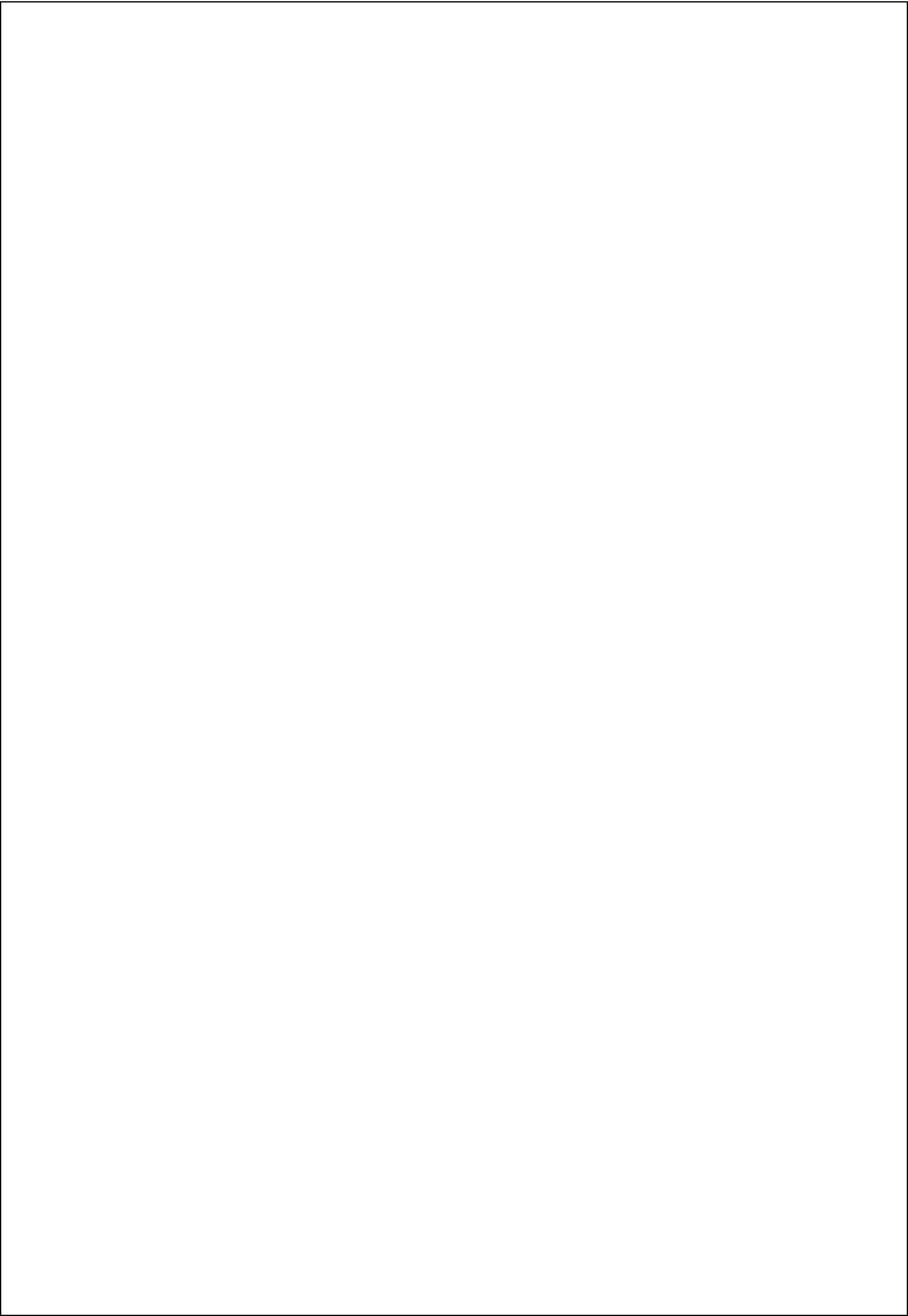
*in*

**INFORMATION TECHNOLOGY**



**ANNA UNIVERSITY CEG CAMPUS  
CHENNAI 25**

**AUG 2024**



# **ANNA UNIVERSITY: CHENNAI 600025**

## **BONAFIDE CERTIFICATE**

Certified that this project work “**Scorpion: Smart Weighbridge**” is the bonafide work of

**Phavankumar R.L    2022115054**

who carried out the project under my supervision.

