AI for Personalized Task Assignments in Civil Engineering

Group 10

Anfal Ahammed: 08

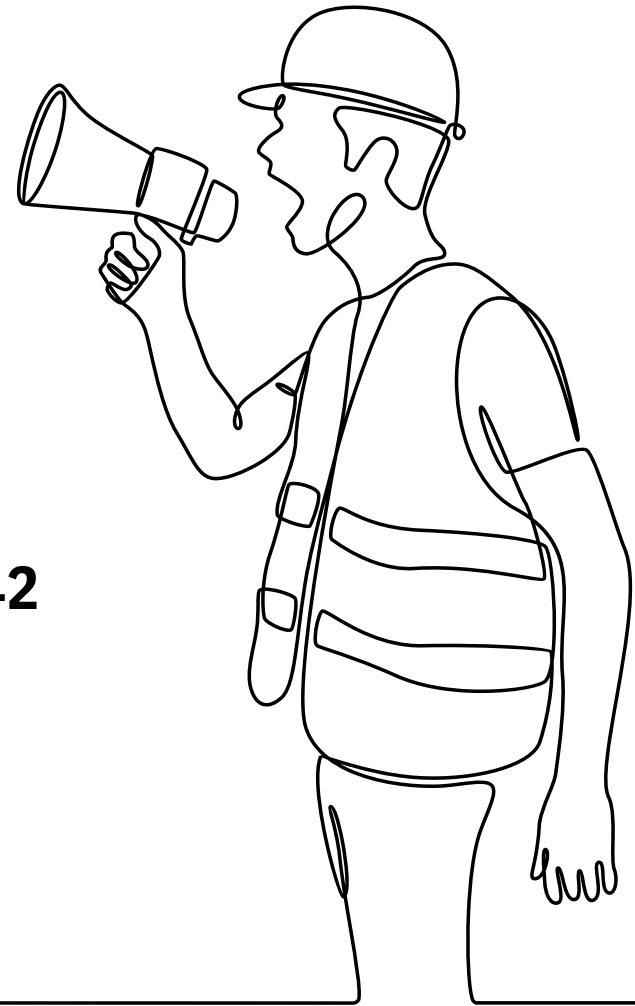
Asrar C H: 13

Mohammed Falahi: 33

Muhammed Fahim Ebrahim A: 42

Guide: Ms. Fathima Shana E

Assistant Professor ADS Department



Introduction

- Manual worker allocation is inefficient and error-prone.
- BERT-based AI model optimizes task assignments using skill matching.
- PPE detection ensures safety compliance on construction sites.

