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A Novel Method for Distance Calculation from Forensic Sketches Converted from Images

Shreyesh Sanjeev[1]; Litty Jose[2]

[2] HOD; Assistant Professor

[1,2] Department of Forensic Science, St Thomas College, Thrissur

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Abstract: Accurate crime scene documentation is essential in forensic investigations, yet traditional sketching methods are time-consuming, prone to human error, and reliant on investigator skill. This study presents a forensic application designed to automate the sketching and measurement process, enhancing efficiency and precision. The application utilizes Sobel edge detection to convert crime scene photographs into sketches, allowing threshold adjustments for optimal detail representation. Additionally, it incorporates a measurement system that computes distances between evidence points based on four fixed reference points. By inputting known straight-line and diagonal distances, investigators can obtain precise spatial measurements without manual calculations. Tested across fifteen simulated crime scenes, the software successfully validated two hypotheses: (1) edge detection can generate detailed forensic sketches, and (2) accurate measurements can be computed using fixed reference points. The model demonstrated 90-95 percentage accuracy, though challenges such as image warping and background noise require further refinement. This study underscores the potential of digital forensic tools in modern investigations. While the prototype is functional, future enhancements including AI integration, advanced noise reduction, and improved security could further optimize its reliability. Once fully developed, this application has the potential to standardize digital crime scene documentation, improve forensic reconstructions, and provide a valuable resource for law enforcement and legal professionals.

Key Words: *Image to Sketch, Sobel Operator, Edge Detection, Flutter, Crime Scene Documentation.*

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I. INTRODUCTION

Accurate crime scene documentation is crucial in forensic investigations, yet traditional sketching methods are time-consuming, error-prone, and require specialized skills. This project introduces a forensic application that automates crime scene sketching by converting photographs into detailed sketches using Sobel edge detection while incorporating a measurement tool that calculates distances based on four fixed reference points. By integrating digital forensic techniques, the software enhances efficiency and accuracy in crime scene reconstruction, reducing reliance on manual methods. Tested on multiple simulated crime scenes, it demonstrated an accuracy rate of approximately 90-95%, though challenges such as image distortion and background noise remain. As forensic science evolves, adopting automated tools can standardize crime scene documentation, improve reliability, and streamline investigations. Future enhancements, including AI integration and advanced noise reduction, will further refine the software, making it a valuable resource for forensic professionals and law enforcement agencies.

➢ *Objectives*

- Develop a working prototype of an app using flutter software that converts images into sketches using edge detection
- Implement an option to adjust the threshold using a slider to control the level of detail included in the sketch.
- Integrate a method to compute the measurements of evidence in the sketch relative to fixed reference points by allowing users to input the distance between them.

➢ *Hypothesis*

- A detailed fair sketch can be generated from an image using edge detection, with adjustable threshold settings to refine the level of detail.
- Accurate measurements of an object's distance in the sketch can be computed if four fixed reference points are provided and the distances between them are inputted.

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II. METHODOLOGY

This study aimed to develop a forensic application that automates crime scene sketching and measurement to improve accuracy and efficiency in forensic documentation.

The procedure involved capturing photographs of fifteen simulated crime scenes, ensuring proper lighting and a clear bird's-eye or 90-degree perspective. These images were uploaded into the application, where they were processed into sketches. Users then selected four fixed reference points and inputted known distances between them, allowing the software to compute measurements for other evidence points automatically. The accuracy of these computed measurements was assessed by comparing them with manually recorded values.

The results demonstrated a 90-95% accuracy rate, confirming the feasibility of the approach while highlighting challenges such as image distortion and background noise. Future refinements, including AI integration, advanced noise reduction, and improved measurement calibration, are proposed to enhance the software's reliability and forensic applicability.

III. RESULTS

Fig 1 Indoor Crime Scene (Homicide)