Dr. S Swamynathan  
**PROFESSOR & HEAD,**  
Department of IST,  
CEG Campus,  
Anna University,  
Chennai - 600025

Mr. Anandraj  
**Admin,**  
Human Resources,  
LCS Controls Pvt Ltd,  
Kottivakam,  
Chennai - 600041

# ABSTRACT

The Scorpion Smart Weighbridge project is designed to modernize traditional weighbridge systems by integrating advanced technologies to enhance accuracy, efficiency, and user experience. Traditional weighbridges often struggle with manual errors, limited data access, and lack of digital integration. Scorpion addresses these issues with a suite of sophisticated features.

At the heart of the Scorpion Smart Weighbridge are high-precision load cells, which ensure accurate and reliable measurements. These sensors minimize errors and provide consistent performance, crucial for precise weight data. The system's automation capabilities streamline the weighing process, reducing manual errors and accelerating operations. Automated data collection allows for quicker and more accurate weighing compared to traditional methods.

Real-time analytics is a standout feature, offering cloud-based data processing that provides valuable insights for optimizing operations. Users can monitor performance metrics, track trends, and make informed decisions based on up-to-date information. The user interface is accessible via desktops, tablets, and smartphones, enhancing flexibility and convenience for managing weighbridge activities.

Security is a top priority, with data encryption and secure transmission protocols in place to protect sensitive information. This ensures data integrity and guards against unauthorized access. Additionally, the Scorpion Smart Weighbridge is scalable, integrating seamlessly with existing ERP systems to adapt to various business needs and future growth.

Leveraging technologies such as IoT, machine learning, and data analytics, the Scorpion Smart Weighbridge transforms traditional weighbridge operations into intelligent, automated processes. This modern approach not only improves accuracy and efficiency but also offers a user-friendly experience, making it a significant advancement in weighbridge technology.

# ACKNOWLEDGEMENT

I want to express my sincere gratitude to LCS Controls Private Limited for the opportunity to intern at their esteemed organization. This experience has been invaluable, offering practical insights into industrial automation and embedded systems. The guidance and support from the team at LCS Controls have been pivotal to my learning.

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# PROJECT OVERVIEW

The Scorpion Smart Weighbridge is an advanced solution for weighing heavy vehicles, designed to enhance accuracy, efficiency, and user experience. Combining robust construction with innovative digital technology, it meets the demands of various industries, making it a reliable choice for modern operations.

With high-precision digital load cells, the Scorpion ensures accurate measurements and automates data collection, reducing manual entry and seamlessly integrating with existing systems. Its user-friendly touchscreen simplifies operation, while real-time monitoring allows for remote access and cloud-based data management. Built to withstand harsh environments, the weighbridge requires minimal maintenance and features advanced security like automatic number plate recognition (ANPR) and encrypted data access.

Serving industries such as logistics, agriculture, construction, and waste management, the Scorpion Smart Weighbridge ensures legal compliance and operational efficiency. It offers improved accuracy, cost-effectiveness through reduced labor and maintenance, enhanced safety by preventing overloading, and streamlined data management for better decision-making. However, higher initial investment and the need for technical support and training are considerations.

Looking ahead, the Scorpion Smart Weighbridge aims to integrate with the Internet of Things (IoT) for enhanced connectivity, utilize advanced analytics and machine learning for optimization, and develop eco-friendly solutions with renewable energy.

This report explores the Scorpion's competitive edge through:

- a. Digital Load Cell Technology
- b. Automated Data Collection and Management
- c. Real-Time Monitoring and Security

Each area will be examined to showcase the weighbridge's ability to overcome challenges, improve efficiency, and deliver superior value across various applications.

# INDUSTRY OVERVIEW

**LCS Controls Private Limited**

**Headquarters:** Chennai, Tamil Nadu

**Founded:** 1985

**Industry:** Automation Machinery Manufacturing

**Website:** [www.lcscon.com](http://www.lcscon.com)

**Phone:** +91 73053 27180



## Overview:

LCS Controls Private Limited is a premier engineering solutions provider, established in 1985 and headquartered in Chennai, India. Over the years, LCS Controls has grown to become a leader in automation and control systems, catering to a wide range of industries including manufacturing, energy, and infrastructure. The company is renowned for its innovative approach, high-quality products, and a strong commitment to customer satisfaction.

## Vision:

LCS Controls aims to be the most trusted partner in automation and control solutions for its clients. The company's vision is to lead the industry by delivering cutting-edge technology, fostering innovation, and setting the highest standards in service and reliability. LCS Controls aspires to create significant value for its clients by enhancing operational efficiency, ensuring safety, and driving sustainable growth.