Problem Statement

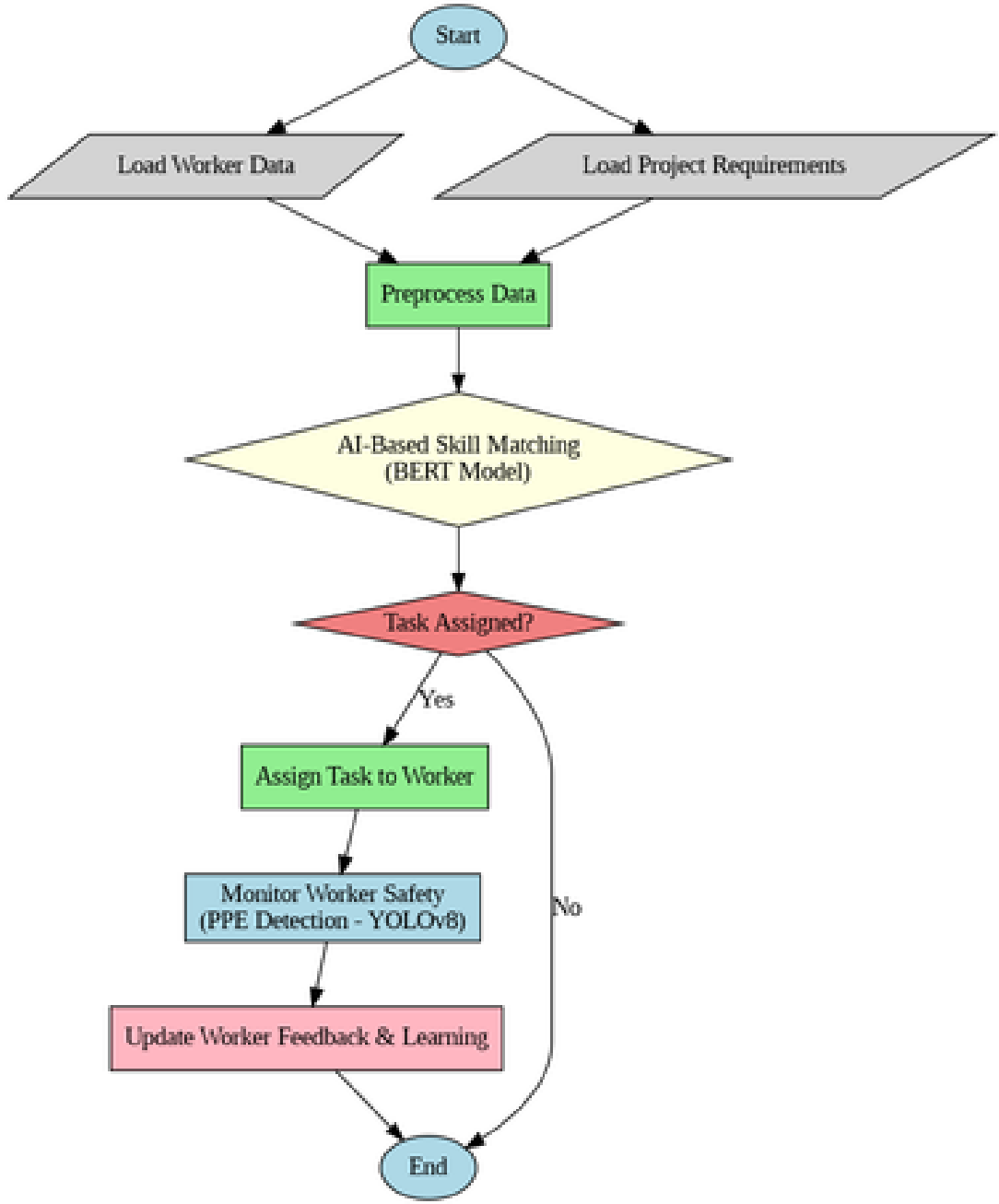
- Traditional task assignment fails to consider worker expertise and health conditions.
- Leads to inefficient workforce management, safety violations, and delays.
- Need for AI-driven optimization to reduce errors and increase productivity.
- Automated detection of Personal Protective Equipment (PPE) using AI to ensure worker safety and compliance on construction sites.

Objectives

- Develop an AI system to match workers to tasks based on skills and experience.
- Implement a Django-based web application for task assignments.
- Integrate PPE detection using YOLOv8 for workplace safety monitoring.

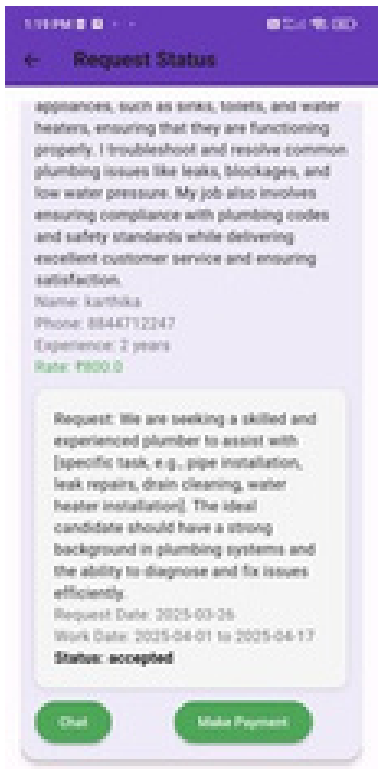
Methodology Overview

- Data Collection : Worker profiles, skills, and job descriptions.
- Pretrained BERT model for worker-task matching based on embeddings.
- Django-based web interface for real-time task allocation.
- YOLOv8model trained for safety gear detection in construction sites.