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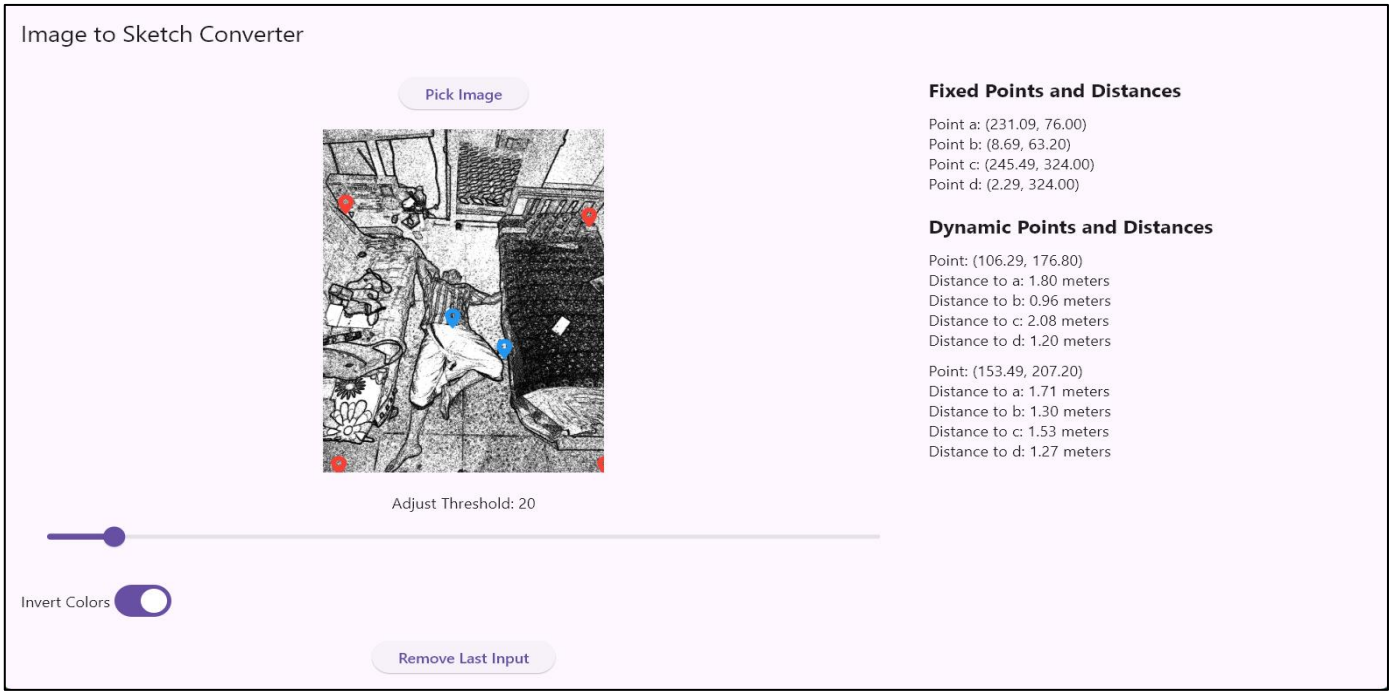

Fig 2 The Fixed Points are ‘A’&’B’ Corners of the Room. ‘C’ Edge of Bed. ‘D’ Middle of Sofa

Fig 3 Indoor Crime Scene (Knife Attack)