## Mission:

LCS Controls' mission is to empower industries with state-of-the-art automation and control solutions that enhance productivity, safety, and sustainability. The company strives to achieve this by:



- Delivering top-quality products and services that meet international standards.
- Providing tailored solutions that address the specific needs of each client.
- Continuously innovating to stay ahead of industry trends and technological advancements.
- Building strong, long-term relationships with clients through exceptional service and support.
- Promoting a culture of excellence, integrity, and continuous improvement among employees.
- Committing to environmentally responsible practices and sustainable development.

### **History:**

- 1985: LCS Controls was founded, marking the beginning of its journey in providing engineering solutions.
- 1990s: The company expanded its operations through organic growth and strategic acquisitions, becoming a significant player in the automation industry in India.
- 2000s: LCS Controls diversified its services by integrating advanced technologies and expanding its client base across various sectors.
- 2010s: The company embraced new technologies like IoT and AI to enhance its automation and control solutions. It also expanded internationally, entering markets in Asia and the Middle East.
- 2020s: LCS Controls reinforced its focus on sustainability and digital transformation, offering solutions that promote energy efficiency and smart manufacturing.

### **Current Operations:**

Today, LCS Controls operates globally, providing cutting-edge solutions that enhance the efficiency and safety of industrial operations. The company has established a strong reputation for its commitment to innovation, customer satisfaction, and sustainable practices, making it a leader in the automation and control industry.

### **Specialties:**

- Industrial Automation
- Machine Vision Systems
- Weight Indicators
- Weigh Bridge Terminals etc.

# PROJECT DESCRIPTION

Scorpion Smart Weighbridge stands out in the weighbridge industry through its adoption of advanced technologies that enhance operational efficiency and maintain a competitive edge. This report provides an in-depth overview of three key technological advancements employed by Scorpion Smart Weighbridge: **Digital Load Cell Technology**, **Automated Data Collection and Management**, and **Real-Time Monitoring and Security**.

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## a. Digital Load Cell Technology

**Overview:** Digital load cell technology marks a significant advancement over traditional analog load cells. Unlike analog systems, which rely on voltage signals that can be affected by interference and inaccuracies, digital load cells convert weight measurements directly into digital signals at the source. This innovation ensures enhanced precision and consistency in weight measurements, which is critical for industries where accuracy is vital.

**Technical Details:** Digital load cells in Scorpion Smart Weighbridge systems are designed to provide high-resolution measurements with minimal error. They integrate strain gauges with digital processing units to accurately measure force and convert it into a digital signal. These signals are then transmitted to a central system for processing and analysis.

### Key Advantages:

- **Enhanced Accuracy:** Digital load cells reduce the impact of environmental factors like temperature fluctuations and mechanical vibrations, which can affect analog load cells.
- **High Resolution:** They offer precise weight readings essential for logistics and industrial processes.
- **Reduced Calibration Needs:** Digital load cells require less frequent calibration, minimizing maintenance efforts and costs.

### Applications:

- **Logistics and Transportation:** Ensures compliance with weight limits and optimizes cargo distribution.
- **Agriculture:** Facilitates efficient planning and inventory management by measuring harvested products or inputs precisely.
- **Waste Management:** Supports better resource management and regulatory compliance through accurate waste measurement.

**Impact:** The integration of digital load cell technology has significantly improved the reliability and efficiency of Scorpion Smart Weighbridge systems. Clients benefit from enhanced accuracy, which boosts operational efficiency and supports better decision-making.

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## **b. Automated Data Collection and Management**

**Overview:** Automated data collection and management are pivotal in modern weighbridge systems. Scorpion Smart Weighbridge incorporates advanced data acquisition and processing technologies to streamline operations and reduce manual intervention. This automation enhances efficiency and ensures accurate data capture and storage.

**Technical Details:** The weighbridge system features sensors and data acquisition modules that automatically record weight data during each weighing operation. This data is transmitted to a cloud-based platform or centralized database for analysis and reporting.

### **Key Features:**

- **Real-Time Data Capture:** Automated sensors ensure up-to-date weight measurements reflective of current conditions.
- **Centralized Data Storage:** Data is stored in a centralized database or cloud platform, making it accessible for analysis and reporting from any location.
- **Error Reduction:** Automation minimizes human error in data entry, resulting in more accurate and reliable records.

## **Applications:**

- **Inventory Management:** Provides accurate weight and volume data for effective stock level management.
- **Operational Efficiency:** Speeds up the weighing process, reduces manual data entry, and enhances overall efficiency.
- **Regulatory Compliance:** Ensures accurate record maintenance for compliance with industry regulations and standards.

