Vin-plate and Chassis Number Mismatch Detection system through Vision-AI for AD Chakan

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1. **Executive Summary**

The project addresses the critical challenge of ensuring accurate VIN plate matching with vehicle data, specifically verifying the alignment of VIN plate details with punched chassis numbers and validating against data encoded within build sheets. Our solution centers around a custom application integrated with the Zebra DS3678 handheld imager, equipped for both barcode scanning and image capture. The workflow seamlessly transits from barcode mode to image mode upon scanning three key barcodes—chassis number, engine number, and model number. Data, comprising images and barcode information, is wirelessly transmitted to a central computer. Here, advanced Optical Character Recognition (OCR) logic powered by the Google Vision API extracts critical data, such as the chassis number and VIN plate details (chassis number, model number and engine number).

A rigorous one-to-one matching process cross-references barcode data with OCR-extracted information from the chassis number image and VIN plate. Successful matches trigger an 'OK' confirmation on the connected display. The solution is tailored for shopfloor deployment, featuring an custom compute unit setup encompassing a touchscreen display, compact CPU, Wi-Fi connectivity, and a junction box for streamlined power supply. A portable, user-friendly metal case houses the setup, complete with a dedicated charging unit for the Zebra scanner. To ensure adaptability, the AI logic undergoes training with distinct vehicle variants such as Bolero max, Pickup trucks. The solution promises to eliminate manual validation errors, amplify production efficiency, and safeguard the brand image against potential fault forward processes.

2. **Project Background**

a) **Data Validation Challenge:** The project stems from the pressing need to tackle inaccuracies in data validation within TCFs. Instances of mismatched VIN plate details and chassis number data might raise concerns regarding data integrity and product quality.

b) **Manual Validation Process:** Historically, data validation has been conducted manually on shopfloors. This labor-intensive process relies on workmen physically cross-referencing VIN plates, chassis numbers, and data encoded in build sheets. The potential for human error in this process poses a significant challenge.

c) **Error Impact on Brand:** Mismatched data not only jeopardizes production efficiency but also poses a substantial risk to brand reputation. Faults in forward processes due to data discrepancies are a primary concern, necessitating a more reliable solution.

d) **Vision for Automation:** The project envisions a future where data validation transcends manual methods and embraces automation. By leveraging cutting-edge technology, such as custom handheld imagers and AI-driven OCR, the aim is to ensure accuracy, eliminate errors, and enhance the brand image.

e) **Seamless Integration**: The transition from manual validation to automation involves seamlessly integrating hardware, software, and AI logic into a unified solution. The project seeks to create a user-friendly system tailored for shop floor deployment.
f) **Robust Training**: To guarantee the solution's effectiveness, the AI logic undergoes rigorous training, encompassing a minimum of four distinct vehicle variants. This ensures adaptability and precision in validation.
g) **Portable and Practical:** A portable metal case housing the system, complete with a dedicated charging unit for the handheld imager, is designed for ease of transportation and practicality in shopfloor environments.

3. Business requirements

- Improve accuracy in matching VIN plate details with vehicle data.
- Minimize manual errors during data validation processes.
- Enhance production efficiency by reducing interruptions due to data discrepancies.
- Safeguard brand reputation by preventing errors in forward processes.
- Create a user-friendly system for shop floor use.
- Optimize operational costs while improving data accuracy.
- Ensure the system can handle various vehicle variants.
- Integrate hardware and software seamlessly.
- Design a portable solution for practical deployment.
- Train AI logic for precise data validation.