Start
Load Worker Data
Load Project Requirements
Preprocess Data
AI-Based Skill Matching
(BERT Model)
Task Assigned?
Yes
No
Assign Task to Worker
Monitor Worker Safety
(PPE Detection - YOLOv8)
Update Worker Feedback & Learning
End

Worker Allocation Using BERT

- Pretrained BERT model fine-tuned for task-worker matching
- Converts text-based job descriptions into vectors.
- Computes cosine similarity between worker profiles and job requirements.

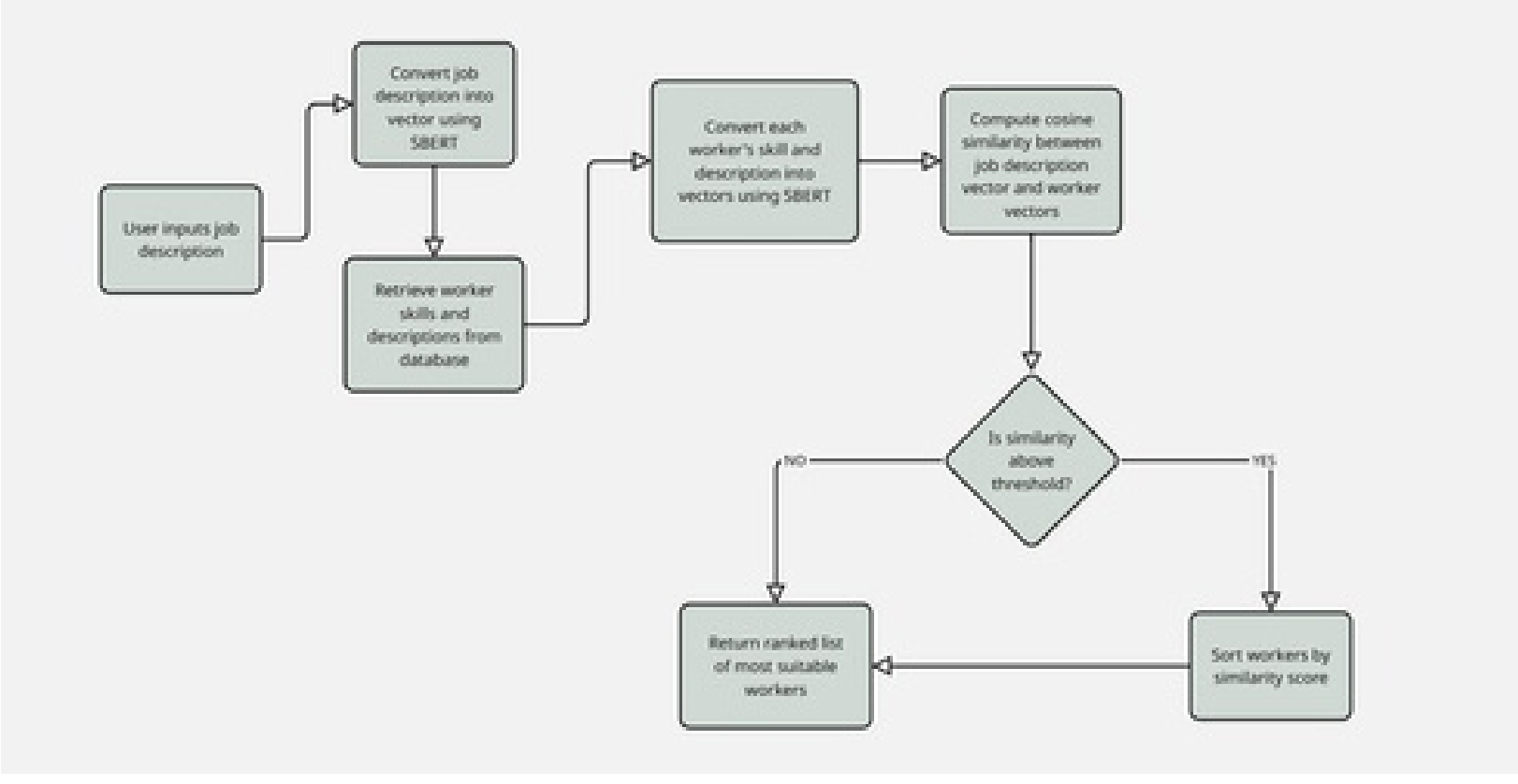


Worker Data Preprocessing

- Collects structured, unstructured worker data (skills, experience, skill description)
