Sun:

1. Hi everyone. I am Sun, and they are Hyde, Prapti, and Tasnia. Today we are presenting our project: Vision-Based Real-Time Safety Gear Monitoring and Alert System for Construction Site. 翻页

Prapti:

2. Construction safety is critically compromised by PPE violations. Traditional manual walk-throughs fail to provide continuous coverage, while existing automated solutions are often too expensive or lack data privacy. Our project addresses these gaps by deploying an edge-optimized YOLOv8 system, ensuring affordable, real-time, and privacy-preserving monitoring for safer sites. 翻页

Tasnia:

3. We utilized the Roboflow Construction Site Safety dataset from Kaggle. Containing over 5,600 labeled images pre-split for training and testing, it provides a robust foundation for our YOLOv8 model. 翻页

4. We selected the YOLOv8 Nano. It is the most lightweight version, with 70% fewer parameters than the 'Small' model. This allows us to run detection in real-time on low-power edge devices without expensive servers. 翻页

Hyde:

5. On the left hand, this is the initial flow chart. I know it's messy, cause this is the original brainstorm of our team. And for the right hand, the project actually starts here. The project follows a four-phase pipeline: Preparation establishes requirements and data foundations, followed by Core Model Development to train and upgrade the detector. Upstream Design manages camera deployment and data ingestion, feeding into Downstream Design, which handles real-time alerts and compliance auditing. 翻页

6. For all details on how I built the model from scratch and achieved reasonably good results, you can check my Colab notebook. I tried tuning the hyperparameters, but the improvement over the baseline model was only 0.001, so the baseline model is still the better option.

7. We achieved a strong mAP50 of 0.80. High Box Precision (0.91) means few false alarms, while Recall (0.71) measures coverage. Crucially, Hardhats, Vests, and Masks perform excellently (>0.87). However, lower scores for 'No-Mask' indicate the model struggles to detect specific missing gear, requiring more negative-sample training.

8. The confusion matrix reveals that missed detections are the primary failure mode, specifically for 'NO-PPE' classes (e.g., NO-Mask) which are frequently misclassified as background. In contrast, inter-class confusion is negligible, except for minor mix-ups between visually similar vehicles and machinery. The model struggles to spot violations rather than mislabeling them.

9. Training is healthy with no overfitting, as losses drop synchronously. However, performance saturated after 70 epochs, indicating that further training yields minimal gains due to model or data limits.

10. Predictions demonstrate high accuracy and confidence for standard PPE. However, 'NO-PPE' classes exhibit frequent missed detections and low confidence scores, visually confirming the model's difficulty in identifying safety violations.

Sun:

11. This slide shows our software user interface. It has three main functions: **Live Monitor**, **Dashboard**, and **Violation Logs**. On the main screen, the **Live Monitor** runs real-time detection to check whether workers are wearing **hard hats** and **safety vests**, and it triggers an alert when a potential violation is detected. And in real construction sites, one camera is usually not enough, so our system supports **multiple camera inputs**. 翻页

12. To switch views, you simply click the camera button in the top-right corner and select the camera you want, and the cameras can also be renamed to make the workflow clearer for users. 翻页

13. Next is the **Dashboard**, where users can quickly view key safety metrics like total violations, compliance rate, total activity, violation trends, and violation distribution over a selected time period. In the top-right corner, you can filter the time range—for example **today**, **this week**, **this month**, or the **entire project**. 翻页

14. Finally, the **Violation Logs** provide the actual evidence behind those numbers. Users can export the records as a **CSV** or download clips in **MP4**, which makes it easier for safety staff and project managers to document issues and reduce safety risks on site. Since our development time was limited, there are still some current limitations, and we have plans to improve them in future iterations.

15. Due to Colab's resource limits, we couldn't fully tune hyperparameters, so our current parameters may not be optimal. Additionally, 'No-PPE' classes performed poorly because the model struggles to learn the absence of gear (which looks very diverse) compared to the presence of gear, often mistaking violations for background.

Hyde: On the software side, I used Gemini App Design for the frontend structure. However, for the backend, I implemented our Yolov8n model best.pt as the backend model instead of using Gemini. Therefore, the API key button and Gemini model shown in the UI can be ignored.