Image Processing in Information Security

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***Abstract*—The article discusses the task of image processing in relation to information security. The results of the analysis of recent literature are presented, and it is shown the methods and means of digital images processing continue to evolve and find new areas of application. The main tasks are related to information security in biometric systems and copyright protection. Object detection on video is one of the key factors for protection against unauthorized access. Due to increase of calculating power of computer accurately determine of object from a background is continue improve. In this article we propose a method for object detection using accurate edge description. The edge detection algorithm is based on curve fitting by cubic polynomial with 1st degree of smoothness (C^1). The method allows obtaining object's edge description and the feature for effective recognition such as curvature. Using curvature makes possible to recognize partially visible objects successfully.**

***Keywords*—information security, biometric system, copyright, digital image processing, digital watermark, aberration of digital image, image segmentation, edge detection, curve fitting, pattern recognition.**

I. INTRODUCTION

In the field of information security image processing tasks are used to organize technical protection against unauthorized access. One of the most effective and widely used means of information unauthorized access is the installation of video cameras. This topic is devoted to many scientific works of recent years aimed at improving the quality of video information. In addition, there are a number of works in the field of protecting video information from unauthorized use and the copyright of video and other information.

II. IIMAGE PROCESSING IN THE FIELD OF INFORMATION SECURITY.

To protect the information as the property methods adding of special marks on video, digital images, electronic text are used. As this means of information protecting from unauthorized access methods for introducing of digital watermark are being developed [1, 2]. A code of digital watermark is analyzed by special decoder. This determines whether information about the legal owner, other data, confirming the authenticity or copyright of video or image containing pictures or text.

When processing data from a video stream received from security cameras, in addition to the task of analyzing scene changes and detecting motion on video [3, 4], it is necessary to perform frame-by-frame data analysis in order to search and recognize objects. Automation of these tasks significantly reduces time of processing.

Image processing is also used in biometric systems as a means of user identification and authentication. The most popular identification systems are scanning of fingerprints, palms, retina and iris, analysis of a person's face [5]. In relation to the processes of scanning and analysis of fingerprints, there are many works devoted to methods of improving quality for solving such problems [6-9].

Recognition of objects on biometric data, processing of scenes of video frames is based on the analysis of contours or edges [10-12]. This stage of image processing plays a key role for further analysis for recognition. It is known that image formation interference may influence the image [13, 14]. To improve image quality in order to correct for hardware

interference, it is necessary to compensate the aberrations that have occurred [15].

To analyze the edges of the selected objects, many different methods have been implemented, the main requirement for which is accuracy or compliance with the permissible deviation of points - residual. One of the significant indicators in the description of the contour is its smoothness [16]. The computing power of today's computers makes it possible to perform the calculation with sufficiently high speed that allows the use of the developed methods in real-time systems.

In connection with the development of 3D scanning and 3D printing technologies, new opportunities appear in the field of design and manufacturing of products, significantly affecting the speed and reducing of time and material resources in production. Accordingly, new tasks appear in the field of information protection [17, 18]. Firstly, this relates to the issue of copyright protection, especially with regard to the production of designer products with privacy stamps. Second, improved methods of processing and creation of models, the emergence of new materials for 3D printing jeopardize the effectiveness of biometric systems [19, 20]. This will contribute to further development and new research to improve information security. Overview of recent years articles shows that researches are based on color and texture analyzing [21-23]

III. EDGES DESCRIPTION

There are many different methods of edge detection and contour description applied to recognition of objects in different fields [24 - 26]. Many researches in field of pattern recognition are based on comparative study between some of contour. Therefore, the accuracy of contour description is very important in this problem. There are many different methods to get information on contour points of object. One of the most popular is curve approximation to the contours with studying of curve's features [27 - 30].

We propose a recognition approach that is based on deriving polynomials of 3rd degrees fitted to the object edges.