**Impact:** Automating data collection and management has improved operational workflows and data accuracy for Scorpion Smart Weighbridge. Clients experience enhanced efficiency, reduced costs, and more reliable reporting, which supports better decision-making and compliance.

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## **c. Real-Time Monitoring and Security**

**Overview:** Real-time monitoring and security are essential components of Scorpion Smart Weighbridge's offerings. Real-time monitoring allows continuous oversight of weighing operations, while robust security measures protect data integrity and prevent unauthorized access.

## **Technical Details:**

- **Real-Time Monitoring:**
  - i. **Live Data Updates:** Provides real-time updates on weight measurements and operational status, enabling prompt decision-making.
  - ii. **Alerts and Notifications:** Automated alerts are triggered for discrepancies or operational issues, allowing quick resolution and minimizing downtime.
- **Security Features:**
  - i. **Data Encryption:** Protects transmitted data against unauthorized access and tampering.

- ii. **User Authentication:** Ensures that only authorized personnel can access or modify information through controlled user authentication protocols.
- iii. **Backup Mechanisms:** Regular data backups prevent data loss due to system failures or security breaches.

**Applications:**

- **Operational Oversight:** Facilitates efficient management by identifying issues early and ensuring smooth weighbridge functioning.
- **Data Protection:** Safeguards sensitive weight data against potential threats, maintaining data integrity and confidentiality.
- **Compliance and Accountability:** Supports regulatory compliance and accountability through accurate records and prevention of unauthorized alterations.

**Impact:** The integration of real-time monitoring and security features has enhanced the reliability and safety of Scorpion Smart Weighbridge systems. Clients benefit from improved operational oversight, data protection, and adherence to regulatory standards.

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This comprehensive approach to integrating advanced technologies in weighbridge solutions underscores Scorpion Smart Weighbridge's commitment to improving accuracy, efficiency, and performance across various industries.

# 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.

## **OS: Accessing Internal PC Directories**

The os module in Python provides functions to interact with the operating system. It allows for navigating and manipulating files and directories, enabling tasks like file reading, writing, and deletion.

### **ReportLab: Creation and Generation of PDFs**

ReportLab is a Python library for generating PDF documents. It supports creating detailed and customizable PDFs with text, images, and graphics, suitable for reports and other documents.

### **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.

### **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.

### **SpeechRecognition: Recognize Speech and Convert to Text**

The SpeechRecognition library converts spoken language into text. It supports various recognition engines and is used for integrating voice commands and transcription features into applications.

### **Tesseract: OCR (Optical Character Recognition)**

Tesseract is an OCR engine that converts images of text into machine-encoded text. It is used for extracting text from scanned documents and images, integrated with Python through tesseract for text recognition tasks.

# PROJECT SPECIFICATIONS



Img. 1: Project setup

## Introduction

During my internship at LCS Controls Private Limited, Chennai, I was involved in the SCORPION Smart Weighbridge project, aimed at automating weighment processes for trucks and heavy vehicles. This project utilized advanced technologies such as PyQt5, Qt Designer, RTSP Ethernet cameras, and Python to enhance efficiency and accuracy in industrial weighing systems.

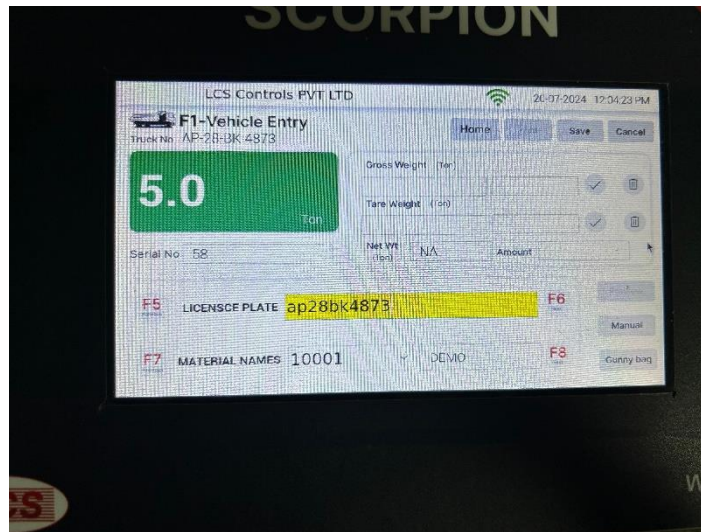
## Training and Initial Responsibilities

The internship began with intensive training in PyQt5 and Qt Designer, essential tools for developing the project's frontend user interfaces (UI/UX). This foundational training equipped me with the skills needed to design intuitive and responsive applications tailored to industrial automation needs.