- Uses text preprocessing techniques(tokenization, stopword removal, stemming)
- Embeds worker profiles tasks into vector space using BERT

BERT Model Fine-Tuning

- Training Strategy: Fine-tune pretrained BERT with task-worker relevance labels.
- Optimization: Uses cross-entropy loss to classify the best-suited worker for a task.



Worker-Task Matching Algorithm

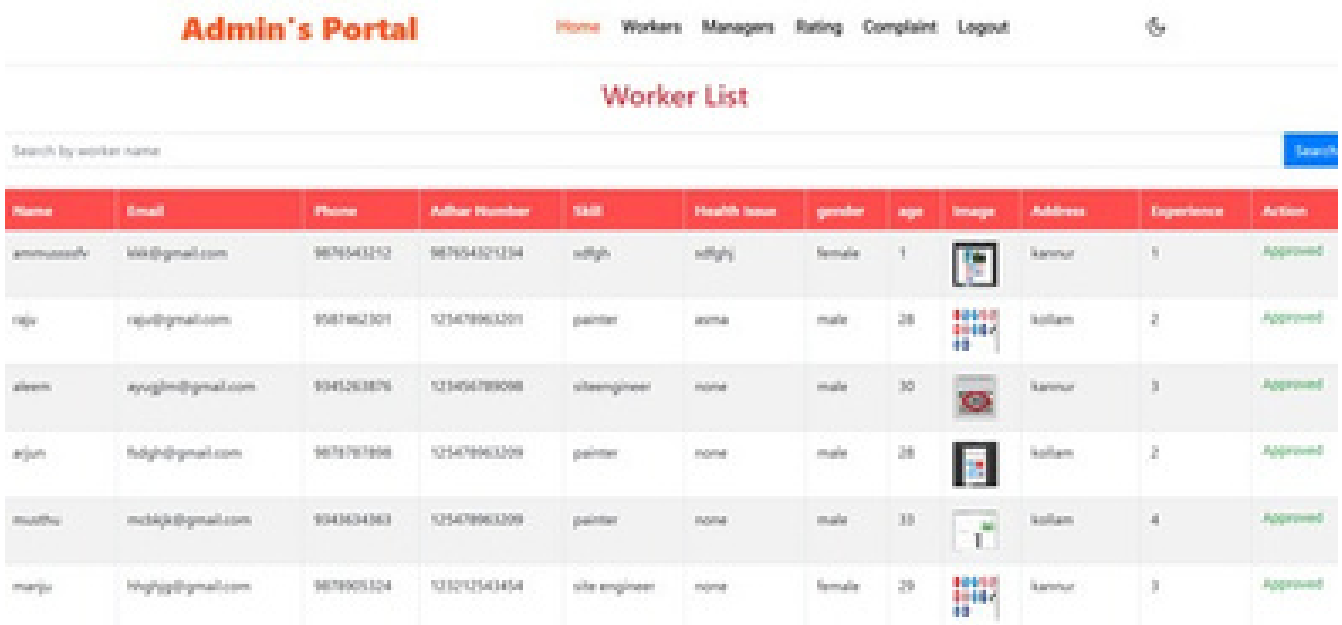
- Converts job descriptions into BERT embeddings.
- Computes similarity scores between job and worker profiles.
- Assigns highest-ranked workers based on similarity thresholds.

