Night-Time Pedestrian Detection Using Vision and Radar Fusion

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1,ABSTRACT

Traffic accidents during night-time conditions account for a significant portion of road fatalities, primarily due to poor visibility and delayed driver response. Conventional pedestrian detection systems that rely solely on vision-based techniques often fail in low-light environments, adverse weather conditions, and glare from headlights. To address these challenges, this project proposes a **Night-Time Pedestrian Detection System using Vision and Radar Fusion**.

To overcome these challenges, this project proposes a **Night-Time Pedestrian Detection System using Vision and Radar Fusion**. The system combines camera-based visual information with radar data to leverage detailed appearance features along with accurate distance and motion measurements.Using deep learning-based feature-level sensor fusion, the proposed system achieves reliable pedestrian detection with reduced false positives. Real-time detection and early warning capabilities make the system suitable for applications such as ADAS, autonomous vehicles, and smart traffic monitoring, thereby enhancing overall road safety.

2. INTRODUCTION

Pedestrian safety is a major concern in modern transportation systems, particularly during night-time driving when visibility is poor. A significant number of pedestrian accidents occur after sunset due to inadequate lighting and delayed driver perception.

Conventional pedestrian detection systems mainly rely on camera-based vision techniques, which perform well during daytime but fail under low-light and adverse weather conditions such as fog, rain, and glare. Radar sensors can operate effectively in such environments but lack detailed object classification.

To address these limitations, this project combines vision and radar sensors using deep learning-based sensor fusion. The integrated approach enables accurate and reliable pedestrian detection at night, thereby improving road safety and accident prevention.

3. EXISTING SYSTEM

The existing pedestrian detection systems are primarily vision-based and use cameras along with image processing and deep learning models to detect pedestrians. These systems analyze video frames to identify human shapes, movements, and features.

3.1 Limitations

- Poor performance in **low-light and night-time conditions**
- High false detection rate due to shadows, reflections, and headlights
- Ineffective during **fog, rain, and smoke**
- No reliable distance or speed estimation

- Limited real-time accuracy in safety-critical scenarios

4. PROPOSED SYSTEM

The proposed system integrates **camera vision data with radar sensor data** to detect pedestrians at night accurately. The vision module uses deep learning models to extract visual features, while the radar module processes range, velocity, and motion data. A sensor fusion mechanism combines both features to make robust detection decisions.

4.1 Advantages

- Reliable pedestrian detection in **complete darkness**
- Works effectively in **bad weather conditions**
- Accurate estimation of distance and movement
- Reduced false alarms
- Real-time detection and alert generation
- Suitable for ADAS and autonomous vehicles

5;SYSTEM REQUIREMENTS

5.1Hardware Requirements

- Processor: Intel i5 or higher
- RAM: Minimum 8 GB
- Storage: 256 GB HDD/SSD
- Camera (RGB / IR / Thermal – optional)
- Radar Sensor (optional for implementation)

5.2 Software Requirements

- Operating System: Windows / Linux
- Programming Language: Python
- Frameworks: TensorFlow / PyTorch
- Libraries: OpenCV, NumPy, Matplotlib
- Development Tools: VS Code / Jupyter Notebook

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