First it's necessary to find all special points on object edges – corner points and points with vertical or horizontal tangent on convex part of the contour. These points determine conditions of curve fitting. Corner point must be on fitting curve and has no fitting error that means the value of residual equals zero. Other points' residual value should be less than the value of permissible tolerance ε. This check improves edge detection accuracy. The value of the tolerance is different and depends on solving problem. When modeling fitting curve, in order to ensure smoothness a value of tangent to the curve is calculated. The value of tangent affects on the next polynomial segment. The point of calculated tangent marked as a point with tangent and become the first point for next segment.

Depending on types of point at the end of edge 6 cases of curve fitting are determined. Curve fitting on edge points always starts with condition when both the 1st and the last points are of corner type – case 1. On figure 1 these points are shown in red color. All points of the edge are in local coordinate system. The fitting curve is 3rd degree polynomial modeling by least square method. All points are checked on fitting error. If there is no point with residual value more than ε, then number of the curve segment on this edge is equal to 1 and we consider next edge. If curve fitting error occurs then number of point in array is reduced and it is the 2nd case with first point as corner (case 2). After successful fitting at the last point the curve tangent is calculated. This value determines the polynomial coefficient on the next segment of the edge with tangent on first point (sown in blue color) and corner point at the end (case 3).

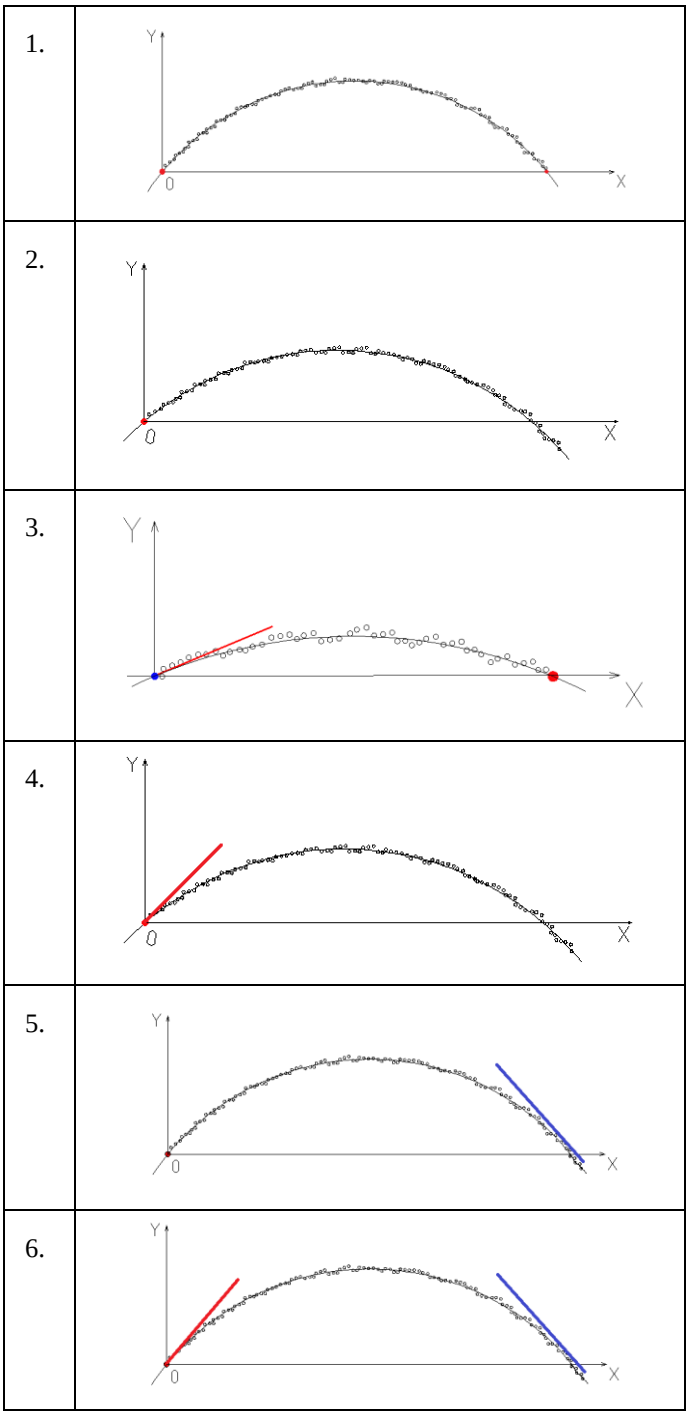

Figure1. Conditions of curve fitting

The 4th case fitting curve has first point and tangent in the first point requirements. The end of the curve is free but for best smoothness we include to array several next points of the edge additionally. Cases 5 and 6 appear when the edge has point with vertical or horizontal tangent at the last point. On Fig.1 they are in the local coordinate system and shown in blue color. In case 5 the first point is of corner point type. In case 6 the first point has tangent calculated on the previous step.

The algorithm of proposed method is presented on figure 2 and figure 3. For every segment of the fitting curve it's necessary to calculate curvatures of curve and object recognition is performed by a comparative graph of curvature.

