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AN ALGORITHM FOR RECOGNITION OF REGULAR AND IRREGULAR SHAPE OBJECT USING ARIA CLASSES

Adnan, Afzal Khan, Tahir khan
madnankhan019@gmail.com, Afzalkhan@uetpeshawar.edu.pk, tahir@uetpeshawar.edu.pk
University of Engineering and technology, Peshawar, Pakistan

Abstract-This paper shows a computerized reasoning methodology for question shape acknowledgment for mechanical framework as shape acknowledgment is principal for automated control and protest getting a handle on. It is not bewildering that pictures contribute basic part in human perception as vision is most developed of our faculties. As machine like robots couldn't see or even recognize a protest. Shape acknowledgment application for robots is fundamental field nowadays. A C++ based reproduction framework utilizing ARIA (Advanced Robotics for Interface and Application) classes is created in the research center for perceiving two dimensional state of a question. This examination work gives finish insight about the decisions made and the last outcomes acquired. The calculation perceives normal and unpredictable shapes in perspective of information gotten from laser examining. Calculation approved through PC recreation tried with different shapes and sees all with the assistance of information investigation.

Keywords-Geometrical shapes, Shape representation, Object Recognition, Edge detection.

1. INTRODUCTION

In some genuine applications robots are by and by comprehensively being used, for instance, space investigation, fire-safeguard missions, military operations, modern computerization, security control and numerous others. Canny robot is a machine that can perform self-sufficiently i.e. with no human intervention. The mechanical group has tested various basic issues of independent versatile robots and multi-robot framework. Multi-robot framework contain a few independent robots for doing a typical assignment agreeably. A few independent versatile robots share the earth in a multi-robot framework. Additionally for protest transportation by multi-robots, question getting a handle on from a transport line robot must have some thought regarding state of the protest.

In apply autonomy and PC vision protest acknowledgment is an essential errand. Dissent shape can be deciphered as a territory surrounded by a system of the question. The basic part in dissent affirmation is to locate the correct shape data [1]. In genuine human can see any question without any attempts; as opposed to machines free from any other person can't see objects. There are many intends to see question's shape; for example, using advanced cameras or lasers. However most systems use computerized cameras for this reason which has three key focal points; Initial, a picture gives rich data on protest in the working condition. Second, speedy and exact vision subsystem might be worked requiring little to no effort. Third, advanced cameras watch and derive the working condition normally as human eyes watch the world. Be that as it may, various blocks exist in the operation of PC vision framework. Initially, since the challenge shape acknowledgment must be done through qualities extraction from the picture, if the lighting conditions change, the outcome can be off base. Second, using advanced pictures shrouded components of the picture won't be in picture. Third, as different light sources may have unmistakable light force levels, so distinguishing a protest can wind up plainly troublesome. Fourth, amid picture preparing with broad measure of data, calculative handling force may not be sufficient, which can influence the general execution of the framework [2]. The other approach to see question shape is with the assistance of laser examine. Laser innovation was presented in 1960 [3]. Laser demonstrates Light Amplification by Stimulated Emission of Radiation. As laser exudes electromagnetic radiations or light when actuated by some wellspring of vitality; the subsequent electromagnetic radiation set parallel line and go about as a directional shaft. This trademark permits exact estimation of range from instrument to a question. Since laser is a dynamic sensor rather than aloof sensor. Case of detached sensor is a camera that utilized the light from an outside source like the sun to take a photo. While a laser examining which is a dynamic or dynamic sensor can be used in any lighting condition.

Keeping in mind the end goal to recognize and see a question shape human vision seems to make utilization of numerous wellsprings of information. Analyst's assent that locale and edge information are utilized to pith a perceptual unit and no more negligible level of protest acknowledgment [4]. There are two techniques for question shape acknowledgment, limit and zone based strategy. In zone based strategy all pixels inside the range of a photo are thought about to get shape portrayal of a dissent. While in limit construct method principle center is with respect to limit of a protest. Limit based technique delineate shape highlight of a challenge all the more clearly when contrasted with zone based system. It needs less calculation and brisk in prepare than territory based strategy [5].

2. RELATED WORK

In this area, investigate work of some obvious creators in a similar field is displayed and short depiction is given of various methodology used for shape affirmation. Albeit the vast majority of the work said here identified with protest acknowledgment in a picture for PC vision; for portable robots to perceive state of a question in a basic and dynamic condition is not being considered such a great amount by specialists.