4. Project flow diagram and architecture

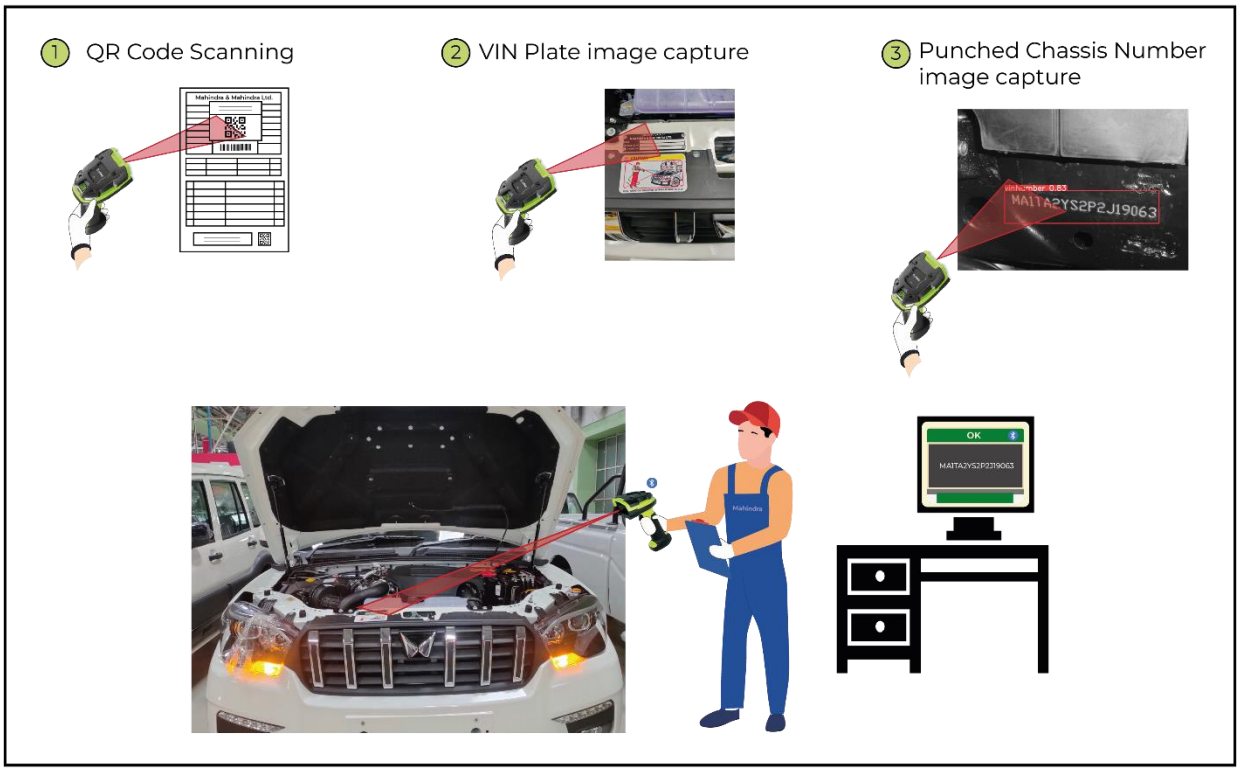

Fig. 1. Proposed Project Scenario

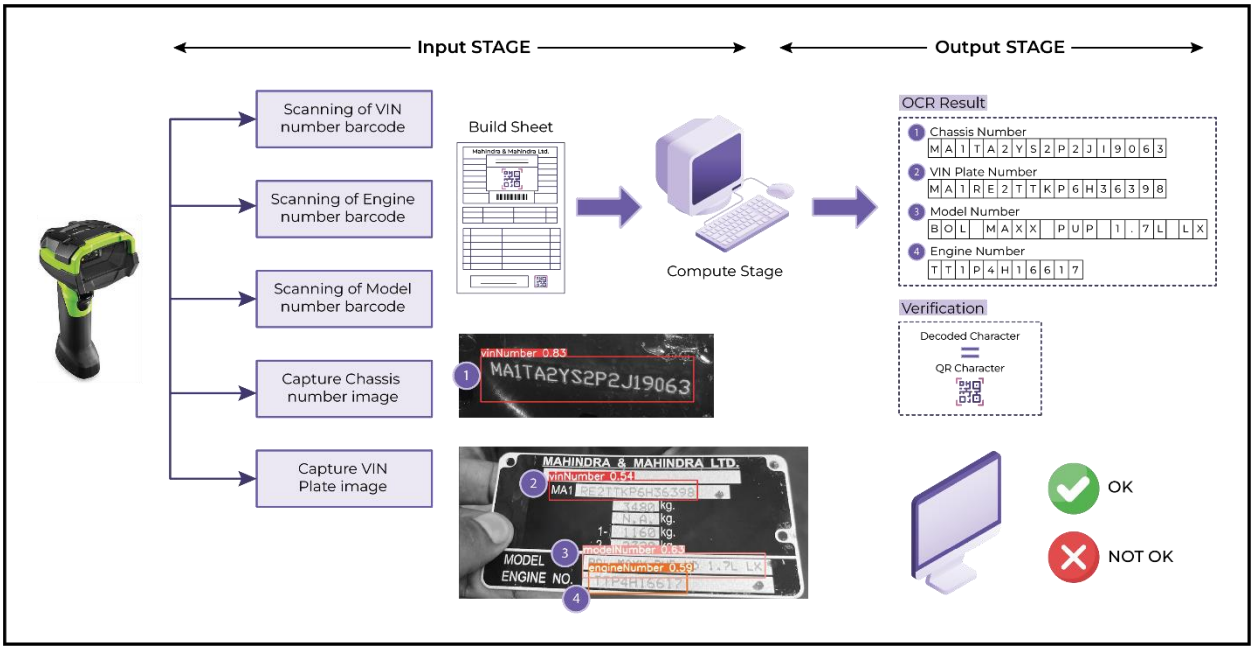

Fig. 2. Project flow diagram

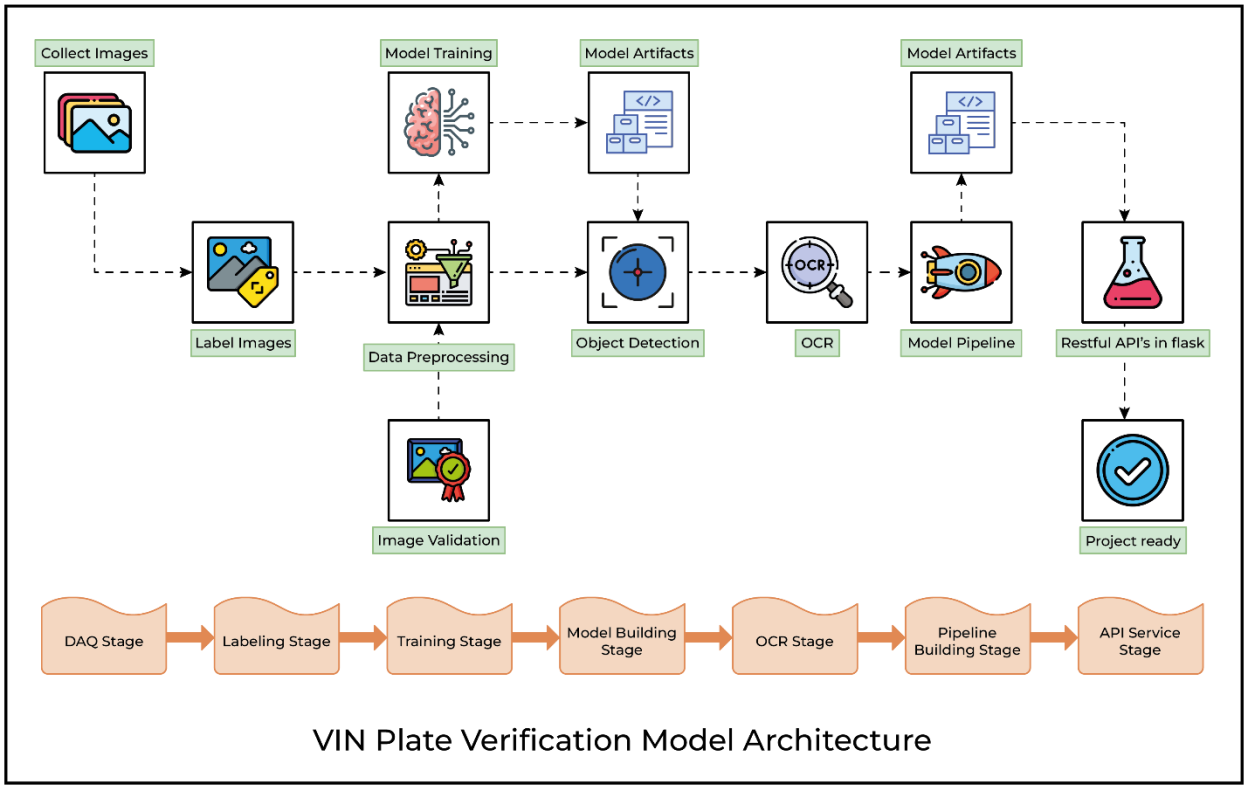

Fig. 3. Model architecture

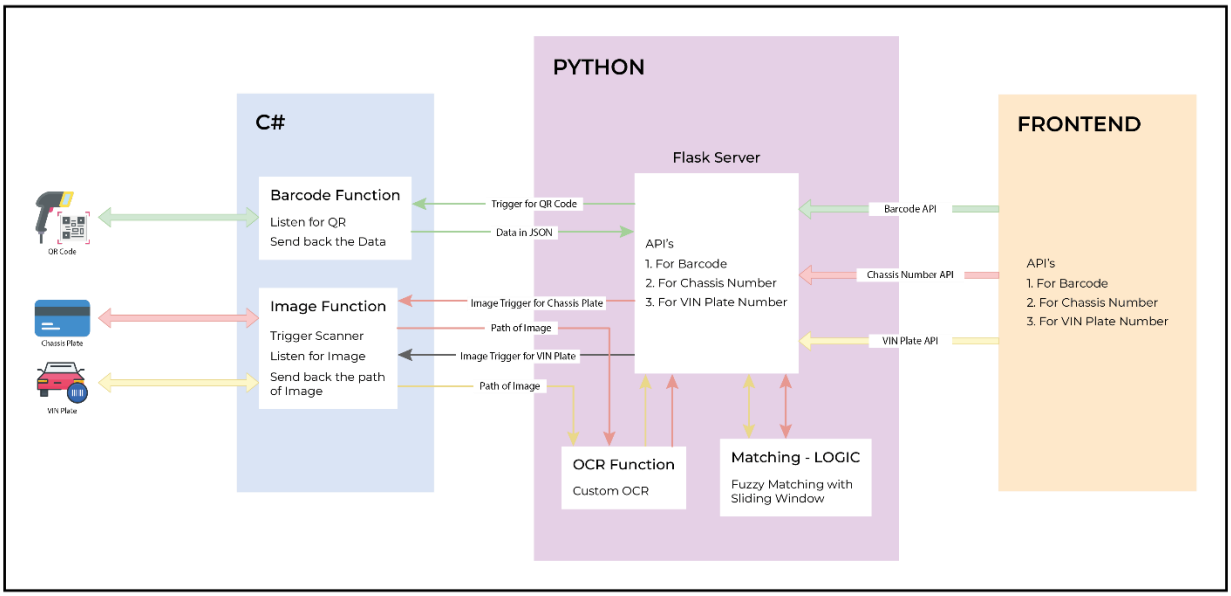

Fig. 4. Technical Architecture

5. **Project Scope:**
   - **Custom Handheld Imager**: Development and integration of a custom handheld imager, specifically the Zebra DS3678 HP, capable of seamless transitions between barcode scanning and image capture modes.
   - **Data Transmission:** Implementation of a robust data transmission system, enabling the wireless transfer of scanned barcode and captured image data to a central computer via Bluetooth connectivity.
   - **Optical Character Recognition (OCR):** Integration of advanced OCR logic powered by the Azure Form Recognizer API/custom trained ocr model to extract text data from images, including chassis numbers and VIN plate details.
   - **Data Validation Logic:** Development of precise data validation logic, facilitating one-to-one matching of barcode data with OCR-extracted information from the chassis number image and VIN plate.
   - **Display Device:** Provision of a display device to showcase validation results, confirming 'OK' status in cases of successful matches.
   - **Shopfloor Setup:** Configuration of a custom compute-setup, encompassing a touchscreen display, compact CPU, Wi-Fi connectivity, and a junction box for streamlined power supply connections.
