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Idle Time Analysis of Construction Equipment by Digital Image Processing

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Abstract:

Correct analyses of construction equipment idle time have great importance for the cost effective energy having of construction equipment's in mega project. The higher productivity can achieve with the less idle time of equipment, however, it is idle time by human usual observation. This paper describes image-processing based methodology to automatically assess\count the idle time of hydraulic excavation. The image color space (HSV)(Hues, Saturation and Values) are used as basis far tracing algorithm and image segmentation. The HSV color space shows important advantages over the RGB (Red, Green and Blue) color space in determining and tracing construction equipment. Experimental executes

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Shows that given methodology has assuring far effective equipment management in construction industry.

Keyword: *Construction equipment, Digital imaging Equipment, Idle time.*

Introduction:

Labor, material, equipment are the three major resources for infrastructure projects. The accomplishment of any project depend on how accordingly construction equipment are planned far and allocated for work, and how efficiently it is utilized for a construction task on equipment waking on construction site Is to measure idle time and working time of the equipment. Here idle time is unproductive time is the time when a piece of machinery is not in used but it could be. Minimizing the idle time of significantly reduce the rental fees, cost of related labor, from infrastructure prospective efficient planning and based on complete and accurate equipment idle time analysis will enhance construction productivity, accompany to cost saving and time saving on other side, a worthy understanding for idle time conditions of construction equipment it is necessary to develop a high quality equipment arrangement plan. Idle time of equipment is hard to be measure and calculate special device such as sensors provided are installed on construction equipment then sensed data can be possessed for idle time & working time measurement. Generally Sensors are not available in many cases, where visuals inspection becomes the main method for utilization status of equipment. It is very common to install cameras on construction site to monitor day to day activities. Adjacent buildings crane are used to established cameras. The cameras produce videos, images of the construction field at given time intervals. The recorded videos can be easily sent to the computers participants of project, so that they can be easily understood ongoing activities on construction site. These generous images, videos data of the construction site provide exclusive opportunity to use an image processing based approach to measure construction equipment idle time.

Image processing has been commonly used in many construction engineering application, such as assessment of construction project progress Y. Wu and K. Kim (2004) which is efficiently assess the level of progress for any construction project[1]. Jeorge Abeid Neto, David Aradite (2002) describes method for recognizing the presence of structural component in digital imagining of a picture which is taken out on construction site to enhance the control of the performance of site[2]. Seokho Chi &Carlos Caldas (2012) presents an automatic image based safety assessment: Automated spatial safety risk identification pf earthmoving an surface mining activities[3]. Y.M.A. Hashash et al. (2007) shows digital image reasoning for tracking excavation activities this paper explores use of image analysis

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for to readily identify changes during excavation activities[4].

RGB & HSV Spaces

Pixel colors is determined with the combination of red, green, blue values i.e. RGB images. This color of RGB spaces are widely used because it can be easily complete with electronic display devices using its accrual nature.

In HSV, hue saturation and value color spaces can generate high quality graphics. HSV is refers in such way that it is similar to the humans recognizing color. In HSV, Hue is act for color expression, Hue act for color representation and has angle from 0 to 360 degree. Saturation shows the range of grey in total color space range for saturation is 0 to 100%. When value is '0', the color is grey and at '1' color is primary color. Value indicates brightness of the color ranges for value is 0 to 100%. At '0' color space will be totally black, increasing value shows the brighten up image in various color.

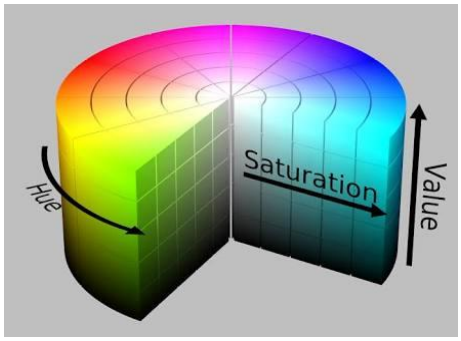

Fig. 1 HSV Concept

Methodology for Work

Before representing the methodology for working and idle time analysis, it is necessary to review some characteristic and assumptions of this experiment. First is camera should be stable and focused while capturing the video. Second is hydraulic excavator should be distinct from background color information used to identify and trace the equipment movement. Video data obtained from BSA Corporation Pvt. Ltd., Pimpri where early phase of construction was carried out under CCTV Surveillance.

Target Segmentation

Target segmentation is the most difficult task in image processing related researchers. There is two conditions which indicates working status of the excavator, first is excavator loading and dumping its buckets and second is the excavator travelling on site for working process. Whatever may happen, the location of segmented excavator changes. Fig. 1 are the sample color image of excavator in RGB color space (Red, Green, Blue respectively) as it can be seen, it is difficult to extract the excavator from RGB color space because some regions of equipment have similar color range in the background. Color information construction site is not consolidated into expanding methodologies because of type of cameras used and the research trend to avoid complicated analysis in favor of fast modeling. However color are prove rich informer from construction site or field to make easy understanding of the scenario. Fig. 2 is the HSV image in which HSV color spaces are used to extract the interested data from image data. As shown in Fig. 3 Grayscale image it is almost impossible to extract the equipment from grayscale because excavator is very close to the grayscale of its background.

