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IGNT EDGE DETECTION BASED 2D MOTION TRACKING SYSTEM

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ABSTRACT

An Edge is a fundamental hint given for the description of 2D/3D Scene. They form the bases for analyzing, interpreting and understanding the concepts in an image. The Edge Detection methods used in the Kinect device are at present without the consideration for the characteristics of the cameras used in a Kinect. In this paper, An Improved Gradient Noise Tolerant Method for Enhanced Edge Detection (IGNT) is used as the principle for the Detection of Edges in the 2D images and 3D geometry of an image/video. This paper studies the concept of the Gradient technique being applied in the Kinect Sensor.

Keywords: Edge Detection, IGNT, sensors, Kinect, camera, 3D modeling, histogram.

INTRODUCTION

One of the fundamental techniques used in image processing is Edge Detection for the purpose of extracting the features from an image [1]. A discontinuity in the value of an image is considered to be an edge. The discontinuity seen in depth, illumination, and orientation are considered in the case of a gray scale image [2].

An Improved Gradient Noise Tolerant Method for Enhanced Edge Detection that automatically performs clustering based image thresholding. In IGNT an input image is preprocessed and thresholded using the pyramid and the automatic thresholding methods. The IGNT method has proven effective due to the binarization and the thresholding performed on the image.

Noise seen in the image covering both Gaussian and high frequency noise is reduced with the occasional binarization performed. This method performs well for increased noise levels thus making the use of this method in real time like the Kinect efficient and effective.

Kinect is a motion sensing input device. Human Computer Interaction has become a necessity across a number of areas [3].

The interaction is established in large means at present by the device spelled as kinect, especially in the field of gaming. The device consists of the sensor capturing the 3D scenes. The features in the scenes are segmented and displayed using image processing and fundamentally with the concept of Edge Detection.

2D imaging is a technique which provides “flat” views of the objects related to the horizontal and vertical dimensions. 3D imaging is based on real time volumetric imaging that allows acquisition of pyramidal data sets [4]. Advances in the Kinect sensors and the algorithms used for combining the 2D images and the 3D geometry of the image have led to the research in the proposed system.

The IGNT method of Edge Detection is implemented in the Kinetic device. The Canny Edge Detection technique is in use at present. IGNT is seen to detect more edge and works well for the kinetic device.

In this paper the use of the Kinetic device for studying the IGNT method is discussed and analyzed.

Kinect the Kinetic device

Kinect is a motion tracking device that is able to capture the movements of the human beings and objects. These are considered as features of an image and are detected and extracted using the Edge Detection Techniques [3].

All the parts in an object or the human body are used for the purpose of tracking. These parts are segmented and detected using the Edge detection [5, 6]. Detecting the parts is classified as facial recognition, hand gestures, full body recognition and sign language recognition. The interesting points in the face, hand, or body is studied, detected and extracted for recognition of the motion or moment created.

The Kinetic motion of the object serves as the input image to the algorithm and thus recognizing the action or the performance of the object to provide the output or the reaction in repose to the action.

Kinect with IGNT

In the proposed IGNT method the Kinect device is used as shown in the Figure-1. It is a kinetic device that is attached to the computer and serves to act like an ordinary camera. It automatically captures and detects edges whenever an image or a scene is captured by the device. This kinetic device is used for capturing and detecting the edges for three dimensional images only and this type of devices are costly.

Cameras are used to capture two dimensional images and to detect edges for the captured images. The kinetic device captures the images or scenes automatically predicting the motion of the objects. Here the images are captured automatically by the camera and is considered as reference images [7].

Then the histogram equalization is taken for that reference image. The histogram of an image represents the relative frequency of occurrence of the various gray levels in the image. Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values.

Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast.

