

Blood Spatter Source Reconstruction from blood stains on adjacent walls Using Image Processing

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Abstract:-Blood Stain Pattern Analysis (BPA) is a subspecialty module in Forensic Sciences. By using this analysis one can find the position of the victim at the crime scene. The goal of this BPA is to find the point of origin by estimating the flights paths from each stain. Generally the point of origin can be found by using the traditional technique like stringing method. In the process of stringing for stains a string is attached to each stain and the string is placed with an angle to represent the path flight of the stain. Using this technique contaminates the crime scene and also takes time to find the point of origin. Here the stain path flight is considered as linear path. The analysis is done by using the images which are photographed in the crime scene.

Keywords: Blood Spatter Analysis, Impact Angle Identification, 3D position of the source, Forensic science and Stringing Method.

I.INTRODUCTION

Blood Spatter analysis is the one of the most important tool in the forensic science in crime scene reconstruction. The blood drops tend to form into a sphere rather than a tear drop in the flight. The sphere formation is due to the surface tension that binds the molecules together. Other factors also affect the blood drop they are the gravity, viscosity, and blood pressure [1].

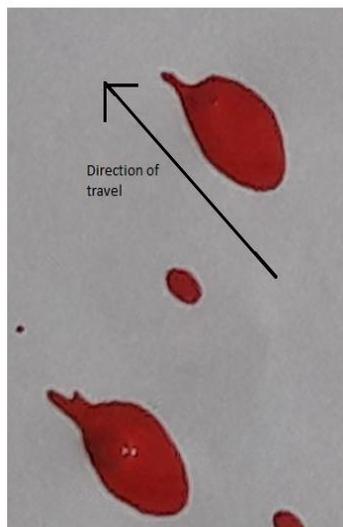


Figure 1: Projection of blood in 2D

The direction of travel of blood stain has to be taken in the direction of the tail of the blood droplet. The measurement of width and length of the ellipses help in calculating the impact angle.

The area of origin is the area in 3D space where the blood source was located at the time of blood spatter. This includes area of convergence with a 3dimension in the Z direction.

II.METHODOLOGY

This includes 7 steps

- A. Identifying only the red color in the image
- B. Cropping an image
- C. Removal of unnecessary stains

- D. Edge detection
- E. Ellipse detection
- F. Source reconstruction
- G. Gravity correction

2.1. Identifying only the red color in the image

Direct binarization of an image results in noise when the blood spatter is on tiles (Tiles with some patterns on it). Due to this noise some of the data may be lost. To retain this data only the red color on the floor (or tile) is detected and processed further.



Figure 2: Original Image

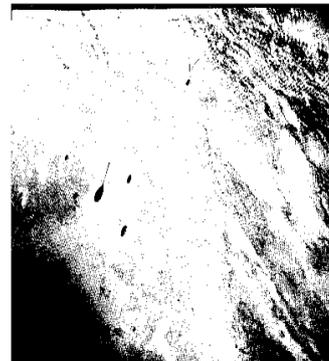


Figure 3: Binarized Image



Figure 4: Only red color is detected

2.2. Cropping an image

The area of interest is cropped from the original image. The unwanted data (area) is removed by using this. Cropping can be done by using `imcrop` command.

2.3. Removal of unnecessary stains

The large blood stains are removed since they are unpredictable and are unusual in shape [4]. The smaller stains are not sufficient to give enough information. The medium size stains generally form an ellipse shape useful for our analysis. The medium size stains are only detected.

2.4. Edge detection

The points at which image brightness changes sharply are identified as edges. The edges can be identified by using various edge detectors like Robert, Sobel, etc. These edge detectors do not produce images with high accuracy. So we will go for canny edge detection. Edges of the ellipses are found by using the canny edge detector. The canny edge detector is used to detect wide range of edges.



Figure 2: Original Gray Image

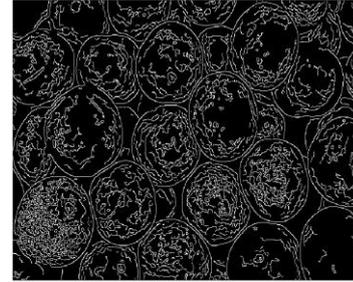


Figure 3: Canny edge detected image

Canny edge detection is a technique that will extract the useful information from the image there by reducing the data to be processed.

2.5. Ellipse detection

Yonghong Xie et. al. Ji proposed a method to find the parameters of the ellipse. In this method it first finds out the ellipse major axis and rest of the parameters are found out from it. Major axis, minor axis, centre, orientation are obtained after the ellipse detection [6].

