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Image processing and analysis developed on Versatile Portable Intelligent VIPRO Platform

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Abstract. The paper presents image processing and analysis using image formation, image operations, sampling & quantization developed on Versatile Portable Intelligent VIPRO Platform. Using appropriate camera settings that a drone is equipped with will help prevent distortions of photography, such as chromatic aberrations and cylinder distortion. These settings will simplify the image processing tasks required in a host of important applications such as feature extraction, land recognition, and so on. This in turn simplifies the processing tasks required in a number of important applications, such as feature extraction, landmark recognition, etc. The results have been integrated on the Versatile Portable Intelligent VIPRO Platform, which enables the development of the intelligent imaging control interfaces with applications to robot vectors, rescue robots, firefighting robots.

Key words: navigation robot, stereo vision, sampling & quantization image
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1. INTRODUCTION

Active robotic sensors are rapidly gaining viability in environmental, defence, and commercial applications. As a result, developing information-driven sensor strategies has been the focus of intense and growing research in artificial intelligence, control theory, and signal processing. We will focus on stereoscopic camera rigs, that is, two rigidly connected cameras in a pair. Specifically, the main problem is the determination of the trajectory of a mobile robotic sensor equipped with a stereo camera rig so that it localizes a collection of possibly mobile targets as accurately as possible under image quantization noise. The advantage of binocular vision, compared to the use of monocular camera systems, is that it provides both depth and bearing measurements of a target from a pair of simultaneous images [1-3].

In aerial photography performed with the help of the drones, it is advisable to use a recommended camera, which, based on the tests performed on it, proved to be able to get the best photographs [4, 5]. In order to obtain professional aerial photographs using drones, it is necessary to use those basic camera settings such as ISO, shutter speed, aperture, focus and measurement together with stabilization of the thorn, which are the most important factors for achieving this goal.

In order to become suitable for digital processing, an image function f(x,y) must be digitized both spatially and in amplitude. Typically, a frame grabber or digitizer is used to sample and quantize the analogue video signal [6, 7]. Hence in order to create an image which is digital, we need to covert continuous data into digital form. There are two steps in which it is done: ***Sampling*** and ***Quantization***.

The sampling rate determines the spatial resolution of the digitized image, while the quantization level determines the number of grey levels in the digitized image. A magnitude of the sampled image is expressed as a digital value in image processing. The transition between continuous values of the image function and its digital equivalent is called quantization.

The number of quantization levels should be high enough for human perception of fine shading details in the image. The occurrence of false contours is the main problem in image which has been quantized with insufficient brightness levels. In digital image processing we will talk about two key stages**:** **s**ampling and quantization that will be defined properly. Spatial and grey-level resolutions will be introduced and examples will be provided, too.

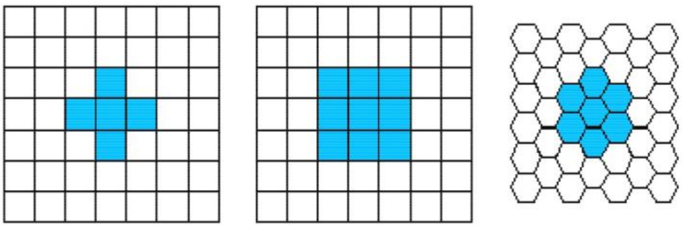
2. IMAGE PROCESSING AND ANALYSIS

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/ features associated with that image. Nowadays, image processing is among rapidly growing technologies.

The ability to obtain the accurate three-dimensional position information in the presence of limited sensor resolution is a crucial task in computer vision and other triangulation systems. If the contrast of an image is highly concentrated on a specific range, e.g. an image is very dark; the information may be lost in those areas which are excessively and uniformly concentrated. The problem is to optimize the contrast of an image in order to represent all the information in the input image.

Filtering is a technique for modifying or enhancing an image. Spatial domain operation or filtering (the processed value for the current pixel depends on both itself and surrounding pixels). Hence filtering is a neighbourhood operation, in which the value of any given pixel in the output image is determined by applying some algorithm to the values of the pixels in the neighbourhood of the corresponding input pixel.

This paper will show how an image is represented in the computer, how a color image is represented in the computer, and the very important concepts of sampling, representation, and quantization. We will present 2-dimensional arrays of pixels which can be subjected to various types of operations. This section will present operations that are very simple but extremely useful and will illustrate how images can actually be manipulated. Imaging techniques will be presented using simple or complicated operations to get clearer images or to highlight fundamental details.