Peng Chang et al [6] displayed shading co-event histograms for seeing items in pictures. In this approach histogram monitors number of sets of particular shading pixels. Model of co-occasion histograms were figured in light of pictures of known articles taken from particular purpose of perspectives. To find the challenge these models are then organized with to sub ranges in test pictures. The calculation is shown on various articles exhibiting that it see questions disregarding jumble out of sight and curving of dissent. Moon et al [5] proposed an ideal edge-based shape acknowledgment unequivocally recognizing two dimensional (2-D) shapes. Expected conditions of response product figured and decided some of its quantifiable properties. Confinement and ID execution were anticipated and balanced its parameters to the degree that per its imaging conditions. Standard usages of the predetermined procedure are vehicle acknowledgment in ethereal pictures, human facial segment disclosure and shape following in video. Felzenszwalb [7] acquainted an arrangement of methods with perceive shapes in pictures. Deformable models were used for the identification of non-unbending articles in both regular and therapeutic pictures. Low level picture division and gathering were additionally considered. Stochastic sentence structure was portrayed that produce discretionary triangulated polygons while catching outline standards of shape consistency. Staffan et al [8] proposed PC vision approach for challenge shape acknowledgment using shading co-event histogram and geometric displaying. The following framework takes a wire-plot model of the challenge and a vote histogram gives a hypothesis of the dissent's region. With a particular ultimate objective to get appearance from changed sides each challenge is spoken to by two histograms. The essential detriment of shading co-event histograms is low proficiency if lighting conditions changes. Tomono et al [9] displayed a structure for building 3-D condition with 3-D dissent and their area data. Initial a 2-D delineate made with the help of laser sweep and protests were identified by planning a yield design with the 2-D plot. At that point vision-based question acknowledgment confirms the identified articles. A succession of monocular pictures utilized for building 3-D question models. To demonstrate the adequacy of this technique different trials were directed in a room having seats and work areas. Stop et al [10] proposed another strategy for worldwide limitation of indoor condition which used dissent affirmation, 3D challenge position and significance information using stereo camera. Profundity data is used just at level centerline in picture where optical center point experiences. In this procedure first coarse stance is evaluated and a short time later a refined stances. Challenge acknowledgment and slightest square fitting were used for assessing coarse posture while molecule sifting calculation for refined stance. The specified work has different drawbacks particularly the plans are computationally costly, having time delays and influences the general productivity if lighting conditions changes. F. Chaumette et al [11] [12] proposed picture-based and position-based visual servo control for 3-D pose estimation of a dissent from the 2-D picture gotten by a camera. Rusi˜nol et al [13] showed a technique to see shapes by dismembering a polygonal gauge of their points of confinement in light of gathered length and exact precise information. As per polygonal figure of the diagram, two shapes thought to be equivalent if amassed turning point and beginning from a reference portion are comparable. Pre-preparing strategy in light of curve length highlights to decide edge revolution. Schindler et al [14] showed a procedure for protest acknowledgment in pictures in light of worldwide shape. In this approach an adaptable shape planning is gathered which is vigorous against non-parametric misshapenings and invariant to scale and pivot. To discover limits the space of potential challenge limits are examined by finished division of the picture. The said approach accomplish acknowledgment rate of 83-91%. Ren Honge et al [15] proposed a calculation which consolidates shading picture division with edge location for protest shape acknowledgment. The calculation can perceive protests in various brightening condition. Kirillov [16] exhibited a technique for challenge shape acknowledgment in a picture utilizing picture preparing and blob examination. Some fundamental strategies were created for recognizing shapes likes circles, triangles and quadrilateral. The said calculation must be utilized for an information picture containing objects of various hues on a dark foundation. F. Ruixia Song et al [1] proposed a novel limit based shape affirmation system. To begin with the state of a dissent is seen as a geometric outline, and the diagram is reached out in a V-arrangement, which change the graph to the range space and measure general part of the challenge. Besides a shape likeness measure computation in context of institutionalized V-descriptor is displayed. Donggang Yul [17] presents a novel and practical procedure for shape examination and affirmation in light of skeleton and morphological structure. A movement of preprocessing figurings, smooth after and progression are introduced. Plan of morphological basic reasons for picture shape are confined and afterward consolidated. Ehsan Moomivand [18] displayed a strategy in which the fundamental property of highlight (centroid) is considered as an essential sign for affirmation. By then, two helper properties, for instance, partition and edges between the centroid and shape frame are registered. Finally, by merging these two fundamental parts, another Feature-Space is created. The proposed shape descriptor can be used as an adjusted system for challenge affirmation.

