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Detection of Mobile Object in Workspace Area

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Abstract

This paper introduces the detection of mobile object in intelligent space robot application. There are three major algorithms, namely object detection, object classification and object tracking. The core of the detection of mobile object comprise of two processes: offline and online. An offline process consists of the training of the model using deference input sources that depend on the application. An online process consists of the matching process and the result of the object poses. The main idea of object classification is to classify into two categories depending on the dimension of object, mobile object and non-mobile object. By using an offline and an online process the whole process becomes faster because there only have object classification and object tracking involved in real time. The positions of the mobile object are represented by symbol X with difference colors for easy comparison with non-mobile object. One of the unique advantages mentioned in this paper, the detection of mobile object only uses image processing that are generated by the algorithms without additional sensor like sonar or IR sensor.

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Keywords*: Object Detection, Object Classification, Object Tracking, Image Processing*

1. Introduction

As the technology growth, mobile robot as one of the advanced in utilize used in manufacturing plant, working robot in dangerous area with means the human can't work there. It has also developed in security and cleaning field's area. A self-localization is a very important factor to work for special things, which we mentioned above. By the time being, a self-localization with the vision systems has advanced solution.

This paper introduces how to detect the object in an image by using a vision system. The image is capture using a single camera for saving the image processing load. Here use the model based on shape object to create data template [1-2]. The idea is assume the mobile robot as mobile objects where the locations of the objects mobile and non-mobile are determine using classification algorithms. Before apply the classification algorithms, all objects in an image are detected by object detection algorithms. For estimate the actual object location, the camera position is fixed at a ceiling and the camera start to setting. The camera setting is includes the length between the camera to area envelope and the camera focus.

The algorithms are generated using two processes, the process are offline and online process. The offline process consists of training of the model, using different input source that depend on the application. Because of training the model use the technique of edge detection, threshold and feature extraction in this process. In the online process, the classification and tracking algorithms are take part. Both of the algorithms are determine which one the mobile object or non-mobile object.

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The main idea in this paper is to monitor mobile object activity in control unit room. After all of the objects in the image are extracted, the objects will be classified into two classes namely mobile object and non-mobile object and the position are representative by cross symbol. This paper, focus on mobile object detection in space area.

2. Background

Nowadays the research of image processing has being more challenging topic in computer vision [3]. The technology is widely use in image detection and object detection in control application because of various advantage low cost installation and easy to maintain. The difficulties are existing in multiple object tracking. The are several method being use are object detection and tracking algorithm and object and part detection by using Histogram of Oriented Gradients (HOG)[4].

Detection of an object is related to computer technology and image processing computer vision that deals with detecting instances of semantic objects of a certain class such as humans, buildings, or cars in digital images and videos. Object is detected using a fixed camera to start with a modular adaptive background model [3].Gaussian-mixture based based modeling method is used to create a Gaussian-mixture based modeling method is used to create a Gaussian-binary mask image foreground. An object detection module takes the foreground pixels generated by background modeling as input and output of object detection. For object detection in general and for part detection HOG is a descriptor of an image region based on local image gradients. For detecting an object in an image, one can decompose the image into overlapping search windows whose size depends on the expected object scale [4].

Tracking algorithm can accept the probabilities of preliminary object detection and keep multiple hypotheses of object trajectory in graph structure [3].The useful information such us position, velocity and size is uses from the previous object state to create an estimate of the object's new state. The combination of a dynamic objects previously estimated and measured will help remove noise from the measurement that would otherwise result in erratic tracking objects. After combining this estimate with additional information of its state, tracking accuracy can be overall improved

Object detection and tracking algorithm is one of digital image processing method. Digital image processing have several categories that is image representation and modeling, image enhancement, image restoration, image analysis, and image data compression [5].

Image representation and modeling is an image consists of many picture elements commonly known as 'pixels'. Each pixel holds a key amount of data. Image representation deals with characterizing the information that each pixel represents. For instance the different brightness levels of an object may be stored in a pixel. One of the main things that need to be done in image processing is to sample and quantize images. sampling rate is can be done easily and it important to do meanwhile quantization of an image is the process of converting from analog to digital, by assigning a finite number of gray levels to the sampled image.

Image enhancement is the parts that require image processing to accentuating the different feature of images whichever for display or analysis intention [5]. Image restoration is the process the process to restore the degraded image. Image restoration is also use to correct image read from camera that show blurry image or out of focus image. Image analysis process is concerned with gaining a description of an image by taking quantitative measurements of it. Image Data Compression is the amount of data that has to be stored with images and moving pictures requires extremely large amounts of storage space. It is for this reason that data compression techniques must be applied.

3. Approach and Method

In this paper there have two processes to generate and implement the project.

3.1 Offline Process

The offline processes are include object detection, creating shape model and train model

3.1.1 Object Etection: Image acquisition could be crucial for the success of the whole project and cameras can view are largest possible area [6]. The camera is mounted at a ceiling directly above the select area to get the work envelope area. The space area is depends on the high between landmarks and the ceiling and also the focus length in the camera. The user can monitor the mobile object in the control room. The application view is shown in Figure 1.