Django Web Application Architecture

- Backend: Django + PostgreSQL for structured data storage.
- Frontend: HTML, CSS, JavaScript for user interaction.
- API Integration : REST APIs for AI model communication.

User Roles & Access Control

- Admin: Approves workers, manages complaints, oversees PPE compliance.
- Worker: Add skills, Updates skills,check job requests , checks payments.
- User: Posts job requests, rates workers, makes payments.



Worker's Portal

Home Rating Skill Payment Chat Feedback Complaint Logout

Add New Skill

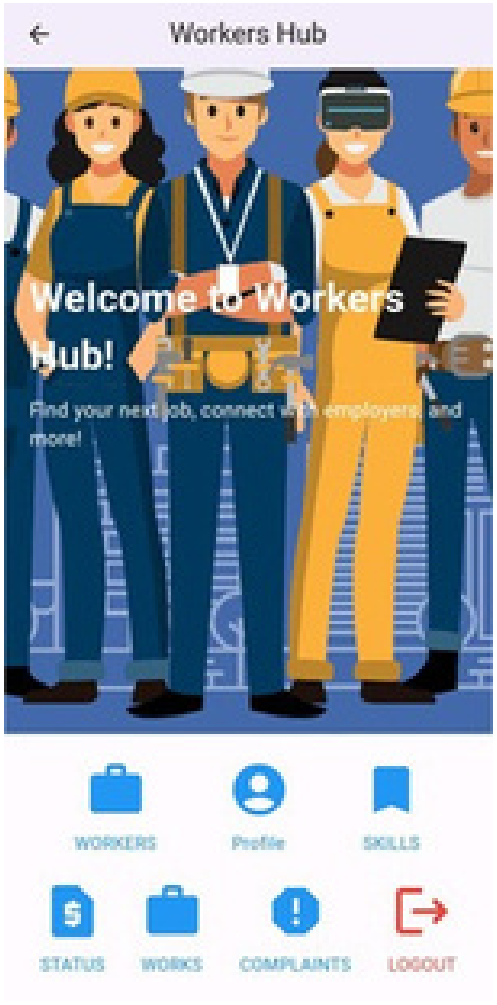
Skill

Experience

Description

Expected remuneration

Submit



Database Schema

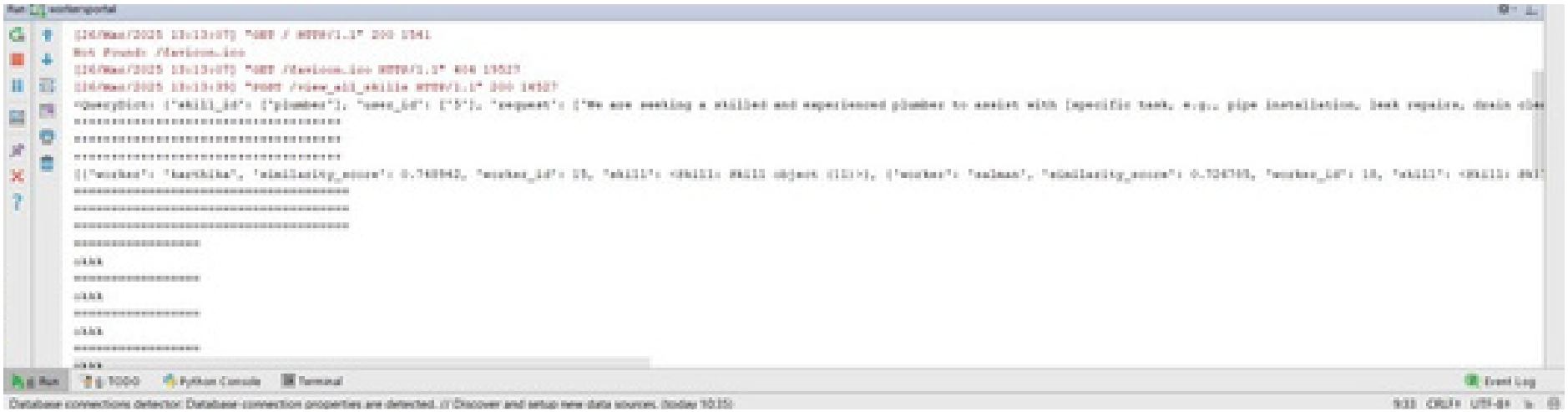
- This database schema is designed using Django ORM.
- Efficiently manages users, workers, job requests, payments, and communication.
- Establishes relationships between different entities using Foreign Keys.