The rest of the paper is organized as follow; Section III explains the proposed model, while Section IV explains the Algorithm and Flow Chart. The explanation of the Simulation results, which includes test bed, is conducted in Section V. Conclusion and future recommendation is given in Section VI. While actual results of MobileSim Simulator are given at the end of paper.

3. PROPOSED MODEL

3.1 Workspace Modeling

The robot and objects from the real world are unequivocally transformed into the design space (C-space). A circular portable robot Pioneer P3-dx with span r is considered to such an extent that the robot can translate in the hunt space with no revolution. Pioneer P3-dx is a conservative differential drive portable robot with dedicated motion controller fully programmable. The robot's embedded controller automatically performs velocity control and position estimate of the robot in space (x, y, theta). The robot is permitted to move in a two-dimensional Euclidean space with static object.

Suppose $\tilde{\eta}$ is a P3-dx robot that moves in a two-dimensional workspace ω. Let the workspace ω be populated with various shape objects τ i.e. $\tau \subseteq \omega$. In like manner $\tilde{\eta}$ can move in the workspace ω, whereas τ stays settled. Utilizing proposed algorithm the robot can move and identify distinctive shape objects.

3.2 Euclidean Space

MobileSim Simulator environment can be considered as 2-Dimensional Euclidean workspace. In Euclidean workspace r^1 the real line is ordered of real numbers from least to greatest as shown in Figure 2. Similarly r^2 the Euclidean plane, points are represented as ordered pairs. For an object in this plane each point will have an ordered pair as shown in Fig. 3.1.

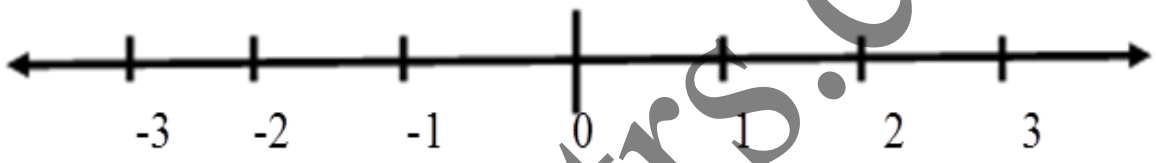

Fig. 3.1 R^1 (Euclidean Real line)

4. OBJECT BOUNDARY EXTRACTION

The boundary of an object serves a noteworthy and crucial element for recognition and subsequently it's proficient and precise detection is exceedingly a necessity. In order to recognize the shape of an object the region inside the boundary are least bothered [13].