   - **AI Logic Training**: Rigorous training of AI logic with a minimum of four distinct vehicle variants to ensure adaptability and precision in data validation.

6. Project timelines

Day	Phase	Activity
1-3	Data Acquisition	Collect and organize image data for training from various vehicle variants.
4-6	Labeling Stage	Create labels for the acquired image dataset, preparing it for AI model training.
7-10	Training Stage	Explore and test different object detection models. Select the optimal model for this use case. Train the selected model using GPUs for accelerated training.
11-13	Model Building Stage	Develop the custom application for barcode scanning and image capture.
14-17	OCR Data Set Creation Stage	Build a custom dataset for OCR model training, including diverse text data from VIN plates and chassis.
18-21	OCR Fine-Tuning Stage	Validate OCR results with extensive testing and fine-tune the OCR model for accuracy.
22-24	Pipeline Building Stage	Design the data processing pipeline for the complete application.
25-28	API Creation Phase	Develop the necessary APIs for data transmission and communication between components.
29-31	Testing and POC Setup	Test the end-to-end application for functionality and accuracy. Deploy the setup in the shop floor for Proof of Concept (POC) testing.
32-40	Production Rollout	Observe system efficiency during the POC phase. Address any issues or optimizations required. Roll out the solution for full production use.

7. Project cost estimation

Sr#	Item (cost-center nature)	Qty	Basic price (INR)	Final price (INR)	Description
1	Hardware (includes compute unit, imager, metal case etc.) (Capex)	1	300000	300000	At actual
