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College name: JEPPIAAR ENGINEERING COLLEGE

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Technology-project name:
"SmartEvac: An Intelligent Evacuation Planning System for Disaster Response"

Submitted By,

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Phase 5: Project Demonstration & Documentation

Title: SmartEvac: An Intelligent Evacuation Planning System for Disaster Response

Abstract:

The SmartEvac project aims to transform emergency evacuation strategies using artificial intelligence, real-time geospatial data, and predictive modeling. In its final phase, SmartEvac integrates advanced routing algorithms, crowd density analysis, and IoT-enabled hazard monitoring to provide dynamic evacuation guidance during natural or human-made disasters. This document offers a comprehensive report on the project's completion, covering the live demonstration, technical documentation, performance evaluation, codebase, and testing outcomes. Designed for scalability and interoperability with emergency management systems, SmartEvac ensures rapid, informed decisions in crisis scenarios. System diagrams, heatmaps, and code snapshots will be included to thoroughly demonstrate the system's architecture and operational flow.

1. Project Demonstration

Overview:

The SmartEvac system will be demonstrated in a simulated disaster scenario, showcasing real-time adaptability, dynamic route planning, and its integration with emergency infrastructure. Key features, algorithmic efficiency, and sensor integrations will be presented live.

Demonstration Details:

- **Scenario Simulation:** A real-time walkthrough using a simulated disaster (e.g., flood or earthquake) will show how SmartEvac responds to evolving hazards and population movement.
- **Dynamic Path Optimization:** The demonstration will highlight the AI model's ability to recalculate optimal evacuation routes based on blocked paths, real-time crowd flow, and incoming data from sensors.
- **IoT Integration:** Sensors will simulate real-time hazard detection (e.g., temperature rise, gas leak), triggering system updates and route changes.
- **Performance Metrics:** Route generation speed, system load capacity, and responsiveness to environmental changes will be demonstrated under varying conditions.
- **Security & Privacy:**Data transmission, encryption protocols, and system robustness during high traffic conditions will be explained and exhibited.

Outcome:

By the end of the demonstration, The demonstration will confirm SmartEvac's ability to operate effectively during emergencies, update plans in real-time, and ensure safe, efficient evacuations with secure data handling.

2. Project Documentation

Overview:

Comprehensive technical and user documentation is provided for SmartEvac, detailing system components, AI logic, network structure, and usage guides for stakeholders and system operators.

Documentation Sections:

- **System Architecture:** Diagrams displaying AI-driven route logic, hazard sensor integration, user input flow, and backend control systems.
- **Code Documentation:** Complete source code with detailed explanations for modules such as real-time mapping, threat detection, pathfinding algorithms, and alert mechanisms.
- **User Guide:** A step-by-step guide for residents and first responders to use SmartEvac via mobile or web platforms.
- **Administrator Guide:** Technical documentation for emergency control room operators, including system monitoring, node setup, and manual overrides.
- **Testing Reports:** Reports on algorithm accuracy, edge case performance, disaster response timing, and fail-safe operation metrics.

Outcome:

The documentation will serve as a definitive reference for deployment teams, developers, and emergency response coordinators, enabling effective system management and expansion.

3. Feedback and Final Adjustments

Overview:

Stakeholder and test user feedback will be gathered through hands-on demonstration sessions and simulated drills. This feedback will guide final refinements before formal handover.

Steps:

- **Feedback Collection:** Input will be solicited via structured feedback forms, interviews, and observational analysis during the simulation.
- **System Refinement:** Updates will be made to improve evacuation path accuracy, UI responsiveness, and system interoperability with external APIs and GIS services.
- **Final Testing:** The updated system will undergo stress testing, functional validation in new scenarios, and edge case simulations (e.g., simultaneous multiple disasters).

Outcome:

These adjustments will ensure that SmartEvac is refined for maximum effectiveness in diverse disaster conditions and fully ready for operational deployment.

4. Final Project Report Submission

Overview:

The final report consolidates all development phases, system benchmarks, AI model evolution, and design decisions made during the project lifecycle. This report will include testing results, performance improvements, and future recommendations.

Report Sections:

- **Executive Summary:** An overview highlighting SmartEvac's objectives, innovation points, and final outcomes.
- **Phase Breakdown:** In-depth summaries of each project stage—from AI routing model development and IoT integration to interface deployment and testing procedures.
- **Challenges & Solutions:** A detailed record of issues such as sensor latency, data synchronization in high-density zones, and user experience barriers, alongside solutions implemented.
- **Outcomes:** A technical and operational evaluation of the system's current capabilities and readiness for city-scale deployment.

Outcome:

The report will provide a complete narrative of SmartEvac's evolution, supporting its adoption by emergency management agencies or integration with smart city systems.

5. Project Handover and Future Works

Overview:

The project will be formally concluded with a structured handover and strategic roadmap for long-term growth and system enhancement.