## Vehicle entry screen

In the entry screen, the user inputs the vehicle number, supervisor name, supplier name, location, and amount followed by recording the weight—either the gross weight (vehicle plus load) or the tare weight (vehicle only). Once all details are filled in, the user clicks "Save" to store the information, which is then ready for further processing on the reentry screen.



Img. 2: Vehicle entry screen

## Vehicle re-entry screen

In the vehicle re-entry screen, the user can select a previously entered bill number or vehicle number from a dropdown menu, making it easy to retrieve and continue with the existing entry. Depending on the situation, the user then records either the gross weight (vehicle plus load) or the tare weight (empty vehicle), consistent with the entry's initial details. The user also specifies the corresponding amount related to the weight measurement. After entering this information, the user clicks "Save" to store the updated data, which is then ready for the next step in the process.



Img. 3: Vehicle re-entry screen

## Dashboard UI/UX Design

### 1. 4-Split Screen Layout with Live Video Feeds

**Objective:** Design an interface that can display live video feeds from multiple sources in a single view.

#### Implementation:

- **Layout:** Used a 4-split screen layout to accommodate four different camera feeds simultaneously. Each split screen shows a live feed from a different IP camera.
- **Integration:** Configured each feed based on its specific IP address and port settings. Utilized libraries such as OpenCV for video stream handling and PyQt5 for UI integration.
- **Real-Time Monitoring:** Ensured that the video feeds are displayed in real time with minimal delay. Implemented error handling to manage cases where a feed might be unavailable or fail.



Img. 4: 4-split screen live feed

## 2. Image Capture Functionality

**Objective:** Enable operators to capture specific images of vehicles or weighment processes directly from the dashboard interface.

### Implementation:

- **Capture Buttons:** Added capture buttons to the UI for each camera feed. These buttons are strategically placed to be easily accessible while monitoring the feeds.
- **Image Storage:** Implemented functionality to save captured images into organized directories. The directory structure follows a date-based format (captured images/yyyy/mm/dd/bill\_no) to streamline data management.
- **Automation:** Ensured that images are automatically saved without requiring additional manual input. Integrated this feature with the system's backend to maintain a smooth workflow.



Img. 5: 2-split image confirmation



Img. 6: Success notification

### 3. PDF Report Generation

#### Objective:

To develop a robust PDF report generation system that consolidates weighment details and captured images into comprehensive reports. These reports are automatically saved and organized for easy retrieval and printing.

#### Implementation:

##### 1. Data Input and Capture:

- **User Input:** The application allows users to enter crucial weighment details including tare weight, supervisor name, item description, gross weight, date, and time.
- **Camera View:** After saving the weighment details, the system transitions to a two-split camera view. This view is used to capture images of vehicle numberplates and the vehicle itself.
- **Image Capture:** Implemented capture functionality within the two-split view, allowing users to take photographs that will be included in the PDF report.

##### 2. PDF Report Generation:

- **Using ReportLab:** Utilized the ReportLab library to create PDF reports. ReportLab offers a powerful toolkit for generating PDFs programmatically.
- **File Structure:** PDF reports are automatically saved in a date-based directory structure (pdf\_reports/yyyy/mm/dd/billno\_time.pdf). This organization facilitates easy tracking and retrieval of reports.
- **Report Content:** Each PDF includes:
  - i. Entered weighment details (tare weight, supervisor name, item, gross weight, date, and time).
  - ii. Captured images of the vehicle and number plate.