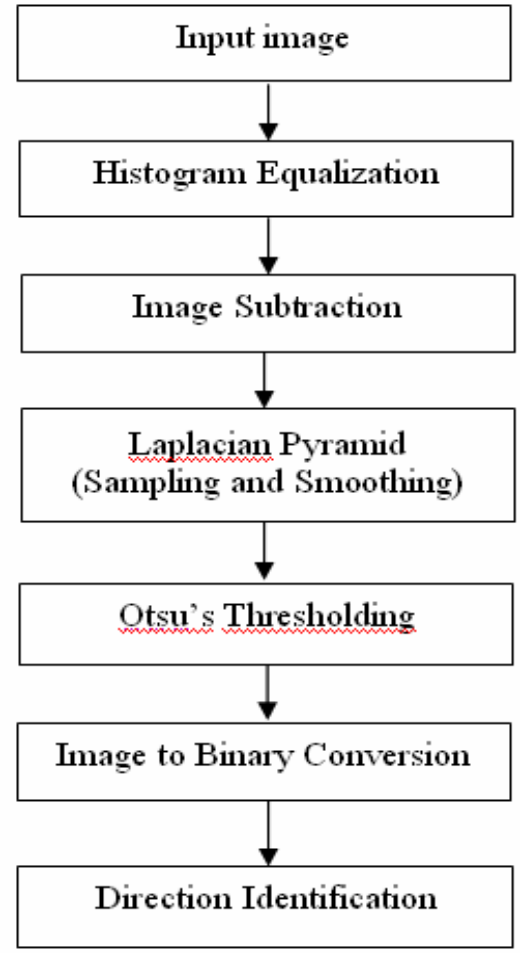


Figure-1. Processes involved in the kinetic device along with improved gradient noise tolerant edge detection method.

Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. In histogram equalization we are trying to maximize the image contrast by applying a gray level transform which tries to flatten the resulting histogram. It turns out that the gray level transform that we are seeking is simply a scaled version of the original image's cumulative histogram. Then Image Subtraction is applied for the Histogram Equalization method.

The IGNT method of edge detection performs Edge Detection based on preprocessing [8], thresholding [9, 10], binarization and feature extraction [11]. It serves as a combination of two and more methods to obtain highest proportional values of edges from an image or scene.

Algorithm

a) Convert colour image to Gray scale image and calculate histogram equalization for the converted gray scale image.

$$pn = \frac{number\ of\ pixels\ with\ intensity\ n}{total\ number\ of\ pixels}$$

n = 0, 1, ..., L − 1. The histogram equalized value will be given by

$$G(i,j) = floor((L-1)\sum_{n=0}^{f(i,j)} p_n)$$

b) Then, by adding the outputs of Image Subtraction a single image is obtained as output.

c) IGNT Algorithm

i. The image is preprocessed by applying the image pyramid reduction and expansion, with smoothing and sampling [8].
ii. Then, the image is thresholded using the automatic thresholding method with the help of the histogram bimodal image [9, 12].
iii. Binarization of the pixels in the image based on the thresholding is performed.
iv. Finally, the features are extracted reducing the Gaussian and high frequency noise with the help of binarization. Feature extraction is performed with the algorithm that produces maximum localization [11].

Thus detecting the objects in an image or scene as its features.

The colored image is converted to Gray scale image and the contrast of the image is enhanced by adjusting the image intensities using histogram equalization. Thus the calculation of histogram equalization for the converted gray scale image is done using the formula given in the algorithm. The histogram equalized value calculated increases the global contrast of the image with the usable data. During the adjustment the intensities are better distributed thus allowing the lower contrast to gain high contrast.

Once the contrast of the image is enhanced and intensity values distributed the image is passed through the process of Image Subtraction. Image Subtraction is performed such that the required foreground part of the image is extracted. Objects are the major part of an image or a video that is to be detected.

Moving object detection forms an important concept in Image Subtraction. The ratio is the difference calculated between the current frame and the reference frame in a video stream. The foreground details obtained as a result is an image with the object and irrelevant data that is termed as noise seen in the image.

The Object recognized is a combination of relevant and irrelevant data. IGNT Algorithm is used as a

proposed technique in Kinect to detect the Edges of the object omitting noise and irrelevant data. In IGNT Algorithm the image is preprocessed, thresholded and the features are extracted.

The preprocessing stage involves, with repeated smoothing and sampling [8, 13]. Pyramid reduction and Expansion is done. Either the Low pass pyramid or, the Band pass pyramid is used in the process. Irregularities and noise are removed during the process. The image is then thresholded using the automatic thresholding method with the help of the histogram bimodal image [9] using Otsu's Thresholding.