Database Schema Overview

- Authentication & Users → Login, Worker, User
- Work & Requests → Skill, Request, request_more
- Ratings & Complaints → Rating, Feedback, Complaint
- Payments & Chat → Payment, Chat

Task Assignment Workflow

- Step 1: Employer submits job request specifying required skills.
- Step 2: AI-based worker matching using BERT-generated similarity scores.
- Step 3: Assign job to worker with highest similarity score.



Task Assignment Workflow

- Text to Vectors → SBERT (all-MiniLM-L6-v2) converts job descriptions & skills into vectors.
- Worker Profiles → Averages skill & description vectors.
- Similarity Check → Uses cosine similarity to match jobs with workers.
- Recommendation → Returns top-matching workers based on scores.

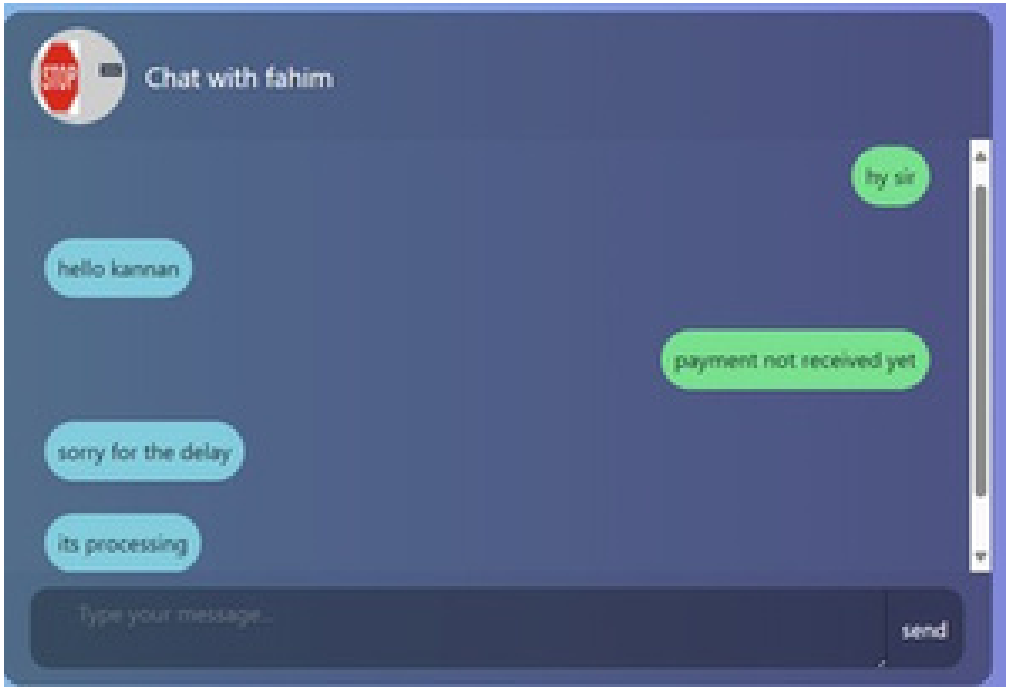
Top Worker Similarity Scores for Painter Task

Worker Name	Worker ID	Similarity Score
Karthika	15	0.740842
Salman	18	0.726795
Arun	10	0.712301
Jithu	8	0.698654
Manu	13	0.685902

- Best Matched Worker: **Karthika**
- Worker ID: 15
- Similarity Score: 0.740842

Communication & Chat System

- Real-time messaging between employers and workers.
- Secure chat storage for reference & documentation.
- Facilitates quick task clarifications and issue resolution.