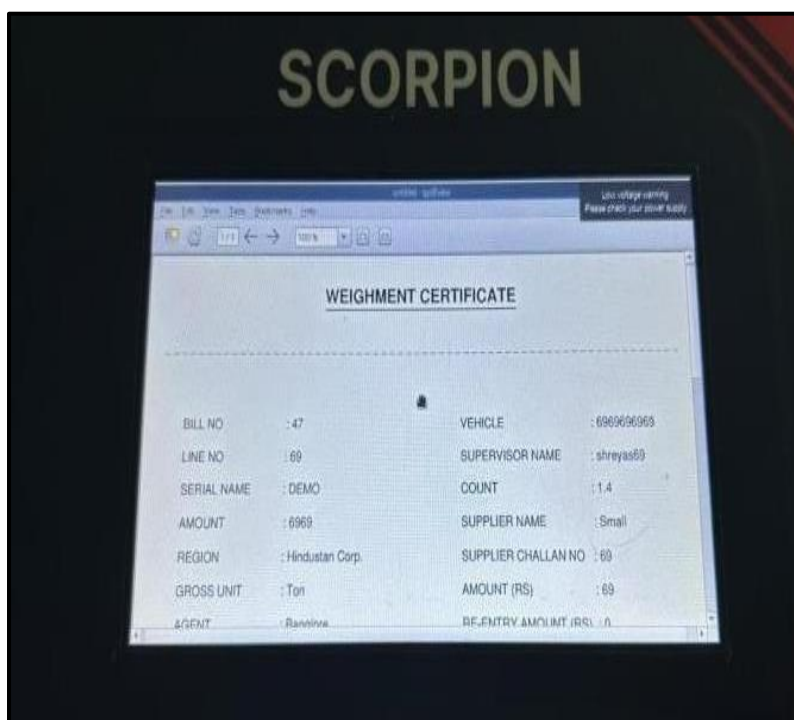
iii. Layout and formatting are designed to meet regulatory standards.

### 3. Printing and Accessibility:

- **Local Network and USB Printers:** Enabled functionality to view and print PDF reports using local network printers or USB printers connected to the application.
- **Direct Printing:** Implemented features for direct printing from the application, ensuring that users can quickly obtain physical copies of the reports without additional steps.

### 4. User Experience:

- **Convenience:** Streamlined the process so that users can easily input details, capture images, and generate reports without navigating through complex workflows.
- **Compliance:** Ensured that the generated reports meet regulatory standards and provide all necessary information for traceability and compliance.



Img. 7: report in PDF viewer

WEIGHMENT CERTIFICATE			
BILL NO	: 55	VEHICLE	: AP28BK7542
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 16:43:29
NETT Wt (Kg)	: 556.5	TARE DATE	: 17-07-2024 16:42:41

LCS - For All Your Weighing Needs

Camera 1

Camera 2

Signature of the Operator

Signature of the Supervisor

Img. 8: sample printed report

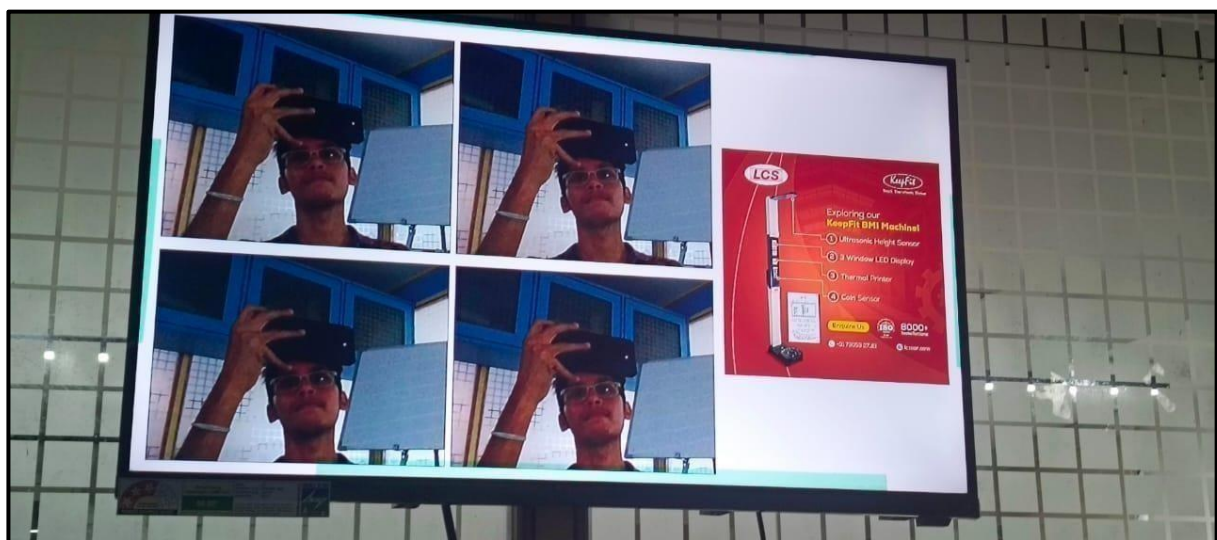


## 4. Dual-Screen Advertisement Display

**Objective:** Enhance the dashboard's functionality by adding an advertisement display feature alongside the primary application.