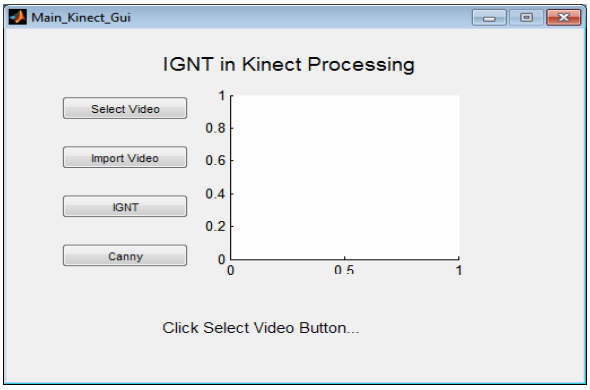
The multilevel thresholding capability seen in the method produces high results of continuous data as required. A more efficient method and an effective technique adding glamour to thresholding is the process of Binarization where the so called gray scale image until now is converted to a binary image using the optimal threshold limit.

Finally, feature extraction is done by reducing the Gaussian and high frequency noise with the help of binarization. The Canny form of Edge Detection algorithm is used. Feature extraction is performed with the algorithm that produces maximum localization [11].Thus detecting the objects in an image or scene as its features. The value obtained serves as the value of reference for the reaction to be given in response to the action in the Kinetic device.

3. RESULTS

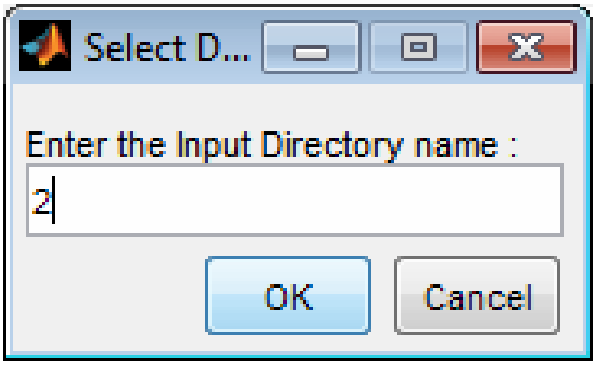
Figure-2 a) Kinect GUI b) Selection importing the video frames of an experimental video c) Preprocessing using IGNT d) Implementation of Canny Edge Detection e) Implementation of the proposed method (IGNT)

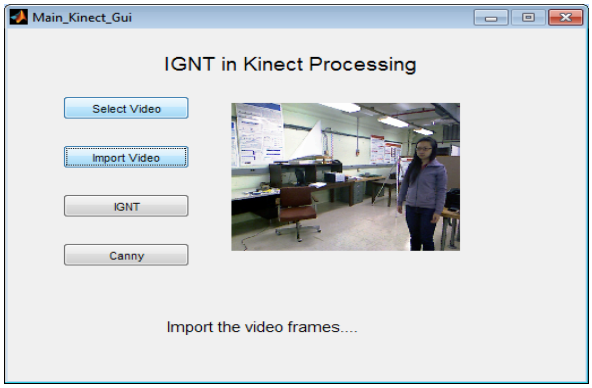
a) Kinect Gui



The Graphical User Interface in Kinect predicts the analysis done in order to compare the results obtained during the use of the Canny Edge Detection Algorithm and the proposed method. The results given prove that the proposed IGNT method is more effective in the Kinect Sensor and produces better motion tracking than the existing method. In this analysis the Kinect Sensor is applied to a video for processing. It is linked to an existing stream. The motion of the object is tracked using the sensor. Kinect absorbs each part of the object in the video and detects the features to be extracted in order for actions to be performed by the system.

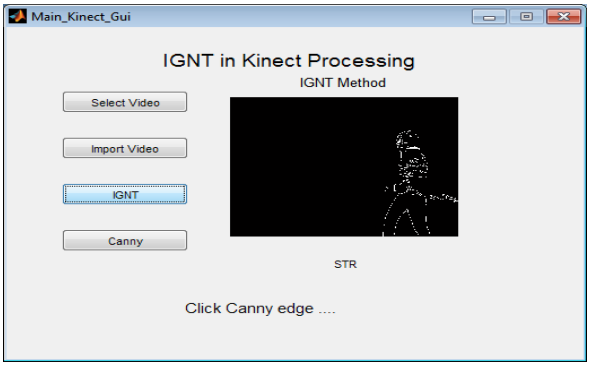
b) Selection importing the video frames of an experimental video