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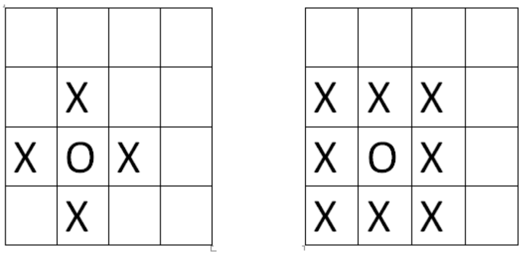


Fig.1. The most common types of neighborhoods used in image operations

Some of the most common neighborhoods are the 4-connected neighborhood and the 8-connected neighborhood in the case of rectangular sampling and the 6-connected neighborhood in the case of hexagonal sampling (fig. 1). The 8 neighbours of the pixel represented by O are all the pixels around it, which enables an operation to go North and South, East and West, as before, but also Northeast and so on, meaning diagonal. The eight-neighbourhood is the most common neighbourhood used today in most modern image processing. However it's important to be aware of the other type of neighbourhood as well, especially when doing segmentation.

For now, as we have 2-dimensional arrays (fig. 2), we can do simple operations between 2-dimensional arrays. For example, we can add them. Every point has a value. Thus, a second image can be added to the first image. Image 1 below can be added to image 2.

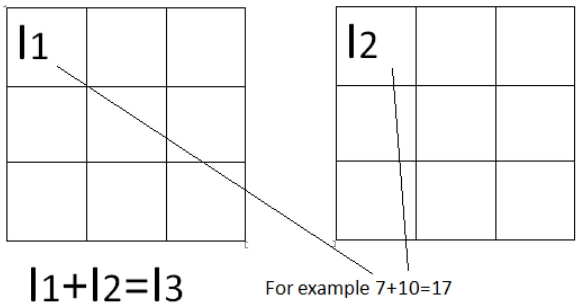
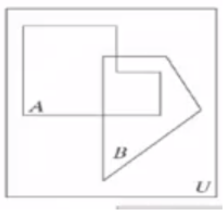
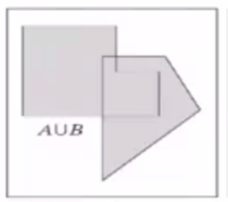


Fig.2.The procedure of adding two values of two images

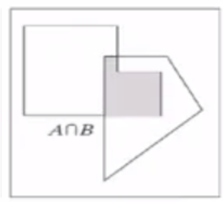
This example uses 3 x 3 image. The values in the upper left corners of the two images are ed. If the value in the top-left corner of the first image is 7 and the value in the top-left corner of the second image is 10, the resulting value is 17. This is repeated for the next pixel and so on. This is a simple addition of images, however an extremely important operation by itself. The images are very noisy, but all the images are aligned. The camera is kept immobile, and nothing is moving. Images are captured one after the other, and then added to each other. as more and more images are added, they become clearer and clearer. This is repeated for the number of images captured for that particular region of space. In essence, what happens is I1 + I2 for however many images there are available. What happens is the image starts becoming clearer and clearer because the image has noise. The actual scene is always the same, but the noise is the one that changes, and when all those images are added, the addition is the same number, plus the noise that is random, and then the noise gets reduced. The basic idea is that this 2-dimensional array can be used to do a number of interesting operations.



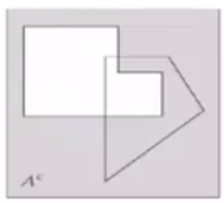
(a) Two sets of coordinates A and B, in 2-D space.



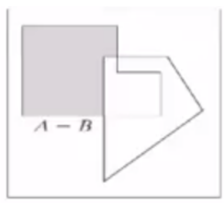
(b) The union of A and B.



(c) The intersection of A and B.(d)The complement of A.