### Implementation:

- **Responsive UI Design:** Created a responsive interface that adapts to different screen sizes and resolutions. This design accommodates the SCORPION application on one screen and advertisements on another.
- **Multi-Functional Display:** Configured the setup to show CCTV camera feeds and dynamic advertisements on a secondary large screen. This approach combines operational monitoring with promotional messaging.
- **User Experience:** Focused on creating a visually appealing and functional display environment that ensures users can seamlessly interact with both the SCORPION application and the advertisement content.



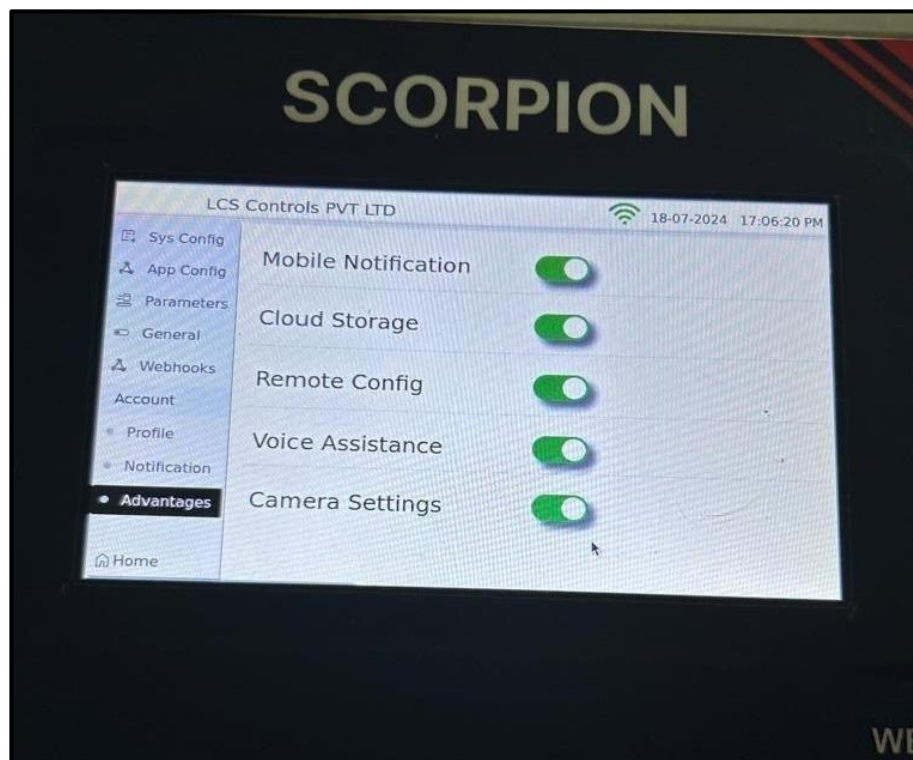
Img. 9: Second screen dynamic ad display

## 5. Voice Assistance Integration

**Objective:** Incorporate voice recognition capabilities to improve user interaction and operational efficiency.

### Implementation:

- **Voice Commands:** Integrated Python's Speech Recognition module to enable voice commands such as “open settings” or “open entry screen.”
- **Vehicle Number Recognition:** Enhanced the system to recognize and automatically fill in vehicle number headers from spoken vehicle number plates. This feature reduces manual data entry and improves accuracy.
- **Workflow Continuity:** Ensured that the voice recognition system is responsive and accurate, contributing to a more streamlined and efficient user experience.



Img. 10: Voice assistance functionality

## 6. Ethernet Camera settings

**Objective:** Configure and manage Ethernet camera feeds for effective monitoring of events like vehicle movement or weighment processes.

### Implementation Details

#### Camera Setup:

- Camera Quantity: Specify the number of connected cameras for accurate feed monitoring.
- Camera Number: Select and configure a specific camera by its unique identifier.

#### Network Configuration:

- IP Address: Input the camera's IP address to establish a connection.
- Port Number: Set the communication port, typically 554 for RTSP.

#### Authentication:

- Username and Password: Enter credentials to secure access to the camera feed and settings.



Img. 11: Ethernet camera settings



## 7. Camera Settings (system overview)

The "Camera Settings" option allows users to enable or disable camera functionalities within the system, controlling access to camera-related options and controls.