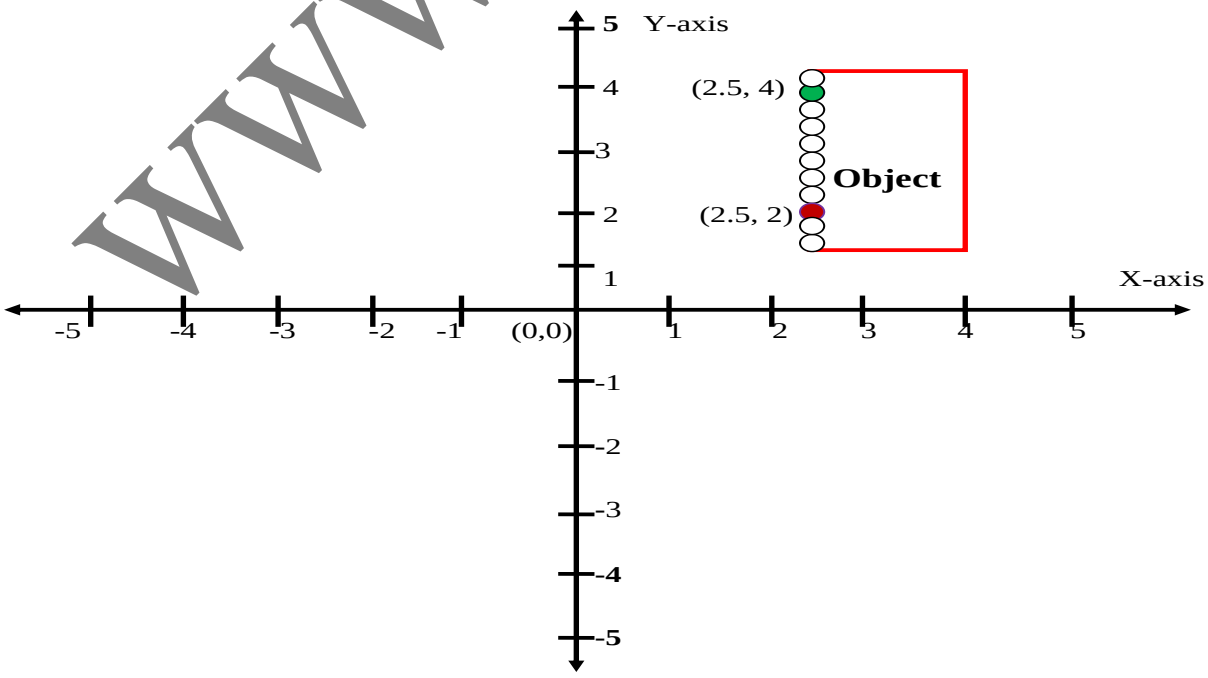

Fig. 4.1 Object in 2-Dimensional Euclidean Plane

As different shape objects are placed in front of robot for laser scanning. Laser can extract only the front coordinates (x, y) of an object after scanning by a robot as shown in Fig 4.1. If an object is rectangular the line must be straight while in case of irregular object line will be like a curve. Straight line is a succession of points that are arranged in the same direction and never change direction in order to go from one point to another as shown in Fig 4.2 while the point of a curve line do change direction from one point to another.

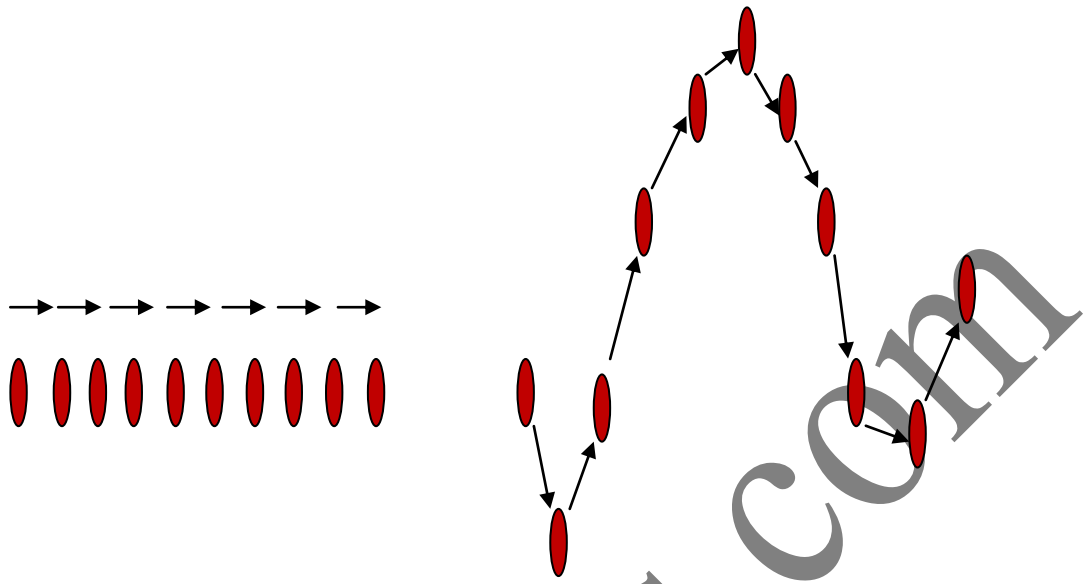

Fig. 4.2 Straight and Curved Line

Regular and irregular shaped objects are classified on the basis of straight and curved lines. Regular objects are further classified into rectangular, triangular or square objects; in case of rectangular and square objects there is a straight line in front of robot for scanning with the help of laser. For triangular objects robot scan two sides and get coordinates of each point either in incremental or detrimental form.

5. PROPOSED MODEL

In robotics one of the most important tasks is the object shape recognition especially in multi robot system for object transportation. The robot should have some idea about the shape and dimension of the object for grasping. The complete proposed model for object shape recognition by robot with the help of laser scanning is shown in Fig. 5.1.

