



Application of Eye-Tracking and Video Analysis Technologies in Medical Education

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Market Needs:

In contemporary medical education, imaging resources have become a foundational component of teaching. These resources span a wide range, including cadaveric dissection videos, endoscopic surgical recordings, first-person perspective content through Virtual Reality (VR), Mixed Reality (MR), and Augmented Reality (AR) headsets, as well as radiological imaging such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). In addition, numerous clinical skill training videos, such as those demonstrating cardiopulmonary resuscitation (CPR) or tracheostomy procedures, serve as essential learning tools.

Despite the abundance of such resources, there remains a significant gap between experts and novice learners in accurately identifying key anatomical and clinical structures.

Common issues include:

1. Beginners often struggle to recognize critical structures or focus on incorrect areas when first exposed to medical imaging education.
2. Instructors frequently find it challenging to discern where learners are likely to misinterpret or fail to recognize important details, making it difficult to tailor instruction accordingly.

In this context, the integration of **eye-tracking technology** offers the potential to analyze and quantify gaze patterns between experts and learners during medical image interpretation. This innovation could have far-reaching impacts on both medical and clinical education. The implementation of such technology may yield the following benefits:

- **For academic and teaching institutions:** Eye-tracking can enhance the objectivity and data-driven nature of medical education. It allows educators to precisely identify student attention patterns and learning behaviors, providing evidence for curriculum improvement, learning outcome assessment, and scholarly dissemination. Moreover,

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it supports the development of intelligent teaching methods and fosters interdisciplinary collaboration.

- **For industry partners:** This technology facilitates the integration of eye-tracking, image analysis, and educational technologies, paving the way for the development of market-ready learning analytics systems and clinical training support tools. It can also promote novel models of academia-industry collaboration, increasing commercialization potential and international competitiveness.

In summary, incorporating eye-tracking and image recognition into medical imaging education can effectively bridge the learning gap between novices and experts. It represents a promising direction for innovative teaching tools and research development, offering substantial potential for both educational and technological advancement.

Our Technology:

Integrating Eye-Tracking and Video Analysis Technologies to Develop Innovative Applications in Medical and Clinical Education

Strength:

Multi-Video Automatic Matching and Synchronized Analysis

The system aligns teacher and student video recordings and performs frame-by-frame comparisons based on a user-defined frame rate, effectively replacing time-consuming manual annotation and calibration processes.

Absolute Gaze Distance Calculation

An integrated algorithm automatically calculates the spatial distance between the gaze focal points of experts and learners in paired videos. This enables precise quantification of differences in visual focus and attention.

Temporal Data Output and Visualization (Timeline Mapping)

Analysis results are exported as structured temporal data (e.g., CSV files) or visualized graphs (e.g., line charts), facilitating downstream statistical analysis or integration with machine learning models.

Quantifying Expert-Learner Visual Differences

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This provides a novel, data-driven evaluation method for medical education, industrial training, and related fields. It enables in-depth exploration of attention patterns and cognitive strategies in clinical decision-making, image interpretation, and precision tasks.

Extendable to Multimodal Integration Analysis

Data from eye-tracking video analysis technologies can serve as the core to be integrated with additional modalities such as EEG, gesture tracking, and physiological signals (e.g., heart rate). This supports the development of multidimensional models of learner attention and clinical decision-making behavior.

Enhancing Advanced Clinical and Procedural Skills Training

In domains such as laparoscopic surgery training, ophthalmic image interpretation, pathology slide analysis, and emergency response (e.g., ACLS/PALS), the system provides real-time feedback on gaze discrepancies between learners and instructors, accelerating mastery of critical skills.

Providing Quantifiable Metrics for Teaching Effectiveness

The platform offers educators an objective tool for assessing teaching impact, supporting both daily instructional refinement and providing robust data for research initiatives and IRB-approved educational studies.

Objectively Measuring “Joint Attention”

By using the system to compare in real time the overlapping areas and duration of focus between the expert and the learner (joint attention), the expert can instantly understand the learner’s focus and adjust teaching strategies accordingly based on objective feedback.

Visualizing Learners’ Learning Process

Through the system’s objective quantification of learners’ visual learning trajectories during class, teachers can identify when a learner’s gaze lingers too long on or drifts away from a specific knowledge point. This allows for individualized guidance to address potential learning difficulties in that area and provides data support for classroom management.

Building Expert-Learner Visual Learning Models

By comparing the gaze trajectories of experts and learners, the system can construct an expert gaze pattern model that helps learners intuitively understand the focal points and

sequence of visual attention used by experts when performing complex visual tasks, such as interpreting medical images or observing surgical demonstrations.

Competing Products:

Manufacturers producing teaching aids and materials for medical education in Taiwan and abroad do not produce similar products.

Intellectual Properties:

In Taiwan, there is no similar patent or article describing this application.

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