### Enabling Camera Settings:

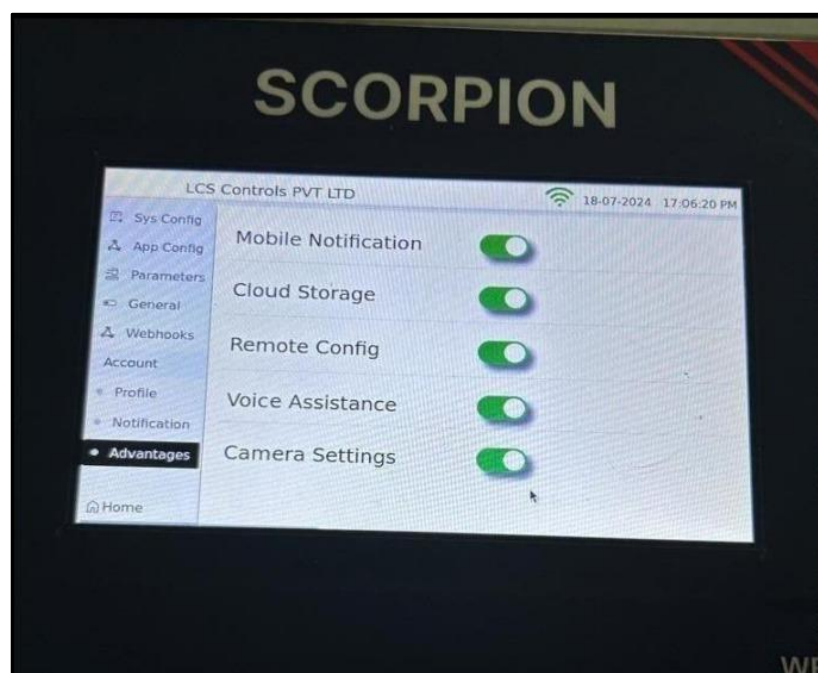
- When switched on (green toggle), all camera functions, including configuration, live feed viewing, image capturing, and storage settings, are activated.
- Operators can configure settings, monitor feeds, and capture images as needed.

### Disabling Camera Settings:

- When switched off, all camera-related features, including feeds, capture buttons, and storage options, become inaccessible or hidden.
- Useful for scenarios where camera monitoring isn't required or to restrict operations for security reasons.

### System Integration:

- The settings are integrated with other components like Mobile Notifications, Cloud Storage, and Remote Config. Enabling the camera also activates related features like cloud storage and mobile notifications.
- Disabling the camera settings ensures these associated features are also turned off, maintaining a secure system environment.



Img. 12: Camera system overview

# CONCLUSION

Scorpion Smart Weighbridge has revolutionized the industrial weighing sector with its advanced technology and innovative solutions. By integrating digital load cells, automated data management, and real-time monitoring, Scorpion delivers accurate, efficient, and reliable weighing systems that set new industry standards. Catering to sectors like transportation, logistics, and manufacturing, Scorpion's weighbridges are designed for high accuracy and durability in demanding environments.

The company's focus on precision and user-friendly features enhances operational efficiency and ensures compliance with regulatory standards. Scorpion's commitment to innovation is evident in its cloud-based data management and real-time analytics, offering businesses valuable insights and seamless integration with other systems.

Despite challenges in data security, system integration, and technological updates, Scorpion addresses these issues through robust security, continuous upgrades, and excellent customer support. Looking forward, Scorpion is poised to lead the industry, driving further advancements in weighbridge technology with its focus on innovation and customer satisfaction.

In conclusion, Scorpion Smart Weighbridge exemplifies how cutting-edge technology and a customer-centric approach can drive success, solidifying its position as a leader in the global weighbridge market.

# **FUTURE ADVANCEMENTS**

## **1. OCR-Driven Man less Weighments**

Scorpion Smart Weighbridge will incorporate OCR technology for fully automated weighments. This feature will enable the system to read vehicle details and documentation without manual input, streamlining operations and minimizing errors.

## **2. Multilingual Voice Assistant**

Future versions will include a voice assistant capable of handling queries in multiple languages. This will allow users to interact with the system using voice commands, making it accessible to a broader audience.

## **3. Localized User Interface**

The weighbridge will offer a UI with text in various regional languages, enhancing user adaptability. This feature will make the system easier to use across different regions, improving the overall user experience.

## **4. Automated Camera Configuration**

Scorpion will introduce automated RTSP configuration for Ethernet-connected devices. This will simplify the setup process, ensuring that cameras and other devices are integrated seamlessly into the system.

# REFERENCES

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[v] <https://docs.reportlab.com/>

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\*\*\*\*\* **END OF REPORT** \*\*\*\*\*