(d) The shaded areas - represent the member of the set operation indicated



(e) The difference between A and B

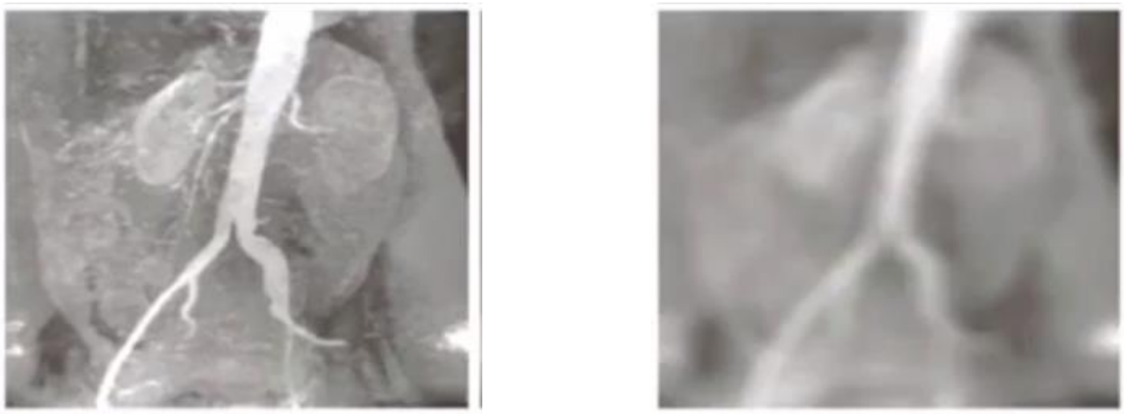
Fig.3. Logic operations

The image enhance was achieved by changing the grey value distributions to make them clearer. In this case, we took I1, I2, and performed I1 - I2. Sometimes, the absolute value is taken, if the sign is not relevant, other times all the pixels are shifted so the negative value becomes zero. Once again, a very simple operation that can have tremendous value.

Logic operations can also be applied to images. The figure 3 shows an image A and an image B, and Figure 3.b shows the result of their logic intersection, AUB. To simplify, we assign 255 to all the values in the shape, and 0 to the rest. B again, is all 255, so we get the union of them. We get the intersection of the pixels have a value of 255 in both objects, or Y values.

The inverse of an image can also be created, and the basic idea is that zero is black and the brightest point has a value of 255. These values can actually be inverted. 0 can become 255, and 255 becomes 0. This is illustrated in figure 3.d and figure 3.e.

Figure A is the input and figure B is the output, and the operation is performed as follows. 0 goes to 255, 255 goes to 0. Image inversion can be used to reveal details that might be easier to observe the inverted image than in the original image.



(a) The aortic angiogram .(b) The result of the eq

Fig.4. Local averaging using neighbourhood processing.

A pixel can be replaced by the average of all of its neighbours, including it self [8-12]. This is done by summing up all the pixel values, dividing by nine and replacing that pixel by that result. To average the entire image, this operation is performed for every single one of the pixels. The eight neighbourhood of a pixel is averaged, and the value of the pixel is replaced by the average of the pixels around it. This is repeated for the next pixel, and so on. After that, the result is overlapped.

The overlap happens because the average of a neighbourhood is used to compute the average of the pixel next to it, and so on. The eight neighbourhood of a pixel will contain part of its own value as the average. Overlapping occurs because we are shifting one pixel at a time. This is done for every single pixel in the image. Figure 4b shows the result of this operation. The noise was removed but the resulting image is very blurry. Some cases benefit greatly from this image processing application.

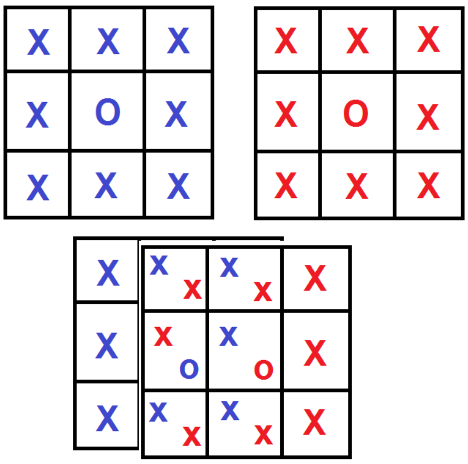


Fig.5 . Ways to combine pixels in from images

To avoid blurring the image excessively, neighborhoods ca still be used, but they're sophisticated neighborhoods in the sense that they understand when there is a big change and they don't go to the other side (fig. 5). This means that only e.g. six values, instead of always averaging nine values may end up being averaged. This is a very simple operation. Every pixel is replaced by a linear combination, in this case an average of the pixels around it.

$$I \Rightarrow [R(I)] \Rightarrow R^{-1} \Rightarrow \textbf{Differences}$$

[R(I)] is the rotation, R^{-1} is the result of the inverse rotation and **Differences** is the subtraction. The reason we have differences is because of the sampling and the discretization of this phase that was discussed above.