An object detection segmenting the image to separate the vehicles from the background is important. To be useful, the segmentation method needs to accurately separate object from the background, be fast enough to operate in real time, be insensitive to lighting and weather conditions, and require a minimum amount of initialization. The technique is including the edge detection, threshold and feature extraction.

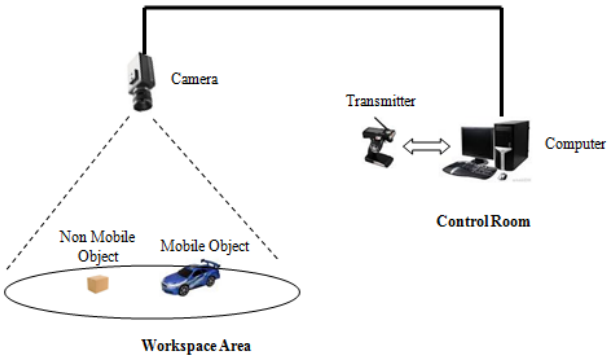


Figure 1. Application View

3.1.2 Creating Shape Model: The shapes of each object are store in own model which means in the offline process what we do is apply object detection to get the object shape and store it into a models. The objects are taking in this process actually the sample object as a reference object for matching process in object classification method. The operator create shape model prepares a template [7], which is passed in the image template, as a shape model used for matching.

3.1.3 Train Model: Train model is used to extracts the final (rigid) model components and trains their mutual relations such as their relative movements, on the basis of the initial components by considering several training images. The principle of the training is to find the initial components in all training images and to analyze their poses (position and orientation). Each model will be train automatically and the online process is take part.

3.2 Online Process

The online processes involve object classification and object tracking algorithms.

3.2.1 Object Classification: Object classification is applied in real time after the models are created. The main idea is to classify the object into the sufficient number of

classes [6,8]. In this paper, have been used the dimension of object into two categories; mobile and non-mobile object. More sophisticated shape-based technique is required. Since classification based on shape is done, the matching technique has take place. The template data is created first before matching process. The result of the dimension category is referred to the template data which satisfies either the mobile and non-mobile object classes.

3.2.2 Object Tracking: The aim of object tracking is to establish a correspondence between objects or object parts in consecutive frames and to extract temporal information about objects such as trajectory, posture, speed and direction. In this paper, the focus is on the direction and position of the object. Tracking detected objects frame by frame and compare the object image direction and position between them [8-9]. The difference between two frames is classified by object classification algorithms. By analyzing the object trajectory information, our tracking algorithm is able to detect and remove objects as well. In this method the mobile and non-mobile object are recognized.

4. Result

4.1 Offline Test

In simulation experiments, there no any simulation software involved only process the static images one by one it approximately 25 images. The image was taking and store in the system and each image has different mobile object positions. The shapes comprise of 7 sample different objects that will be use as reference during the simulation process. Figure 2 show 7 images that need to create theirs shapes and store into “templates” models. In order to run the simulation system, there is a need to generate the shape models first and store its shape into “templates” models. After generated “templates” models the simulation process start to runs. Here only 25 images will simulate one by one image until the end. The sample images simulation shown in Figure 3 is a tracking process frame by frame and Figure 4 shows the position of all object appear in the image is represent by X symbol. In this case each object in an image frame will classified by comparing with the objects shape in the template models.

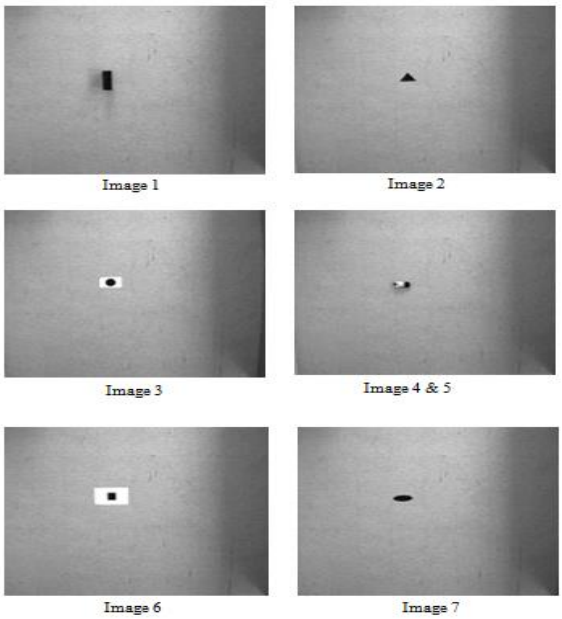


Figure 2. Create Shape Images

4.1.2 Online Test: This system used one monochrome camera and the matching objects process is base on objects shape in the "templates" models. In order to run this system same as simulation process, firstly objects shape will be create and store it into the "templates" models. There were 7 shapes to determine or classify which one the objects into theirs groups; non mobile object and mobile robot. The online experiment was conduct in indoor environment within 1 x 1 meter square enclosed area by collecting and storing an image in each mobile object path. After a "templates" model was done, the system will able to be generate. The objects were appeared on the screen monitor layout which is represented by X symbols with different colors where the destinations are red, white and maroon. Figure 5 show the sample images for simulation with moving mobile object.