Fig. 2 Original Image

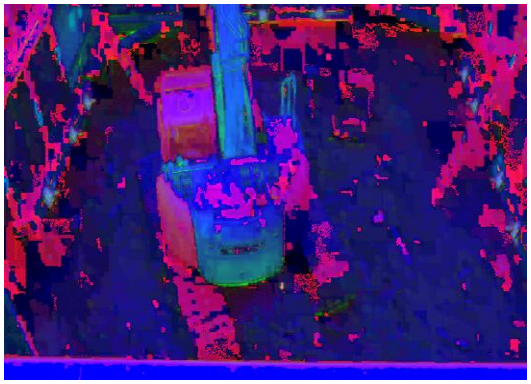

Fig. 3 HSV image

Fig. 4 Grayscale Image

Fig. 5 Saturation Image

Object Extraction

After segmentation process targeted extraction is most important and challenging job. Separation of the object from its background region sums what increase the precision of the image processing analysis. For separation unique color, shape, size these features are used for this type of tracking. Color range information cannot use because similar color range equipment can appear on the site which may causes confusion. The number of pixels of excavator also varies when the equipment changes its direction and movement. Once done with identified location of hydraulic excavator, we assumed the location of equipment in next image. Therefore, the hydraulic excavator as the object in the present image with the closet centroid distance from the proceeding image of that hydraulic excavator.

Movement Indicator

It is very important step whether the equipment actually moves or not. For this many properties i.e. coordinates of top left, top right, left bottom, major minor axis are used theoretically but in reality these options are not that much feasible. Small changes in weather and lightening system can change the image quality. Hence the centroid coordinates of segmented region as a simplest indicator of movement were tried. Threshold value is important factor which may affect the accuracy of idle time calculation, thus the distance between object's centroid differs by more than threshold value then the object is considered to be moved.

Program Architecture

An image processing program was developed using MATLAB to automatically estimate the idle time of interested equipment. A total 7690 frames from video were studied. For extra accuracy two functions are added first is video resizing which avoid unwanted data from image which reduce processing time. Fig. 6 shows the flowchart of whole programme.

Discussion & Results

The proposed methodology, accuracy may achieve. The results show that the hydraulic excavator was worked for 362 seconds during 542 seconds during investigation period, with idle time 180 seconds. The movement indicator threshold value fix upon the movement condition of the object. This value may vary for different type of equipments, camera resolution, and lightening condition etc. excavators location also affect the threshold value. For example, a excavator located 200 meter away from the camera will require a different movement indicator threshold value than same excavator located 100 meter away from camera. That's why precise calibration process should be conducted out idle time analysis.

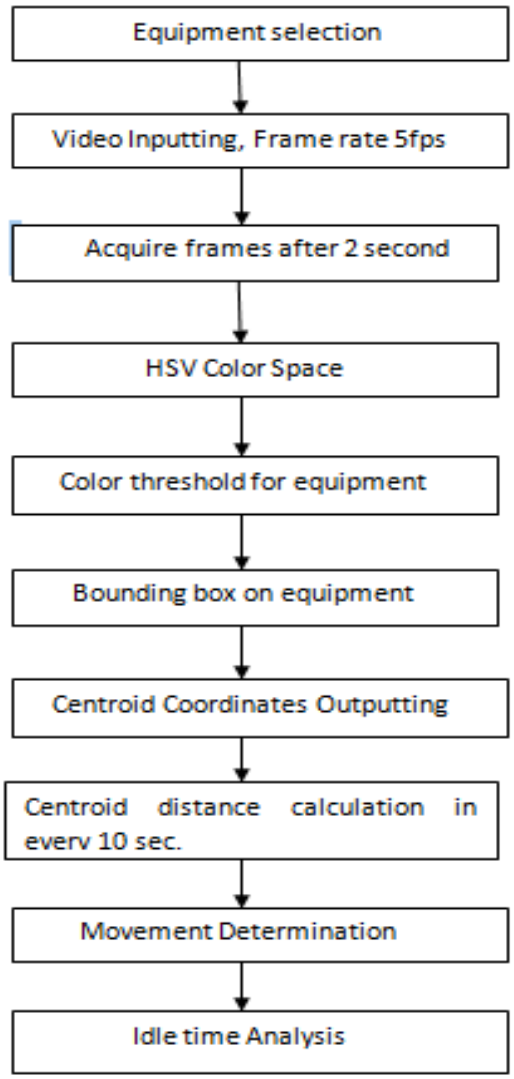

Fig. 6 Flow Chart

Conclusion and Future Work

Paper presented the encouraging outcome of an image processing based methodology in construction field which can help project manager better awareness of construction equipments usage and increased productivity. Using HSV color spaces and simple threshold setting the proposed methodology able to effectively measure idle time of any construction equipment.

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