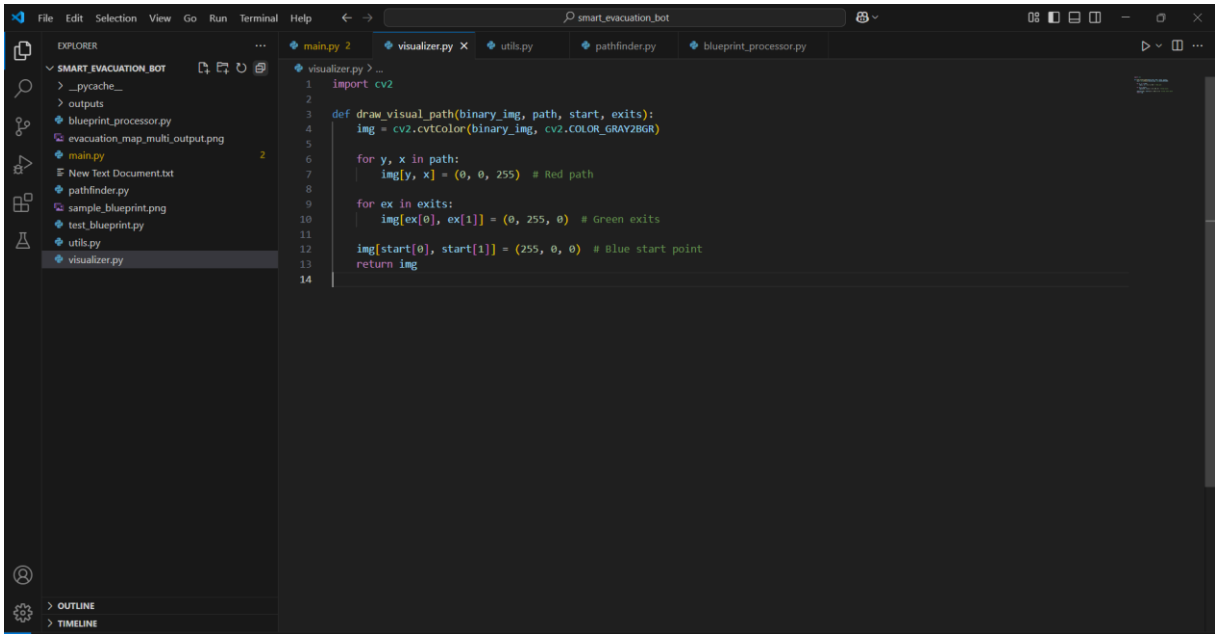
Handover Details:

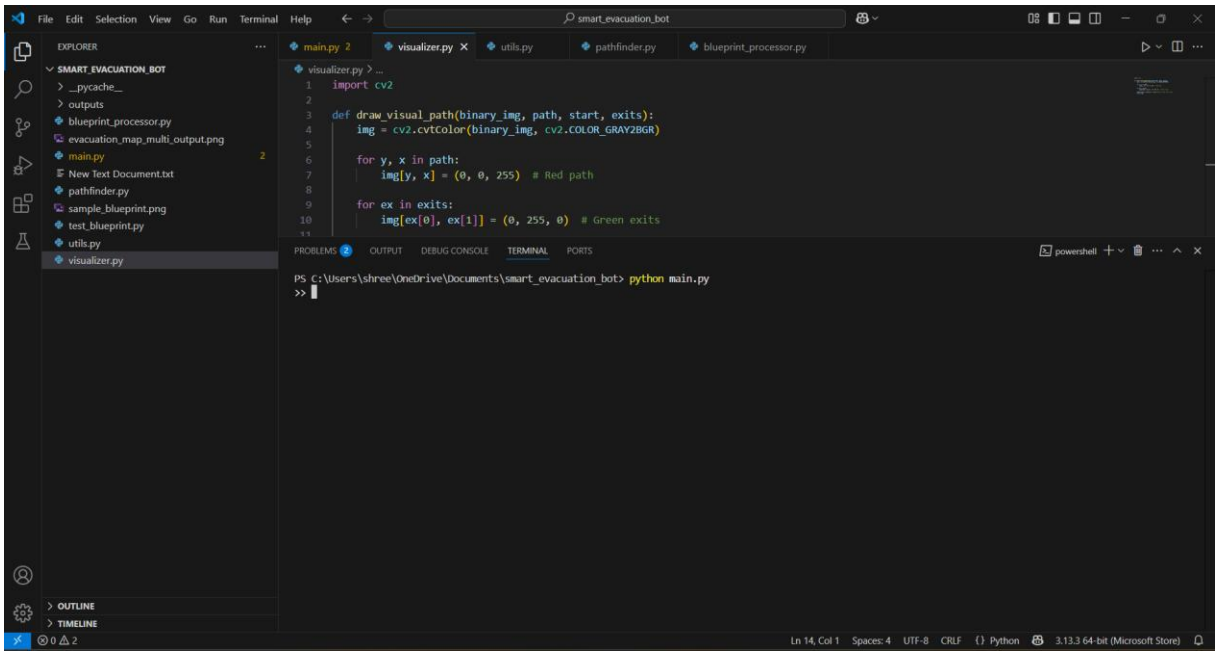
- **Next Steps:** Recommendations will include expanding disaster type support (e.g., tsunamis, wildfires), multilingual support for public alerts, and AI-enhanced predictive analytics for pre-disaster planning.
- **System Scalability:** Guidelines for scaling SmartEvac across regions with different infrastructure and user density levels.
- **Integration Opportunities:** Future plans for integration with national emergency alert systems, traffic control units, and public transport networks.

