BONAFIDE CERTIFICATE

Certified that this thesis titled "A Hybrid Approach for Geometric Primitives Extraction" is the bonafied work of Mr. J. PRAKASH (Reg.No: CSE04D013), who carried out the research under my supervision. Certified further that, to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation of the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Date:

Place: Chennai

Dr. K. RAJESH

IP Analyst

Philips Electronics India Ltd.,

Manyata Tech Park, Nagavara

Bangalore-560 045

Karnataka, India.

Email: rajesh.nair@philips.com

DECLARATION

I hereby declare that this submission is my own work and that to the best of my knowledge and belief it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

Date: J. PRAKASH

Place: Chennai (Reg.No: CSE04D013)

ABSTRACT

This work presents a novel method for geometrical object identification with their applications. The proposed method adopts a hybrid scheme which comprises of Eigenvalues of covariance matrix, Standard Hough Transform and Bresenham's raster scan algorithms. This work uses the fact that, the large Eigenvalues and small Eigenvalues of covariance matrix are associated with characteristic parameters of geometric primitives such as straight lines, circles and ellipses.

The small Eigenvalues for a line segment in the continuous domain will be zero, regardless of length and orientation of the line segment. The large Eigenvalues and small Eigenvalues will be equal, if the object is a full circle. If the object is an ellipse, then the small Eigenvalues and large Eigenvalues correspond to the semiminor and semimajor axes. Hence, in this work the large Eigenvalues and small Eigenvalues of a covariance matrix can be used to extract the geometric primitives in images.

The Hough Transform can be used to detect arbitrary shapes in images. However, Hough Transform requires the complete specification of the exact shape of the target object to achieve precise identification and segmentation. Unfortunately, the conventional sequential approach based on direct application of Hough Transform is limited, because the memory space and computing time increase exponentially with the number of parameters of the analytical curve. In this work, the sparse matrix technique is used to perform the Hough Transform of the given image**.** Sparse matrices provide an advantage of matrix storage space and computational time, because they squeeze zero elements and contain a small number of nonzero elements.

Finding meaningful and valid Hough peaks from the Hough parameter space is an important step for identification of geometric primitives in images. In the proposed approach, Hough peaks are identified based on neighborhood suppression scheme. After finding the meaningful and distinct Hough peaks, coordinates of the geometric feature are obtained using Bresenham's raster scan algorithms. Since, quantization in parameter space of the Hough Transform gives both the real and false primitives, a statistical analysis based on the Eigenvalues of covariance matrix is used to characterize and identify the geometrical primitives.

The algorithms based on Hough Transform require more memory and high computational time. The proposed method has the advantages of small storage, high speed and accuracy in identifying the geometrical features. The proposed method has been tested on both synthetic and real images. Several experiments have been conducted with considerable background noise to reveal the efficacy and robustness of the algorithm. Experimental results about the accuracy of the proposed method, comparisons with Hough Transform and its variants are also reported.

The proposed method is implemented on various applications of computer vision and pattern analysis. The straight line detection approach is used to identify the lanes in automated transport systems. The circular objects identification is used to identify the coins and the elliptical features extraction is used for human face segmentation and detection.

Keywords: Covariance matrix, Coin identification, Eigenvalues, Face segmentation, Geometric primitives, Hough Transform, Lane detection, Raster scan algorithm.

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LIST OF ABBREVIATIONS AND SYMBOLS

AGV	Automated Guided Vehicles
CCD	Charge Coupled Device
CHT	Circular Hough Transform
CoHT	Combinatorial Hough Transform
DQP	Dynamically Quantized Pyramids
DQS	Dynamically Quantized Space
EA	Evolutionary Pursuit
GA	Genetic Algorithm
GHT	General Hough Transform
GPS	Global Positioning System
HT	Hough Transform
ICA	Independent Component Analysis
ITS	Intelligent Transport Systems
JAFFE	Japanese Female Face Expressions
KM	Kernel Models
LDA	Linear Discriminant analysis
MIT	Massachusetts Institute Technology
PCA	Principal Component Analysis
PDF	Probability Density Function
PHT	Probabilistic Hough Transform
PPHT	Progressive Probabilistic Hough Transform
RHT	Randomized Hough Transform
SHT	Standard Hough Transform
T	Threshold

c	Covariance matrix
λ	Eigenvalues
λ_s	Small Eigenvalues
λ_l	Large Eigenvalues
r	Radius
ɤ	Error ratio
ρ	Length of HT parameter space
θ	Angle of orientation
σ	Variance