Action-Aware Vision Language Navigation: A Novel Reinforcement Learning Framework for Dynamic Navigation in VR and Beyond

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Visually impaired individuals have difficulty understanding their environment and the actions of others due to their limited visual abilities. Previous research has shown that approaches used in robotics and augmented reality can provide navigation assistance, but these approaches struggle to understand dynamic environments. Existing approaches such as SLAM-based navigation and VLN have limitations in understanding dynamic environments. In order to assist visually impaired individuals in navigating to their destinations, we propose a cross-modal transformer-based action-aware VLN system that understands natural language instructions and dynamic environments, including human actions, to aid navigation. Our project innovatively proposes a vision and language-based navigation framework that includes an Agent with scene navigation and action recognition algorithms, and a Simulator with human action. To train the Navigation Agent and Simulator, we will use reinforcement learning with a dynamic environment simulator that includes virtual human figures and their actions. Our framework is capable of: 1) using the cross-modal transformer structure to understand and reason about events and actions using vision, text, and audio, 2) navigating in environments with human actions, and 3) understanding natural language instructions. Experimental results demonstrate our framework outperforms other methods, and its benefits are evident in VLN navigation. Our ablation study demonstrates the benefits of leveraging visual and language modalities to understand human-like events. Our project has potential applications in fields such as robotics, augmented reality, and human-computer interactions, and could help advance the field of artificial intelligence in the area of vision understanding.

Awards Won:
Association for Computing Machinery: Second Award of $3,000
Fourth Award of $500