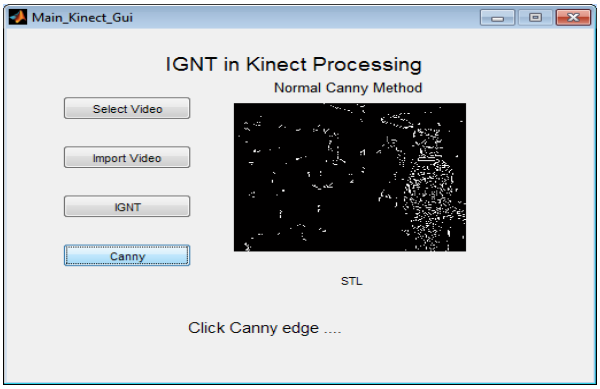


The video used for the purpose of experimentation is imported and executed. Once the video is imported the contrast of the image is improved and the intensities are thus adjusted forming the process of histogram equalization. The intensity of the image depends on the sensors being used for the purpose. In such cases histogram equalization forms the bases of improving the scenes for understanding and processing. Kinetic motion is a part of the object featured and is to be separated from the background that is also detected by the Kinect sensor. The process of Image Subtraction is performed after histogram calculation. The results obtained are shown in the Figure-2(c). The gradient values obtained during the preprocessing are smoothed and sampled in order to reduce the noise seen in the scenes. Each sequence of frames is processed and the object is detected in each frame. The changes from one to the other considered as the motion of the object, is predicted and is studied.

c) Preprocessing using IGNT

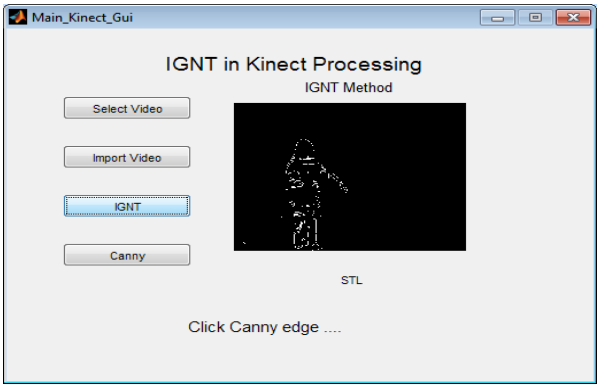


d) Implementation of Canny Edge Detection



Canny Edge Detection technique is applied to the image after preprocessing. It can be seen in Figure-2(d) the noise and irrelevant data present in the image is also detected as an Edge. Thus the object is not clearly recognized. Thus Kinect is in a state of inhibiting the background noise also to be an edge. Kinect makes guess of the action to be performed and is not well aware of the situation. Understanding of the sign language input given by the human becomes most probably a guess reaction rather than the reaction to be produced as a result of the action. The object changes seen in the frames are inevitable and unclear. The transitions are not exact. In the proposed method noise is being tolerated using binarization and thresholding. The execution of the proposed technique involves automatic thresholding enhancing the Kinect to detect the edges of the object without the involvement of noise. Thus the Kinect Sensor detects only the edges of the featured object.

e) Implementation of the proposed method (IGNT)



As shown in the Figure-2(e) it can be seen that the proposed method overcomes the difficulties of recognizing the object seen in the existing method.

Figure-2 predicts the results that have been obtained by implementing An Improved Gradient Edge Detection Method in Kinect for sensing the 2D and 3D images. The Canny Edge Detection Technique and the Proposed Edge Detection Techniques are relatively analyzed [14, 15].

4. CONCLUSIONS

Human Computer Interaction is in essence a common requirement for understanding the tasks to be performed today. The goal of HCI is to minimize the distance between the human mental model of what they want and computer understanding of the model.

Kinetic Device is one such device that minimizes the barrier and maximizes the relationship. Yet the device is still under research and development. In this paper the proposed Improved Gradient Noise Tolerant Edge Detection Method is used in the Kinetic Device reducing the noise and discontinuities in the data to be processed and for detecting Edges both in two and three dimensions. The Gradient method improves the Edge Detection by automatic thresholding, binarization and feature detection. Equalization of the histogram in the sequence of the frames in the video enhances the video for processing. Separating the background from the object overcomes the disadvantages of the existing method.

Kinect processing is working in a large sequence towards a number of applications today. The combination of the processes of equalization, binarization, thresholding and feature extraction based object identification has defeated the questions imposed by the existing techniques and thus improving the working principle of the Kinetic Device.

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