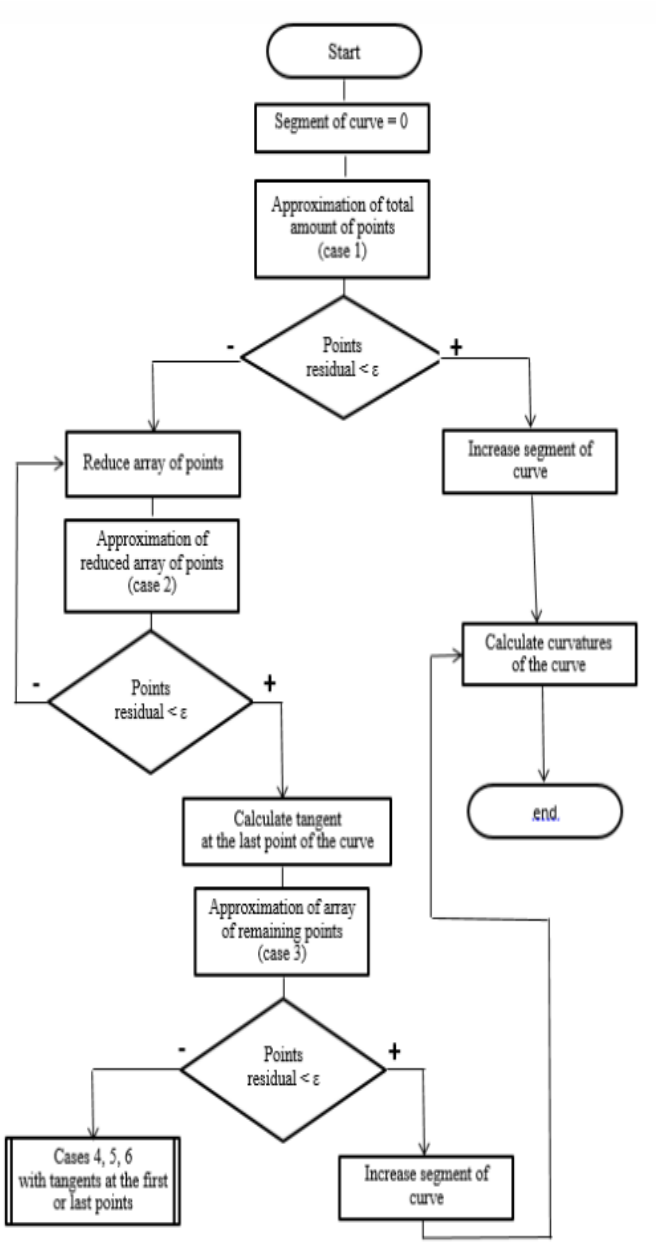

Figure 2. Diagram of curve fitting

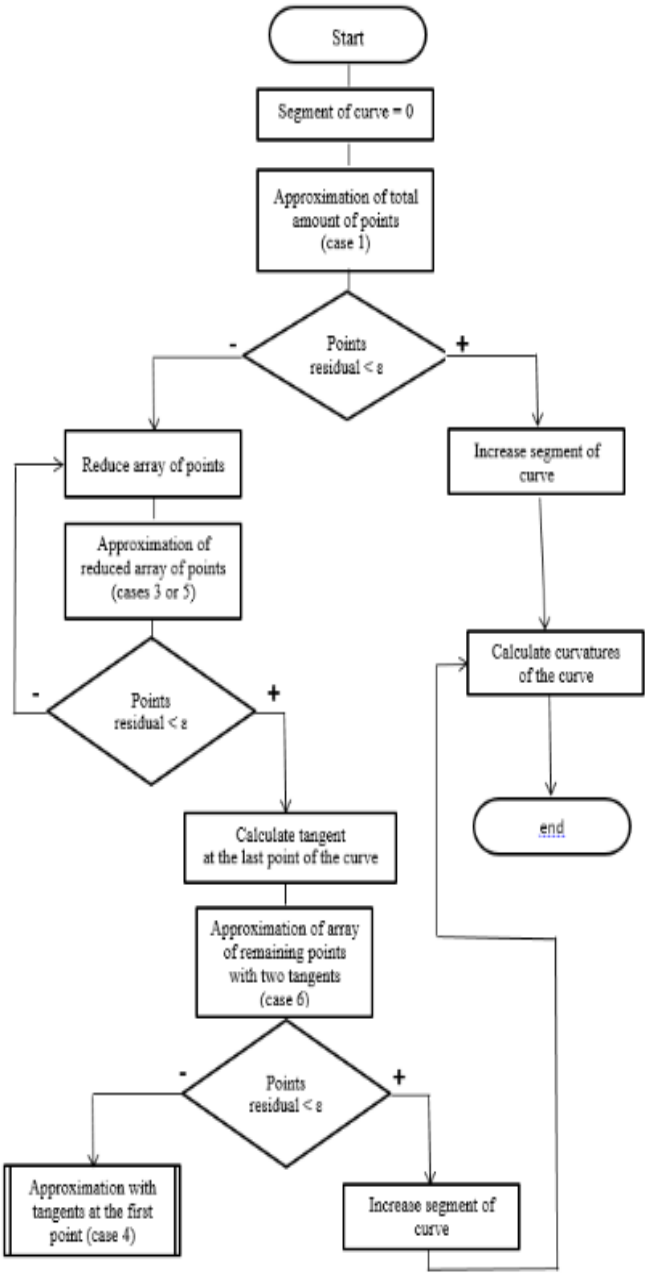

Figure 3. Diagram of curve fitting with vertical or horizontal tangent at the last point

The method of curve fitting described above substitutes edge points, gives a fitting curve with the 1st degree of smoothness (C^1). This allows to obtain the values of curvature invariant to rotation, scale and useful to recognize partially visible objects. Changes of curvature value are used to measure similarities of shape of recognized object and reference object.

Using points with vertical or horizontal tangents and tangent to curve on previous step simplify the computational complexity and edge description of complex shape. The

program implementation of the algorithm presented above shows good results for complex shape description.

IV. CONCLUSION

For successful recognition of two-dimensional object the key role plays accurate description of edges by curve fitting. Curve modeling process important to obtain necessary information on edge shape. One of the feature invariant to rotation, scale is curvature of fitting curve with the 1st degree of smoothness (C^1) which allows recognizing of partially visible object

Methods and means for processing digital information are widely used in the field of information security. With development of information technology of 3D printing new challenges in the field of copyright protection and improving information protection appears.

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