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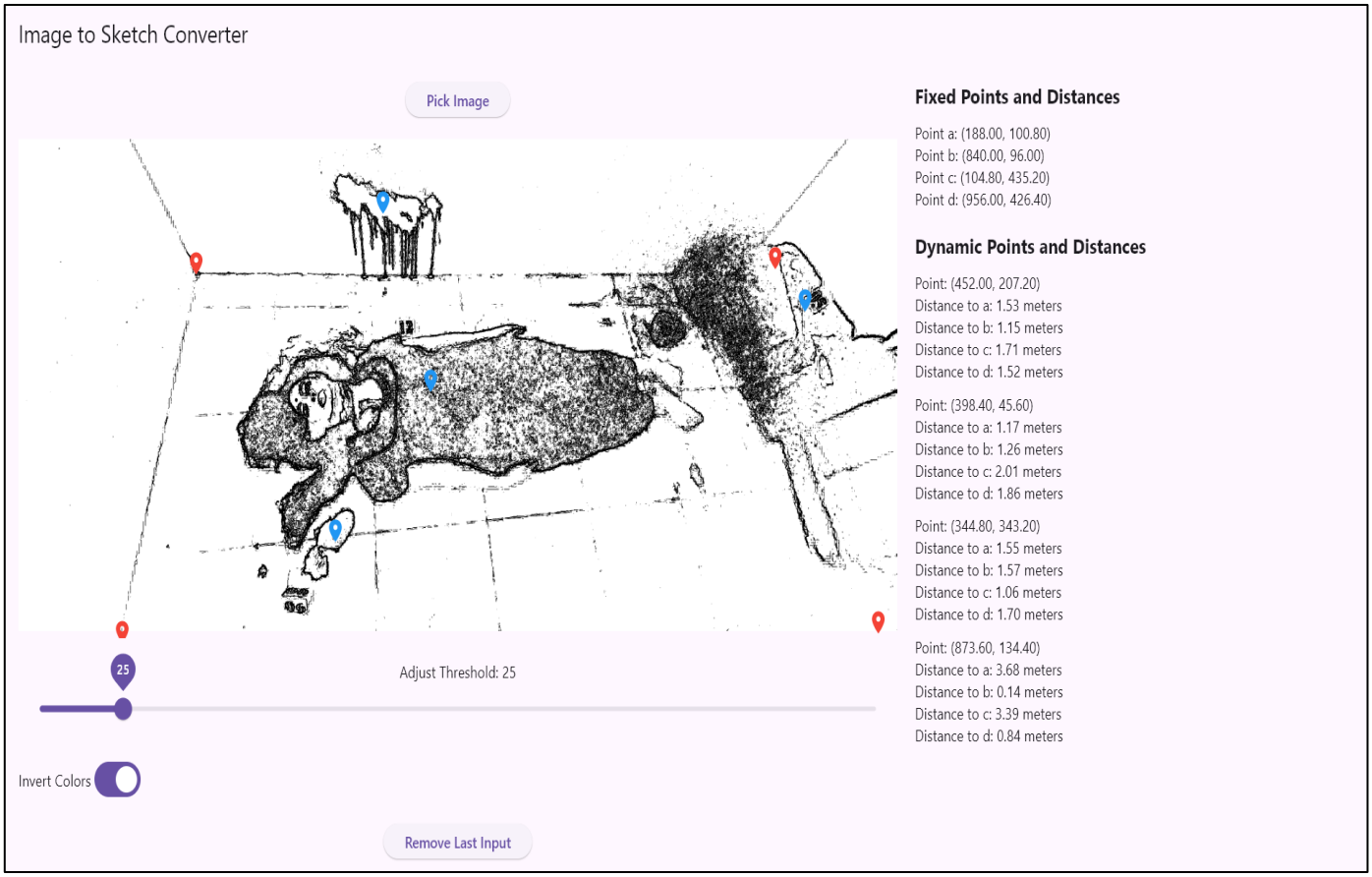

Fig 4 Fixed Points ‘A’ Middle of Table. ‘B’ Corner of Room ‘C’ Corner of Frame ‘D’ Corner of Room


Fig 5 Outdoor Crime Scene (Suicide)

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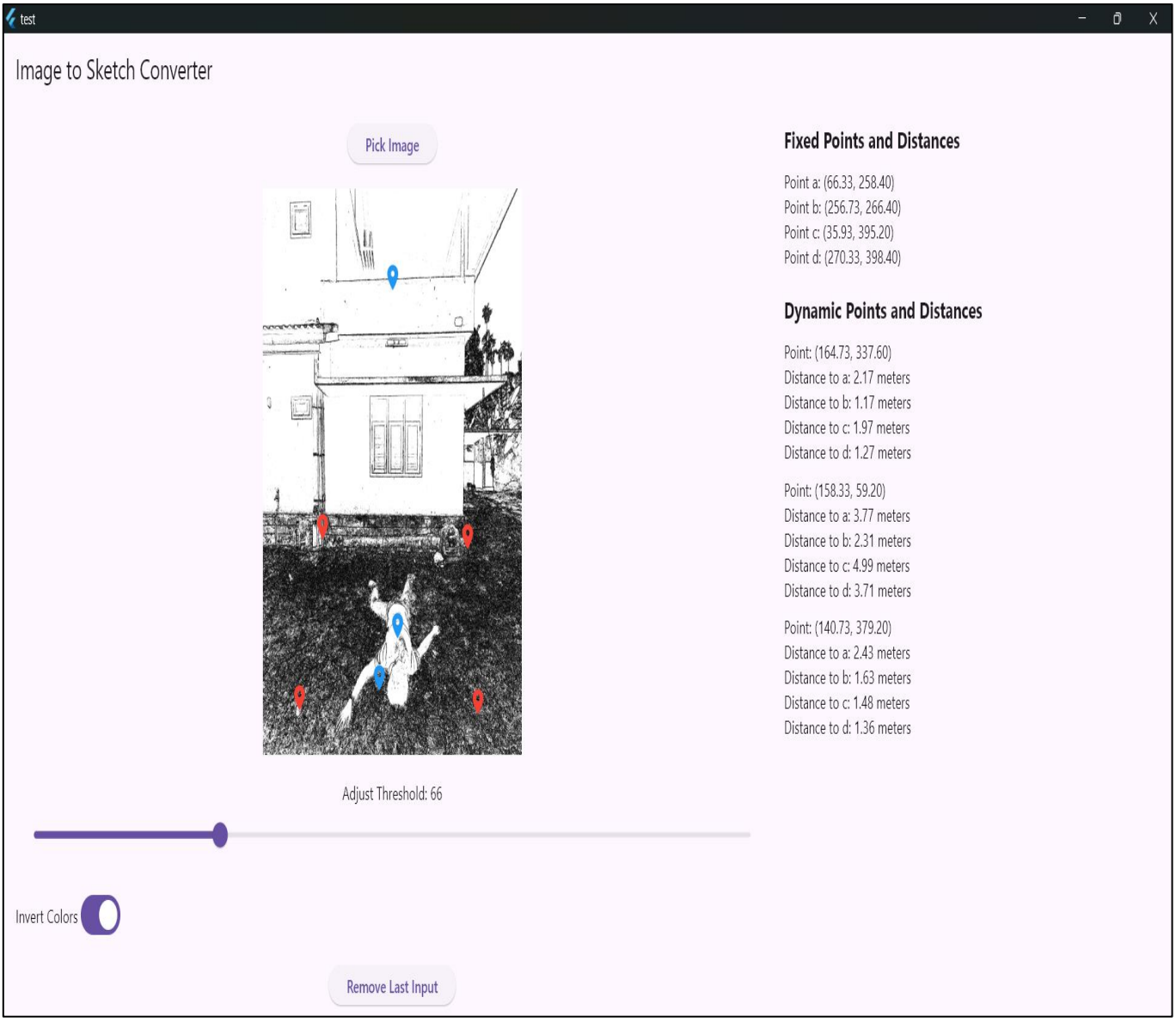