Payment & Worker Compensation System

- Integrated payment gateway for secure worker transactions.
- Transaction history stored for record-keeping & transparency.
- Workers view pending payments & completed transactions.

PPE Detection: Enhancing Site Safety

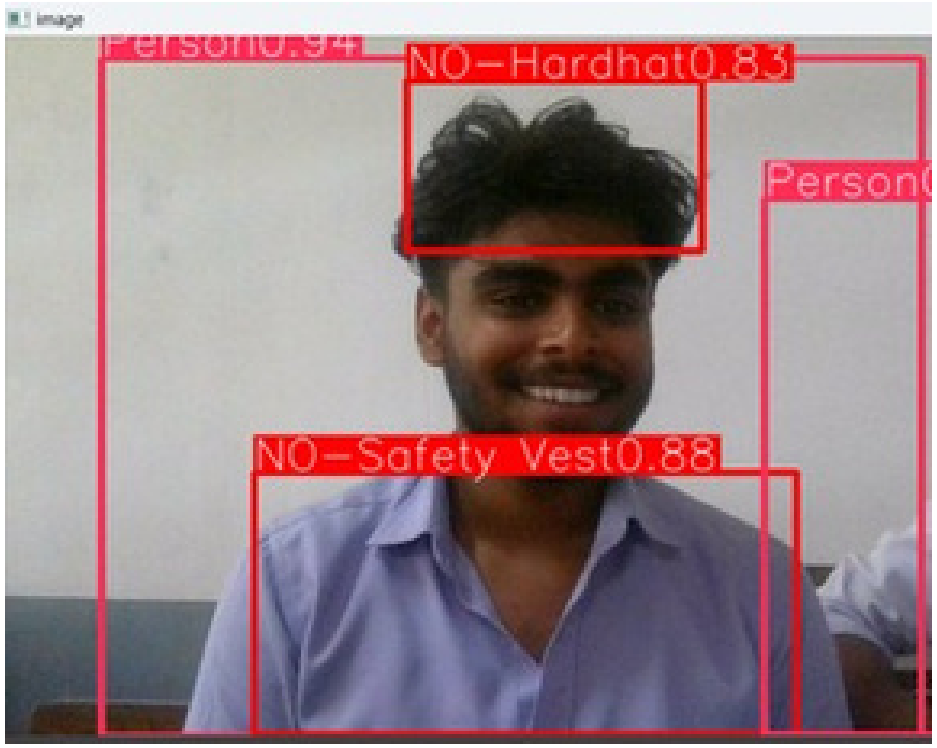
- Uses YOLOv8 model to detect PPE violations.
- Identifies helmets, safety vests, and missing safety gear.
- Reduces accidents by ensuring compliance with safety regulations.

PPE Detection Dataset & Model Training

- Dataset : Roboflow PPE dataset (5 object classes).
- Training Setup :
  - YOLOv8 model trained for 50 epochs.
  - Batch size: 16, learning rate: 1e-3.
- Evaluation Metrics : mAP (Mean Average Precision) for accuracy.

