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Title: **TOPIC ABSTRACT FORM**

College	College of Engineering
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Program	BS Computer Engineering

Proposed Title

VigilAI: A Machine Learning-Powered Multi-Camera Proctoring System for High-Fidelity Behavior Analysis via Integrated Pose and Object Recognition

Background of the Proposed Topic:

The development of Artificial Intelligence (AI) has become a major technological advance, designed to replace the need for manual work conducted by humans in different fields (Anjila, 2021). In response to the changes in education, many institutions have embraced technology by developing 'smart classrooms' to improve teaching quality through advanced tools. Despite this technological investment, these classrooms have not yet reached their full potential, as only a limited number of institutions have integrated Artificial Intelligence into their smart classroom infrastructure. According to (Busu, 2024) classrooms utilizing AI bring a significant transformation to education, enabling personalized learning, streamlining administrative tasks, and improving the creation of educational content. Despite these advances, one area where AI's potential remains largely untapped is in monitoring and analyzing student behavior during examinations.

Scholars from Batangas State University (Datingaling et al., 2025) successfully designed and developed an AI-powered application system for digitizing behavioral coding during examinations through action recognition and computer vision. Conducted in a fixed classroom setting, they compiled 1.7 million behavior sequences; trained and compared three action recognition models. They integrated this with YOLOv8 for human detection and pose estimation to flag suspicious behavior. This research demonstrates a pathway toward using AI for accurately showing different examination behaviors to help identify potential academic misconduct.

While this existing research proves that AI can successfully classify behaviors, there are several gaps that must be addressed to use the system as a real-time assistive tool. Their findings are based on a two-camera setup which limits the coverage and data diversity. The validity of any detection system is based on its quality of data, a limited labeling team risks bias. Thus, there is a need for experts in labeling suspicious behaviors for more reliable data. Lastly, the existing models were trained on staged clips, to increase the accuracy of the system, training these models on actual examinations should be considered.

This study VigilAI: A Machine Learning-Powered Multi-Camera Proctoring System for High-Fidelity Behavior Analysis via Integrated Pose and Object Recognition proposes the development and utilization of the existing system that incorporates multiple cameras to improve the monitoring and observation of the students during examinations, presented through software with clear visualizations, and by training the AI to identify and detect prohibited objects and suspicious behavior. Through these improvements, the research will develop a more robust tool designed to assist human proctors in a live examination setting.

The main objective of this study is to design and develop a machine-learning powered multi-camera proctoring system that provides high-fidelity behavioral analysis through integrated object detection and pose recognition. Specifically, this study aims to:

1. Implement data coverage and detection accuracy by implementing a multi-camera setup positioned at varying angles and heights (150–350 cm) to minimize blind spots and improve behavior recognition.

2. Reduce annotation bias by involving multiple experts in labeling suspicious behaviors and establishing a standardized annotation protocol for consistent dataset creation.

3. Enhance the model's generalizability by incorporating diverse real-world examination footage from college students across different year levels, programs, and classroom environments.

4. Evaluate the system's overall performance in different lighting conditions, seating arrangements, and camera setups to ensure its accuracy and reliability in actual exam scenarios.

Research Methodology:

The proposed topic uses both developmental research and machine learning research to design, build, and evaluate Multi-Camera Proctoring System that utilize machine learning. The system integrates camera vision, pose detection, object detection, and behavioral analysis to improve the reliability of academic proctoring.

A. Development Method

The previous model will serve as the foundation for the improvement of the system development. Rapid Application Development (RAD) methodology was adopted in this study to emphasize rapid prototyping, user involvement, and iterative feedback. The development of the improved model will undergo five major processes: Planning, Designing, Development, Implementation, and Testing

1. Planning
   Having the previous model in mind, the researchers determined the recommendations and goals for the improvement and modification of the specifications. The researchers determined that the model will undergo a series of testing the machine capabilities while incorporating the newer generation of software (YOLOv11 and TensorFlow framework) and also hardware (CCTV cameras and Laptop), while also taking into account the process of importing of raw inputs from the video feed of the camera, preprocessing and data cleaning, data transformation through AI Visualization and Head & Arm Visualization, and data output visualizations for the software architecture. Project scheduling, data gathering, and the distribution of the task for the team will also be settled.

2. Designing
   During the designing, the researchers create the overall system structure of theVigilAI, this includes the camera's strategic placement and how they will work together, how the detection and analysis of object and behavior will operate in order for the identification of objects and behaviours. The layout of the proctor dashboard, the alert system, and the behavior logs are also planned. This process will also help the researchers understand how the data will be captured, processed, analyzed and stored.

3. Development
   The development process will focus on the development of the VigilAI. The researchers will train YOLO V11 to detect objects for possible cheating material and for the behavioral analysis of the students including the gestures and movements with the help of the multiple CCTV cameras setup that processes realtime video and recorded video. Proctor dashboard, the alert system, and the behavior logs are programmed and tested before the implementation to ensure that the system is working correctly.

4. Implementation
   The implementation of the VigilAI in a controlled classroom during an examination will be the environment and will signify the start of this process. This will let the researcher test the system's features and whether the system will be able to satisfy the objectives of the study. Modifications and corrections will be made if problems arise.