Fig 6 Fixed Points 'A'&'B' Edge of Wall. 'C' Tree Stump 'D' Rock

IV. HYPOTHEIS-BASED INTEPRETATION

The study successfully validated both hypotheses. The first hypothesis stated that a detailed forensic sketch could be generated from an image using edge detection with adjustable threshold settings. This was confirmed through the application's use of Sobel edge detection, which effectively converted crime scene photographs into sketches while allowing users to refine details.

The second hypothesis proposed that accurate measurements of an object's distance within the sketch could be computed if four fixed reference points were provided. Testing across multiple simulated crime scenes confirmed this, with the software achieving 90-95% accuracy in distance calculations. However, minor discrepancies due to image distortion and background noise highlighted the need for further refinement in measurement precision.

Overall, the findings demonstrate that automated sketching and measurement tools can enhance forensic documentation by reducing manual errors and improving efficiency. Future improvements, such as advanced calibration techniques and noise reduction methods, could further optimize the accuracy and reliability of the software.

V. DISCUISSION AND CONCLUSION

➢ *Major Findings*

This study successfully developed a forensic application that automates crime scene sketching and measurement, reducing reliance on manual methods. The software converts photographs into sketches using Sobel edge detection and calculates distances between evidence points based on four fixed reference points. Tested across fifteen simulated crime scenes, the application demonstrated an accuracy rate of approximately 90-95%, validating its effectiveness. The results confirmed that edge detection can generate detailed forensic sketches and that precise measurements can be computed when fixed reference points are provided, making crime scene documentation more efficient and reliable.

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➢ *Limitations*

While the software performed well, certain challenges were identified. Image distortion and background noise impacted measurement accuracy, and the system requires properly captured images taken from a bird's-eye or 90-degree perspective for optimal results. Additionally, the lack of built-in image-saving functionality means users must take screenshots, which may affect image quality.

➢ *Suggestions for Further Studies*

Future research should explore integrating multiple edge detection methods, such as Canny, to improve adaptability based on image quality. Noise reduction techniques like Gaussian blur could enhance clarity, while security features such as encryption and tamper-proofing could ensure forensic reliability. Expanding the application for mobile platforms would enhance accessibility, allowing investigators to document crime scenes more effectively in real time.

➢ *Implications*

Automating crime scene sketching and measurement has significant implications for forensic science. Standardizing documentation minimizes human error, improves investigative efficiency, and strengthens legal proceedings. With further refinements, this technology could become a valuable tool for forensic professionals, transforming the way crime scenes are documented and analysed.

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