2	One time application development/customization cost includes frontend, and backend (revenue)	1	300000	300000	2 AI resources (5k/day) for a month
3	API cost (per year)* (revenue)	1	50000	50000	4.2K (approx.) per month Form recognizer API cost
4	AMC cost (per year)* (revenue)	1	120000	120000	Sustenance support 2days/month at 5K each day for an AI resource. Starting from next year.
5	VAPT cost* (revenue)	7	8500	59500	At actuals (8.5K per iteration with total 7 iterations)
	Total		**778500/-**	**778500/-**	

8. Additional terms

- The pricing does not include any travel & accommodation, our team will travel at the location for around 5 days (max) for implementation. Accommodation/ travel charges will be debited as per actuals.
- A separate QR code should be provided in the build sheet for OCR purpose.
- Any out-of-scope requests will incur additional costs.
- Any change beyond the scope agreed during the completion of the requirements analysis phase would have a significant impact on the project time-lines.
- Any support requirements will be remotely managed with a ticket. The change management will be costed separately as per the case.
- We will be eventually developing a custom trained ocr model (ongoing activity for 2 months), and hosting it locally. This will avoid API service cost going forward.
- We are implementing an in-house pretrained AI model to do OCR at local system, testing the performance of this OCR model is in progress yet. Once we test it extensively, we won't need external APIs such as google vision to do OCR. Therefore, cost for line item#3 would not be applicable if we are using offline OCR model.