If all the stains are circle in shape then circles are detected indicating that the projection is perpendicular to the image plane. Detecting partially occluded ellipses using the Hough transform is done by H. K. Yuen, J. Illingworth, J. Kittler [8]. Ellipse detection can also be done by using Direct least squares fitting of ellipses [5].

2.6. Source reconstruction

In the source reconstruction 3D position is found by using 2D image. The 3D projection of the lines from the image is done by using impact angle formula. If the lines meet at one point then that point is the position of source .If the lines meet at different intersecting points then the concept of profile line is used [7].The blood pattern analysis have to be done to identify the point of origin [3].There are different types of blood stains which needs to be analyzed [2]

2.7. Gravity correction

Gravity plays an important role while doing the source reconstruction. The analysis is made on the basis that the path is straight but due to gravity the path is actually parabolic. The gravity factor is added to the height obtained in the above step.

III.RESULTS

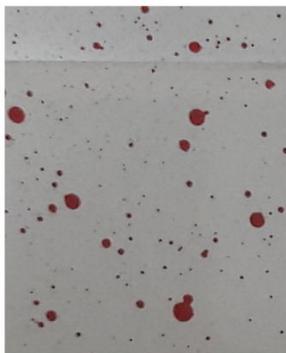


Figure 4:Original Image



Figure 5:Rotated Image



Figure 6:Red samples detected

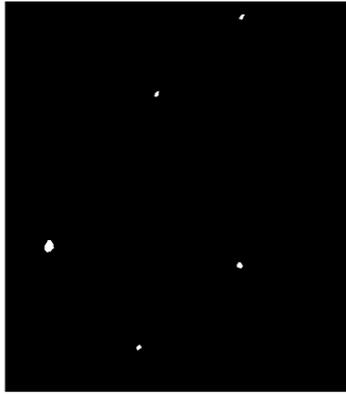


Figure 7: Eroded Image

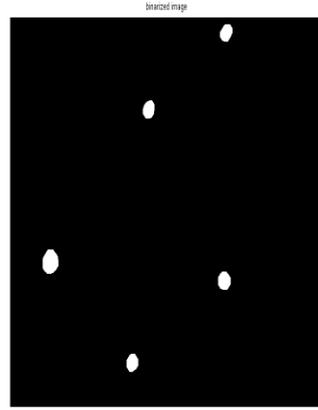


Figure 8: Dilated Image

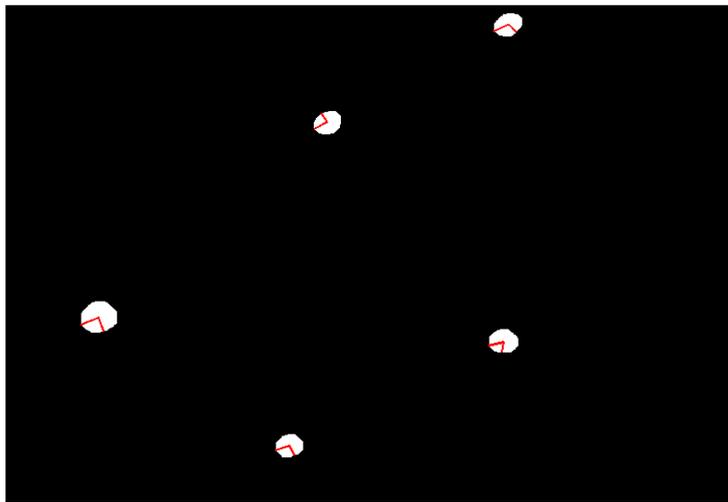


Figure 9: Major and Minor axis detection

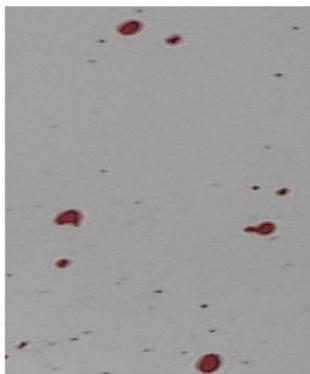


Figure 10: Original Image

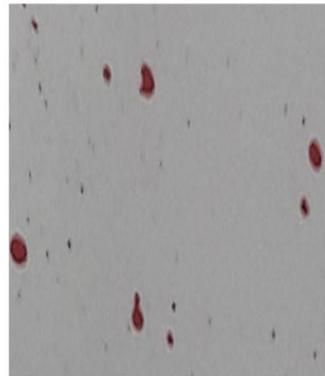


Figure 11: Rotated Image



Figure 12: Red samples detected



Figure 13: Eroded Image



Figure 14: Dilated Image

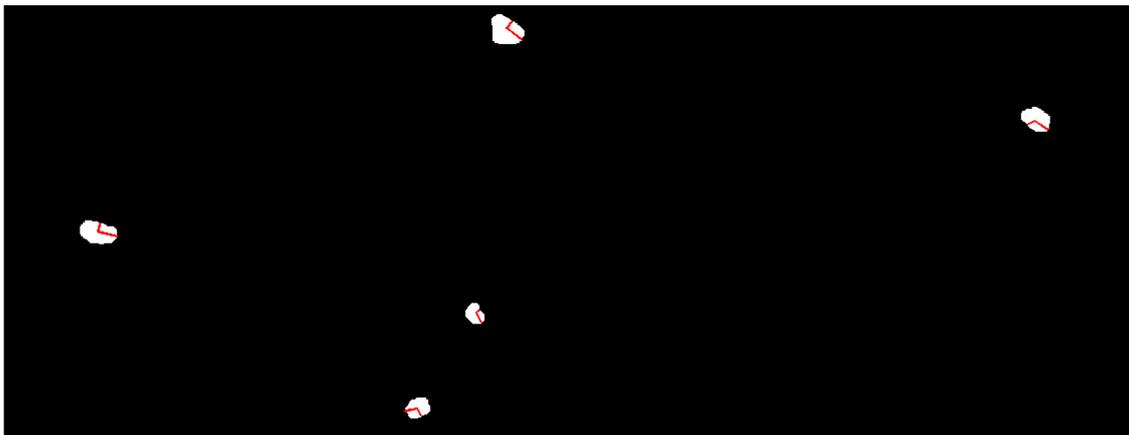


Figure 15: Major and minor axis detection

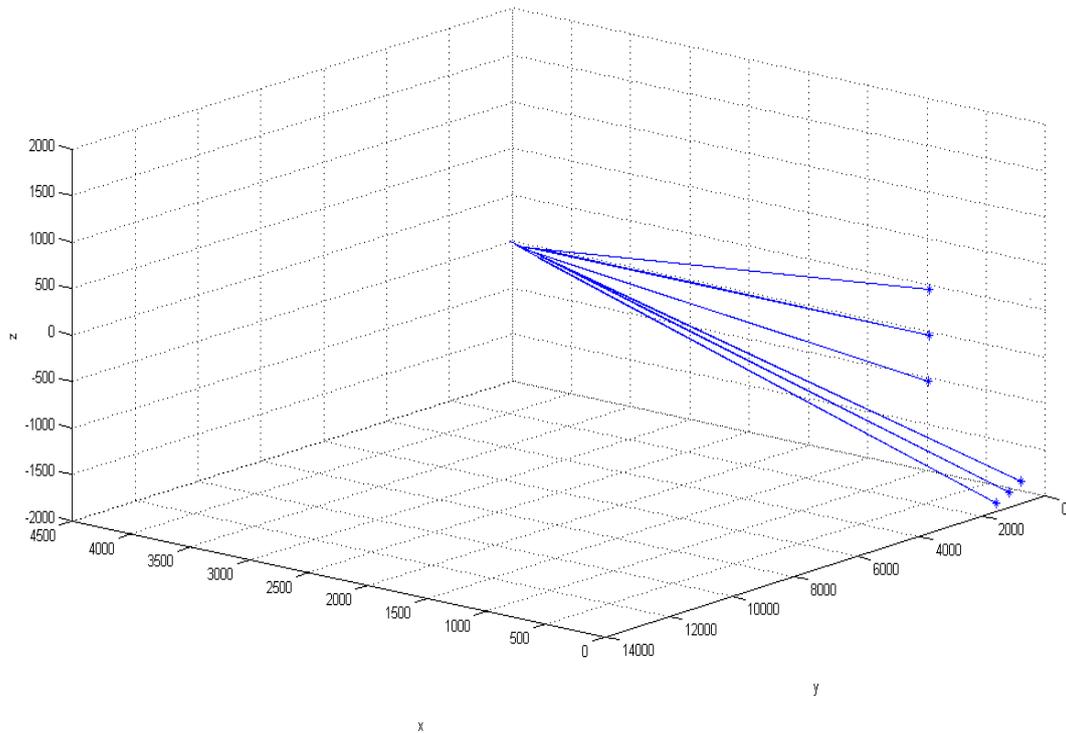


Figure 16: Projection of trajectories from blood samples in 3D

IV.CONCLUSION

The point of intersection of all the projections is considered as source of spatter .From this point we can identify how far from the adjacent walls and how much height from the floor the spatter has occurred .The 3D model is developed from the photographed crimescene images and the human effort is reduced.

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