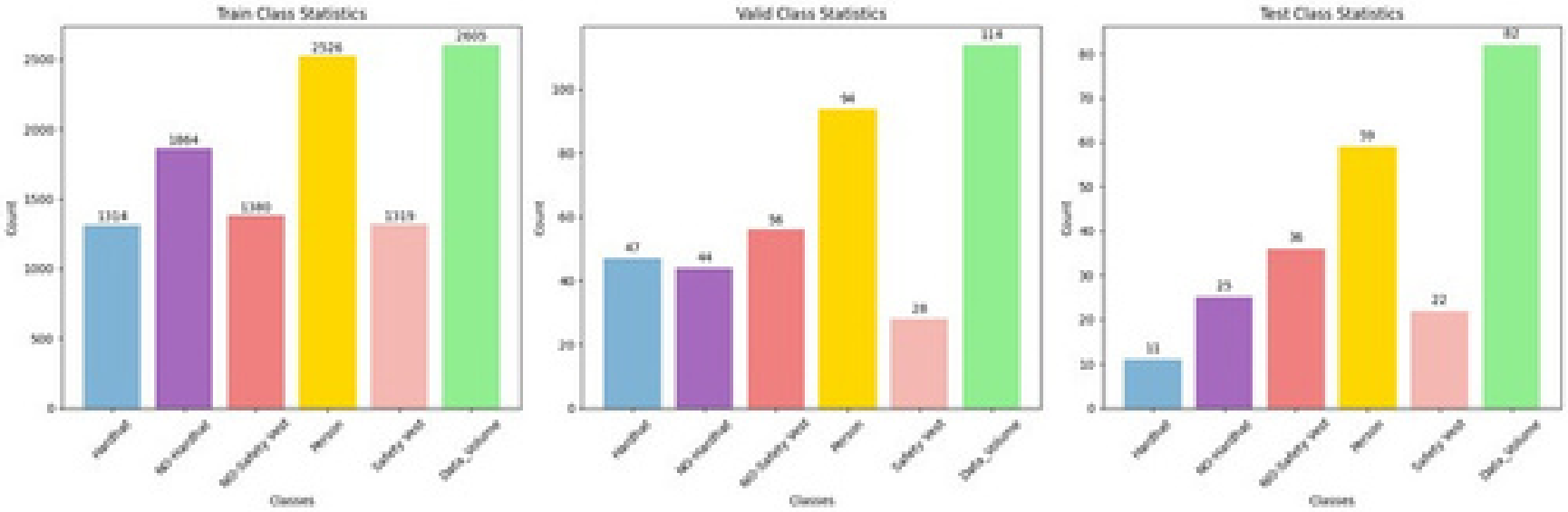
PPE Detection Algorithm

- YOLOv8 modelprocesses video feed frame by frame.
- Classifies detected objects into compliant & non-compliantcategories .
- Violation strigger real-time alerts.



PPE Detection Accuracy & Performance

- Hardhat detection accuracy: 92%.
- Safety-vest detection accurac y : 89%
- Processing Speed: 20 FPS onRTX 3060 GPU.



Comparison: Traditional vs AI-Based Worker Allocation

Metric	Manual Assignment	AI-Based Assignment	Improvement
Speed (min/task)	30	3	90% faster
Accuracy (%)	70	92	+22%
Cost (₹/task)	500	350	30% reduction

Figure 2: Quantitative Comparison Between Manual and AI-Based Task Assignment

Challenges & Limitations

- Data Scarcity : Need for large-scale labeled worker-task data.
- Model Bias : Ensuring fair worker-task distribution.
- AI Adoption : Resistance from construction firms to AI-based tasking.

AI Impact on Civil Engineering Industry

- Reduces task misallocation , improving efficiency.
- Ensures workforce safety through PPE monitoring.
- Optimizes labor cost by assigning the right workers to the right jobs.

Future Enhancements

- Worker health monitoring integration via IoT sensors.
- Geospatial AI allocation to optimize worker deployment based on location.

- AI-powered multilingual worker support for diverse labor forces.

Conclusion

- BERT-based AI significantly improves worker-task matching.
- PPE detection enhances safety compliance on construction sites.
- The system enhances efficiency, safety, and cost-effectiveness in civil engineering.

References

[1] R. Cheng and H. Wu, “Improving workforce efficiency through data-driven role assignment,” 2021.

[2] K. O’Reilly and M. Thompson, “Health and safety data integration in civil workforces: The role of AI,” 2020.

[3] S. Patel and P. Singh, “The role of artificial intelligence in reducing human error in civil infrastructure,” 2020.

[4] A. A. Karakhan, C. A. Nnaji, J. A. Gambatese, and D. R. Simmons, “Best prac- tice strategies for workforce development and sustainability in construction,” Practice Periodical on Structural Design and Construction, vol. 28, no. 1, p. 04022058, 2023.

[5] M. A. Nayeem, “Workforce management decisions in the construction industry in the UAE,” Journal of Comparative International Management, vol. 23, no. 1, pp. 55-69, 2020

THANK YOU..