The organization of the computer means controlled by the image's parameters

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ABSTRACT

A new concept of working out computer means, with the architecture controlled by the parameters of the images (CPI) is being suggested. The methods and processor structures of image parameters determination are presented. The architectures of general-purpose multiprocessor computer systems CPI with fixed and reconfigurable structures were elaborated and investigated. The analytical estimation of the image processing time depending on the image parameters, characteristics of the processor conveyer and the image memory modules are presented. The methods of the system organization, which optimize the number of processors, are proposed.

Keywords: image parameters, computer means, adaptive processing, complexity

1. INTRODUCTION

The progress in science and engineering is connected with the development of new concepts and trends in working out high effective intellectual computer means of image processing and recognition.

At present different types of multiprocessor computer systems with matrix, pipeline and pyramid organization have been created[1-5].

One of the disadvantages of these computer means is that during image input and their further processing the characteristics of the initial image are not taking into accounted. All this doesn't allow to use effectively computer means resources.

At the same time it is known that during the brain activity the redistribution of its computing resources takes place with respect of the peculiarities of the information being taken from the external medium through different channels. We may cite as an example the human ability to perform some mental operations simultaneously such as acoustic analysis, visual and other kinds of information. However, the redistribution of computer resources when the main attention is given only to one of the solved problems due to the peculiarities of the given information takes place.In this paper a new concept of working out computer means, with the architecture of CPI is presented (chapter 2).

This concept is intended to organize the adaptive image processing based on extracting the exactly necessary volume of information from the initial image and its further processing as well as on redistribution of computer resources depending on the image parameters being analyzed.

Such an approach allows to organize the new trends of the researches. 1) The construction of the computer systems, CPI. 2) The construction of adaptive special purpose processors, CPI. The first trend of investigations includes the elaboration of general-purpose computer systems with fixed architecture and reconfigurable computer systems, CPI; problem-oriented computer systems, CPI. The second trend supposes the elaboration of the special-purpose processors for separate operations on image processing such as image coordinate transformation, the calculation of image moment features, etc. These processors may be used either separately or within existing image processing computer systems.

The methods and processors structures of image parameters determination are presented in chapter 3.The architectures of general-purpose multiprocessor computer systems, CPI, with fixed and reconfigurable structures were elaborated and investigated (chapter 4).

The analytical estimation of the image processing time in dependence on the image parameters, characteristics of the processors conveyer and the image memory modules is presented in chapter 5. The methods of the systems organization, which optimize the number of processors, are proposed in chapter 6.

2. A NEW CONCEPT OF IMAGE PROCESSING COMPUTER MEANS

The concept suggested allows to evaluate the computing means for image processing, which have a possibility of the computer resources redistribution and the computing processes reorganization depending on the characteristics of the images analyzed. In this case, one organizes the adaptive image processing, which is based on the extraction of exactly necessary volume of information from the initial image and its following analysis.

Let the initial image be described by the function P(x,y), which is characterized by a set of the image parameters $IP=\{p_1,p_2,...p_k\}$. Let the problem of image P(x,y) processing be described in the following way: $W\{P(x,y)\} \rightarrow RO$, where W is a processing function; RO is a processing result, it may be presented as a new image or some numeric data.

In general, the function W may consist of a totality of separate operations: $W=\{w_1,w_2,...,w_k\}$. We suppose that there is some computing media for the realization of the function W, which consists of the sets of the processor elements $PE=\{pe_1,pe_2,...,pe_{lp}\}$, memory units $MU=\{mu_1,mu_2,...,mu_{lm}\}$, control units $CU=\{cu_1,cu_2,...,cu_{lc}\}$ and others.

According to the suggested approach (Figure 1) at the first stage one determines the image's P(x,y) parameters, the information on which will be used later to control the computing means architecture.

At the second stage according to the set of parameters IP, from the input image the necessary volume of information is extracted which is to be processed. For such volume of information the necessary and sufficient number of the discretization elements (pixels) of the input image will be supposed:

$$DE=N\cdot M, \text{ were } N=f_1(IP),\ M=f_2(IP) \qquad (1)$$

The parameters N, M will determine the dimensionality of a matrix of the digitized image:

$\Phi\{P(x,y)\} \rightarrow P=||p_{ij}||_{NM}$, where Φ is a discretization operator. This operator must correspond to the next criteria.

1. Of providing minimal time T_p of the image processing, i.e.:

$$\beta_1 = T_p/T'_p \leq \varepsilon_1, \qquad (2)$$

where T'_p is a reference processing time, ε_1 is the control parameter of the processing times ratio.

2. Of providing the required accuracy of the results, i.e.

$$\beta_2 = f_R(RO,RO') \leq \varepsilon_2, \qquad (3)$$

where RO' is a reference result value, ε_2 is a given accuracy. At the next stage on the basis of the parameters IP values the adjustment of the computing media architecture is being carried out, after that the direct image processing is performed.

The analysis shows that between the resources of the processor elements LP and the number DE of pixels to be processed of the image the following correlation are possible: DE(#)LP, where (#) is a sign of the ratio (<, =, >). At this stage depending on the sign (#) the operator of the computing media architecture adjustment is formed correspondingly: $ON_A=\{ON_{VP},ON_{VS}\}$, where ON_{VP} is an operator of the computing process adjustment; ON_{VS} is an operator of the computer media adjustment.

The operator ON_{VP} determines the type of the computing process N_{VP}: $ON_{VP}=f_p\{DE,LP\}\rightarrow N_{VP}$. The operator ON_{VS} characterizes the type of the structure of the computer media: $ON_{VS}=f_S\{DE,PE\}\rightarrow N_{VS}$. The operator ON_A must meet the requirement of satisfying the conditions (2), (3).