5. Testing
   During the testing, the researchers will start the testing process in a classroom during an examination. The researchers will check the function of every feature, the usability of the system, whether the user can navigate the interface and understand the logs and alerts , the accuracy of the object detection and behavioral analysis of the system, and the responsiveness of the system in terms of how fast the detection. The data gathered will be analyzed and discussed throughout the paper.

B. Tools and Technologies Used

a. Hardware
   - CCTV Cameras and Laptop

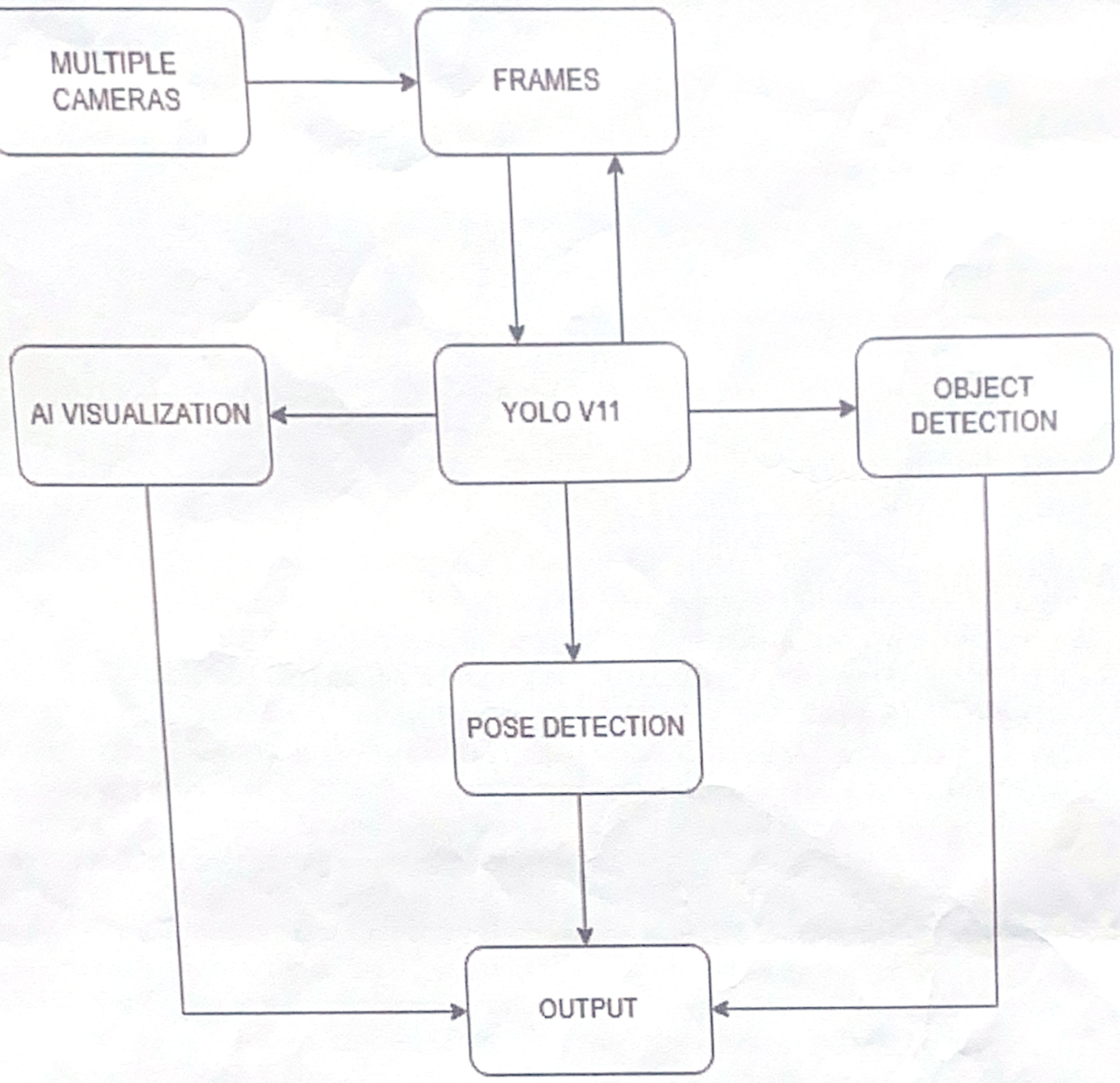
b. Programming Language
   - Python

c. Frameworks
   - PyQt (GUI)
   - TensorFlow (Machine Learning)

d. Deep learning Model
   - YOLOv11

e. Libraries
   - OpenCV

nceptual Framework



TOPIC EVALUATION COMMITTEE

The topic abstract has been thoroughly reviewed by the Topic Evaluation Committee.

	Signature	Remarks
Faculty Expert 2 Engr. Laila C. Hernandez		- What improvement you will do from the past projects !
Faculty Expert 1 Jeffrey Sarwat		- Identify the source of vectors & previous work. Don't just focus on the recommendation
Dr. JEN ALDWAYNE B. DELMO (Research Facilitator)		

Tracking No. _____