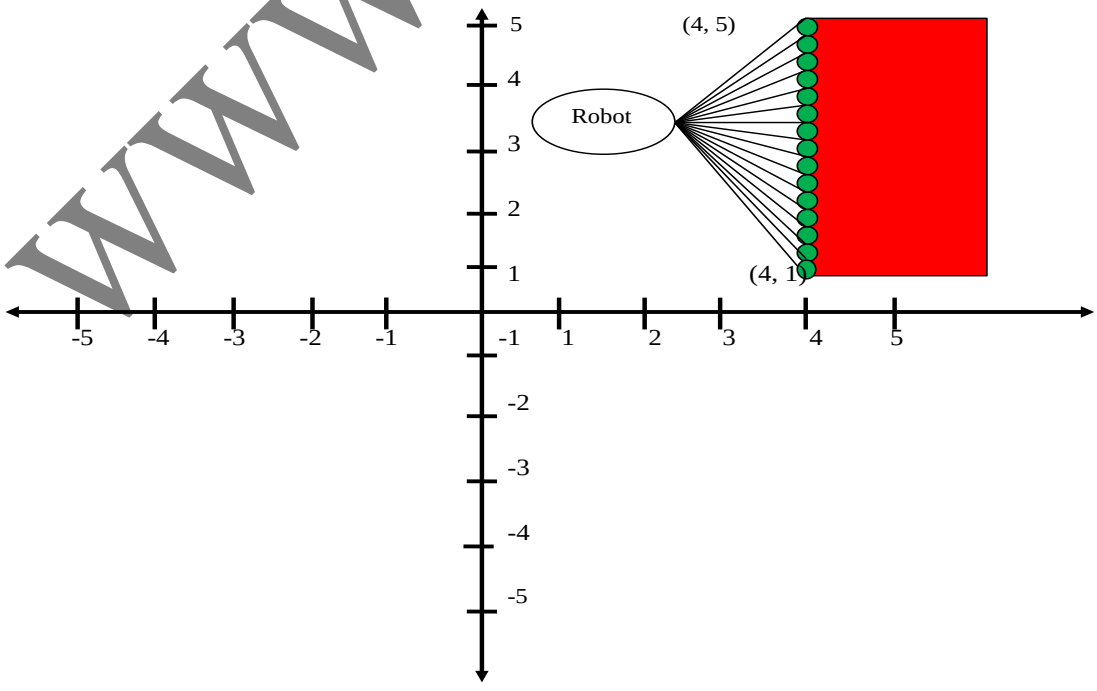

Fig. 5.1 Robot Performing Laser Scanning to Get Target Coordinates

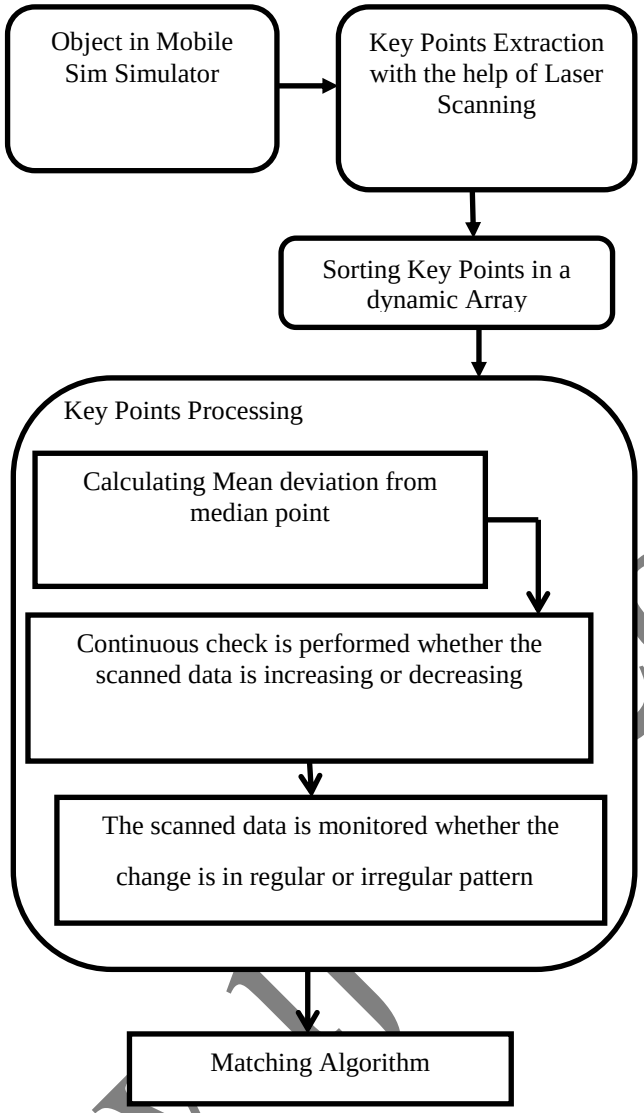

Fig. 5.2 Flow Chart for the Proposed Model

Proposed model for object shape recognition consists of three phases:

- Key Points Extraction
- Key Points Validation
- Matching Algorithm.