4. IOSQ INTELLIGENT CONTROL INTERFACES USING VIPRO PLATFORM

Intelligent control interfaces through image analysis using Images Operation Sampling & Quantization (IOSQ) apply advanced control strategies adapted for space imagine and colour imagine modeling represented in the computer, and the very important concepts of sampling, representation, and quantization.

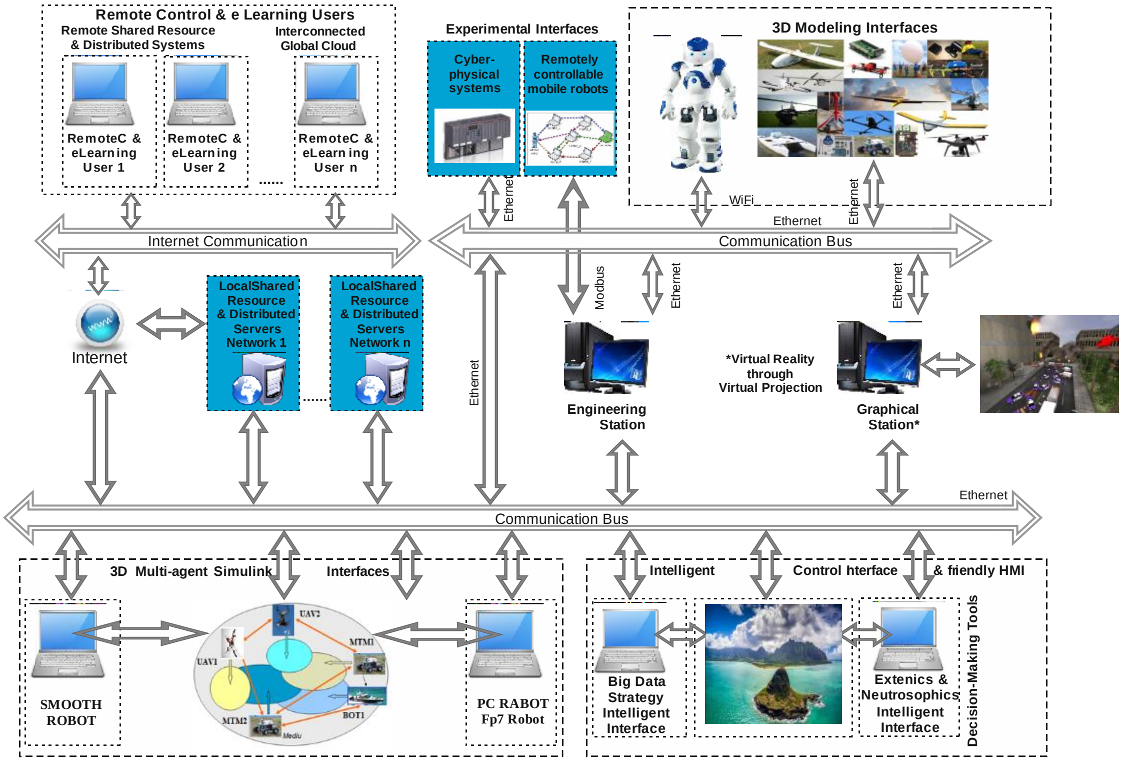


Fig. 6. IOSQ interface integrated in the VIPRO Platform

Starting from the Versatile Intelligent Portable Robot VIPRO Platform [13-15], with open architecture system and adaptive control network [16], presented in Figure 6, was developed to improve the navigation robot, providing unlimited power for design, test, experiment the real time control methods by integrating the intelligent control interfaces (ICIs) in robot modeling and simulation for all types of robot vectors, rescue robots, firefighting robots, aerial robots.

4. CONCLUSIONS

Nowadays, stereo vision has been widely used in military, industry, civil engineering, amusement and scores of other areas. Stereo vision system can help robots and machines to observe surrounding environment with depth perception like human do. It can not only find distances from objects to cameras but also effectively identify and track objects. Using the right camera and settings which are proven for this kind of photos will allow you to avoid distorted photos such as chromatic aberration and barrel distortion.

The use of mathematical algorithms in image processing helps to improve image quality and to highlight or eliminate some parameters that are of interest to us. These algorithms can also be used to compose images using different sources representing a very important component in the medical environment as well.

Natural images provide essential raw material for vision research. They are used for the testing of computer vision algorithms, as the source of image statistics, and to stimulate observers in psychophysical experiments. Natural images are captured by both biological and photographic systems.

Biological vision has evolved to function in an environment of natural image structure and statistics, whereas photographic systems have been developed to meet various commercial criteria.

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