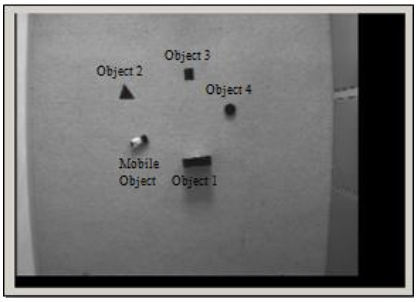


Figure 3. Sample Images for Simulation with Mobile Object

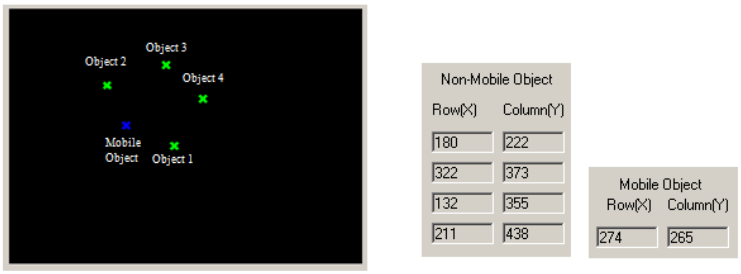
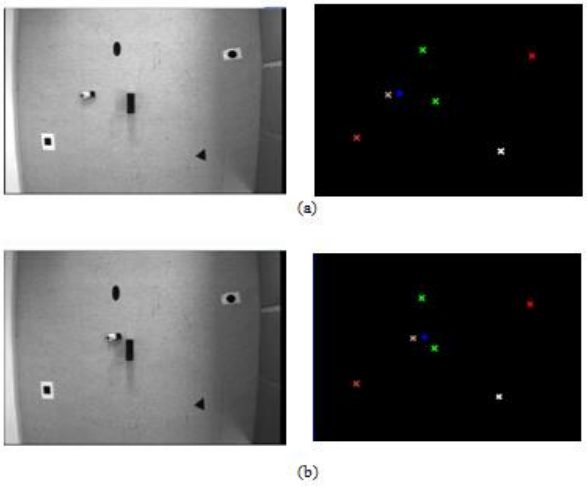


Figure 4. Screen Display for Object Position



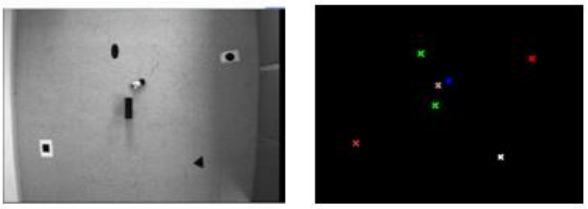


Figure 5. Sample Images for Simulation with Moving Mobile Object

5. Discussion

The systems are constructed from several algorithms; there is object detection, object classification and object tracking and a single camera. There use the image processing software and integrated with visual basic programming as a medium to create the screen layout at the control room. The visual basic is used to integrate all the algorithms in the systems.

This paper only uses the image processing library in the image processing software and apply it to the application. The matching process is dividing into two parts: offline and online. In offline process, there have object detection, create shape model and train model are involve. The concept in create shape model is to create template matching and to train the model at template. In the train model, first region of interest that covers the template in the training image must be specified. Only those part of the image that really significant and stable should be used for training. The template is only store the shape of object. The online process is includes object classification and object tracking algorithms. This process are also comprises the matching process itself.

During an optional test, firstly train the image by using sample image to created shape model in each shape. The illumination must be set correctly because the threshold value is deference according illumination. The threshold will affect the shape of object in the template matching procedure. Camera calibration is a first steps to doing in online application. The calibrations are included the camera height, area, camera focus and also how to converted image coordinated to word coordinated.

Mobile and non-mobile object are represent in cross symbols but difference color. This is because we want to ensure the user know which one the non-mobile and mobile object by looking in the screen monitor at control unit without going to the real area envelope.

6. Conclusions and Future Work

As conclusion there are several algorithms involve in this paper in order to implement the mobile object detection. The image is taken in a real time from camera and processes it by using object detection, object classification and object tracking. The algorithm is related to each other to ensure the good result. The mobile and non-mobile coordinate are display at the monitor in control unit room with difference color of cross symbols.

The future work is to produce a more efficient system and to increase data template in object classification for non-mobile object. Additional intelligent will be achieved by interfacing the mobile object and system to train the mobile object to achieve the target destination with obstacle avoidance.

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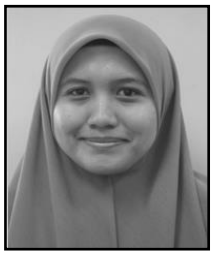

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