5.1 Key Points Extraction

In this stage highly distinctive features are extracted from the object with the help of laser scanning. Steps involved in the key point extraction are initialization of laser for scanning extracting key points i.e. coordinates of each point of an object in front of robot as shown in Figure. 7; And sorting key points in a dynamic array. Array is basically collection of data in C++ language. The coordinates of a scanned object is sorted in a dynamic array. For static array the number of data sorted should be pre-determined. Here the numbers of points are unknown and hence dynamic array is being used. Dynamic array has the ability to collect and sort any number of data.

5.2 Key Points Processing

It is the stage which helps to find exact shape of the object. The extracted points in an array are analyzed. Three processes are performed simultaneously.

- Median Point of every scan is taken and all other points compared with median point to calculate Mean Deviation from Median point.
- A continuous check is performed whether the scan data is continuously increasing or decreasing.
- The scanned data is monitored whether the change is in regular or irregular pattern.

5.3 Matching Algorithm

This is the heart of the object shape acknowledgment model. Based on the value returned by Key Points Validation objects are categorized as rectangular/square, triangular or irregular in shape.

- If mean deviation from median points the object in front of robot is Rectangular.
- If deviation from median is not less than one and scanned data is continuously changing non-uniformly the object shape is Irregular.

6. EXPERIMENT RESULTS

Simulations of the proposed algorithm are carried out on Intel(R) Core(TM) i3-2310M CPU@ 2.10 GHz (4 CPUs), 2048 MB RAM using Microsoft Visual Studio C++ 2010. Mapper3 is used to create different shapes object. Advance Robotics for Interface and Application (ARIA) provides interface with C++ Library and framework for controlling and receiving data from all mobile robots. For simulating mobile robots, for debugging and experimentation with ARIA MobileSim simulator is used. MobileSim provides a simulated control connection via TCP similar to the real robot serial port connection. ARIA automatically connects to this TCP port making it easy to run the same program using the simulator and on the real robot with no changes.

6.1 Test Bed

The test bed utilized in the present work comprises ActiveMedia Pioneer P3-DX robot. The rugged P3-DX has 16.5 cm drive wheels, gyro, CCD camera and a laser range discoverer. The laser range finder in the present framework utilizes a SICK LMS 200 2D scanner which has a level scope of 180^o with a maximum resolution of 0.5^o [19].
Simulation environment for different shape objects is shown in Fig.10.

6.2 Environment 1

Environment 1 consists of an Irregular object as shown in Fig. 6.1. Robot comes in front of object and starts laser scanning.