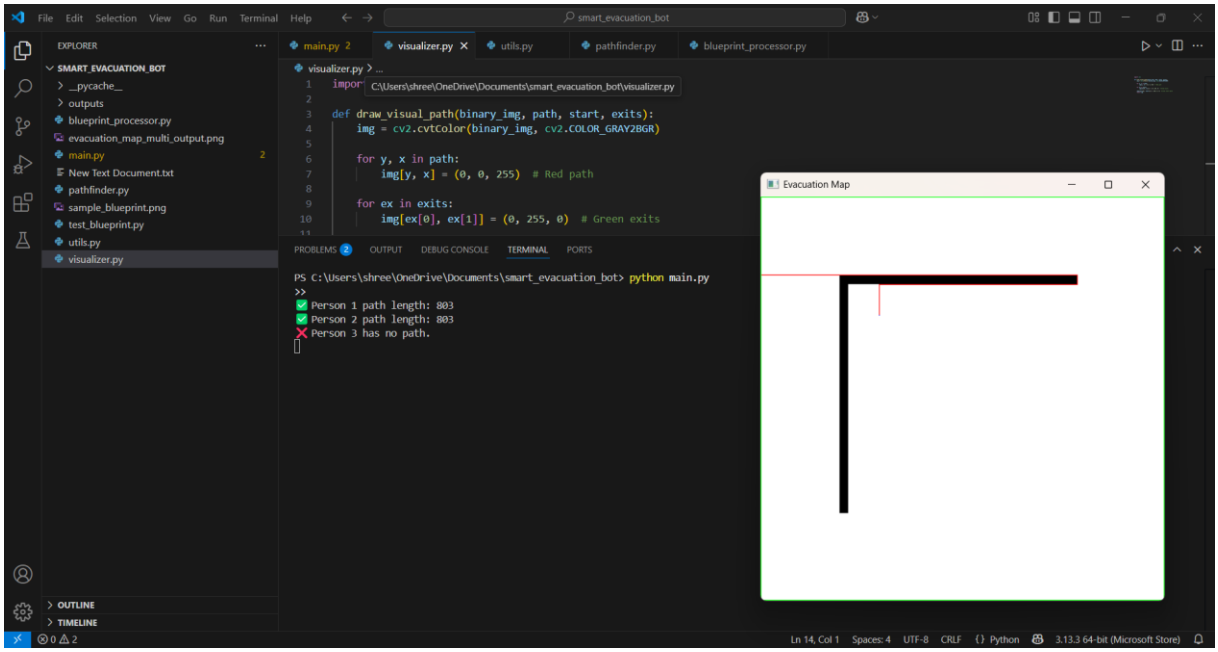
Outcome:

SmartEvac will be formally transitioned to relevant authorities or research entities, along with all technical assets and a clear roadmap for feature upgrades, system scaling, and continuous innovation.

Screenshots of source code and Working final project.






File Edit Selection View Go Run Terminal Help
smart_evacuation_bot
EXPLORER
SMART_EVACUATION_BOT
__pycache__
outputs
blueprint_processor.py
evacuation_map_multi_output.png
main.py
New Text Document.txt
pathfinder.py
sample_blueprint.png
test_blueprint.py
utils.py
visualizer.py
main.py 2
visualizer.py
utils.py
pathfinder.py
blueprint_processor.py
C:\Users\shree\OneDrive\Documents\smart_evacuation_bot\visualizer.py
def draw_visual_path(binary_img, path, start, exits):
img = cv2.cvtColor(binary_img, cv2.COLOR_GRAY2BGR)
for y, x in path:
img[y, x] = (0, 0, 255) # Red path
for ex in exits:
img[ex[0], ex[1]] = (0, 255, 0) # Green exits
PROBLEMS 2
OUTPUT
DEBUG CONSOLE
TERMINAL
PORTS
PS C:\Users\shree\OneDrive\Documents\smart_evacuation_bot> python main.py
>>
Person 1 path length: 803
Person 2 path length: 803
Person 3 has no path.
Evacuation Map
OUTLINE
TIMELINE
Ln 14, Col 1
Spaces: 4
UTF-8
CRLF
Python
3.13.3 64-bit (Microsoft Store)