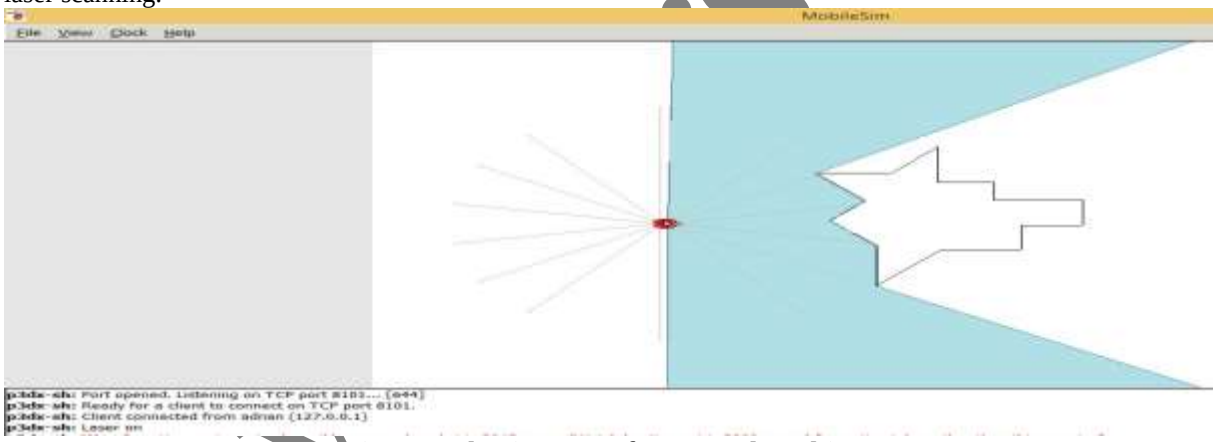

Fig. 6.1 Robot in Front of an Irregular Object

Table-6.1 Scanned Data in mm(x, y) Coordinates for Irregular Object

x	y	x	y	x	y	x	y
3693.96	2206.94	4580.26	1307.35	4121.38	71.5723	5212.08	-1294.28
3731.92	2142.5	4646.82	1239.48	4183	0	5210.92	-1390.63
3777.49	2082.26	4707.53	1168.48	4261.35	-74.0157	5212.77	-1488.72
3839.75	2030.46	4789.57	1100.91	4342.37	-150.905	5210.87	-1586.7
3896.88	1974.86	4859.9	1028.54	4424.96	-230.802	5211.87	-1686.61
3960.41	1921.38	4872.2	942.978	4504.05	-313.486	5212.84	-1787.69
4020.54	1865.01	4774.67	838.2	4584.57	-399.26	5212.8	-1889.66
4078.06	1806.32	4673.01	736.806	4685.31	-490.238	5212.8	-1992.53
4130.13	1744.22	4573.26	639.779	4785.22	-584.973	5212.8	-2098.55
4193.33	1685.73	4495.4	549.387	4885.2	-683.618	5212.8	-2205.29
4258.52	1626.63	4418.78	462.225	4989.07	-786.965	5212.8	-2313.92
4321.03	1565.08	4317.59	375.903	5085.87	-893.073	5212.8	-2422.45
4382.68	1501.85	4236.71	294.791	5209.88	-1008.62	5212.8	-2533.79
4446.27	1437.86	4156.32	216.723	5210.07	-1102.97	5212.8	-2647.67
4505.11	1370.93	4097.52	142.355	5210.49	-1198.09	5212.8	-2762.37

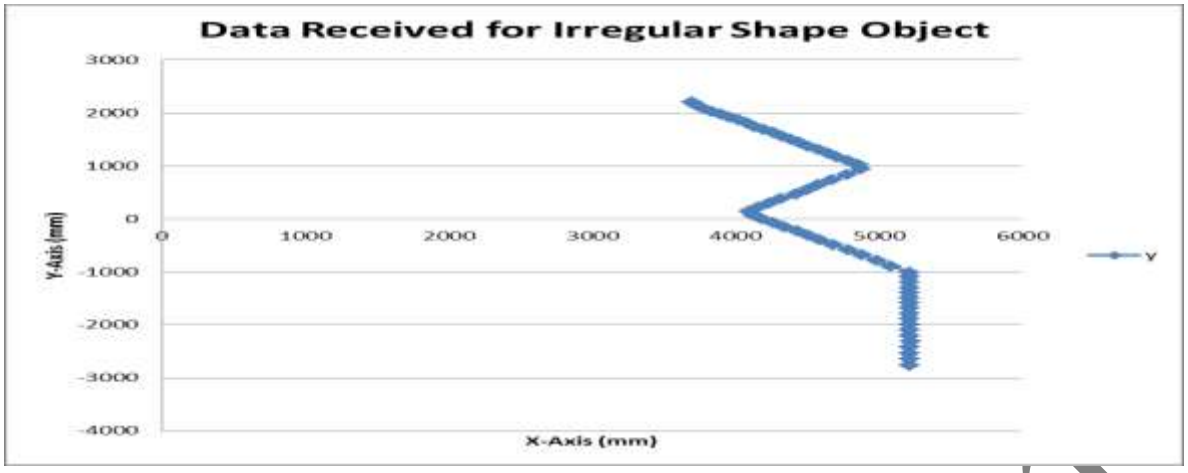

Fig. 6.2 Graph Showing Irregularity of Scanned Data

6.3 Environment 2

Environment 2 consists of a Rectangular object as shown in Fig. 6.3.

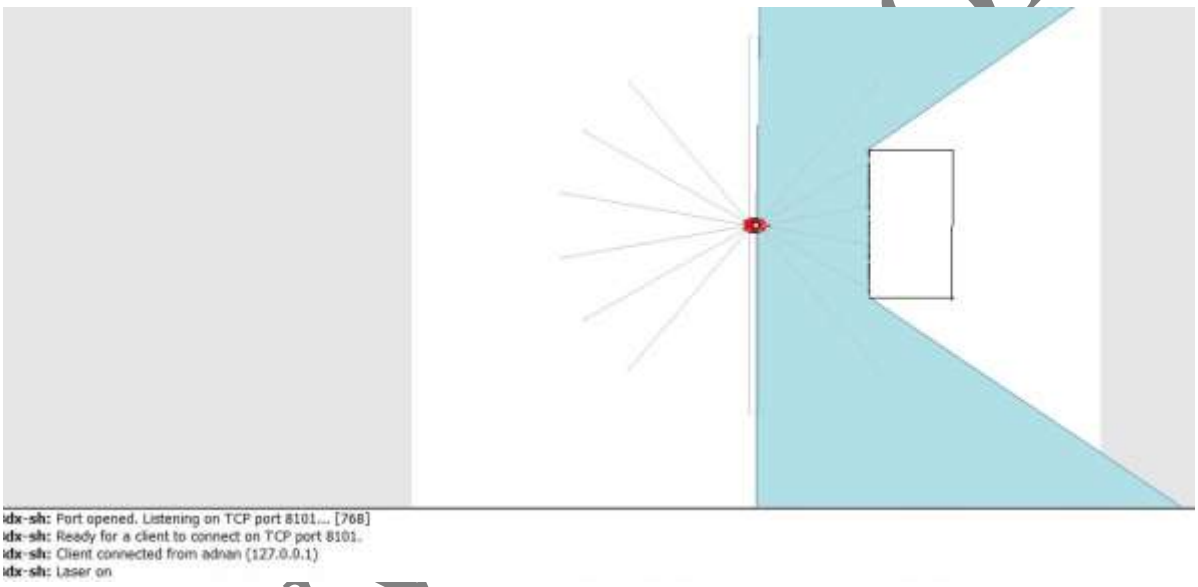

Fig. 6.3 Robot in Front of an Rectangular Object

Table-6.1 Scanned Data in mm(x, y) Coordinates for Regular Object

x	y	x	y	x	y	x	y
7435.44	2409.1	7449	1043.94	7464.46	-259.772	7472.53	-1583.87
7437.14	2267.34	7453.19	912.558	7462.79	-390.008		
7438.1	2126.82	7455.05	781.35	7464.82	-520.523		
7442.21	1988.51	7454.6	650.356	7468.55	-651.576		
7439.88	1849.73	7454.85	519.825	7467.98	-782.709		
7443.75	1713.68	7459.79	389.851	7469.07	-914.508		
7445.14	1578.05	7458.47	259.772	7466.83	-1046.44		
7444.44	1442.9	7460.87	129.863	7472.12	-1180.14		
7447.44	1309.48	7461	0	7471.07	-1313.65		
7451.38	1176.86	7462.87	-129.889	7472.53	-1448.43		

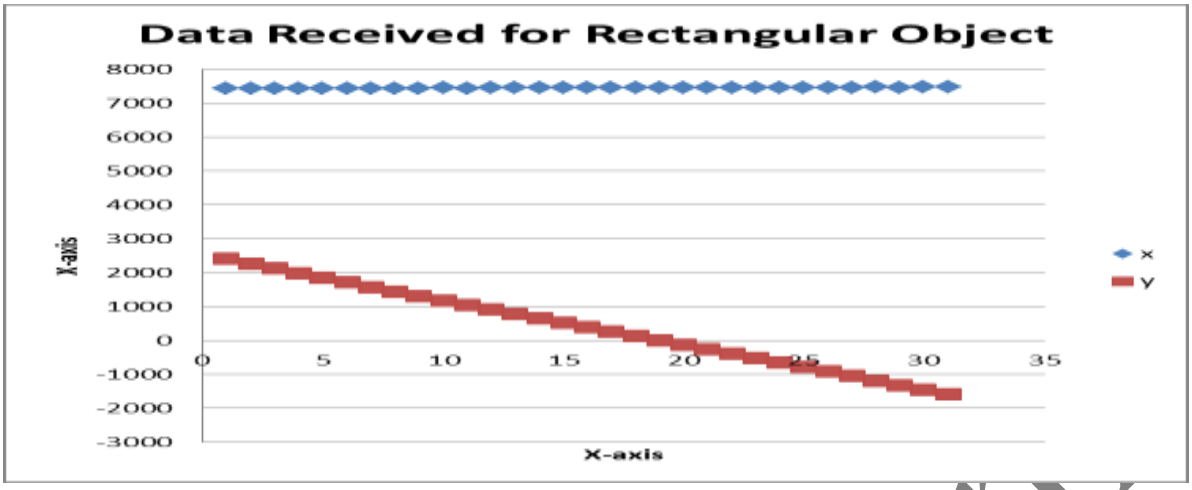

Fig. 6.4 Graph Showing Regularity of Scanned Data

CONCLUSION AND FUTURE RECOMENDATION

Object shape recognition method has been proposed in this model. Its fundamental goal is to differentiate between basic shapes such as regular or irregular object in simulator or genuine condition. By coordinating the separation measured among all points on a shape contour the proposed descriptor extract structural information from shapes effectively. The experimental results demonstrate the validity of described path.

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