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Research Article

EQUIPMENT AND TECHNOLOGIES USED TO IMPLEMENT APPLIED TV TASKS AT THE PRESENT STAGE OF DEVELOPMENT

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ABSTRACT

This paper examines the areas of application of digital technologies in applied television systems and modern means of implementing such systems. The results of the use of digital television technologies are also presented.

KEYWORDS

software, SaaS, Google Earth, Google Maps.

INTRODUCTION

Applied TV with the development of digital technologies has received processors with neural architecture, machine learning principles and Internet services. It has become difficult to draw a line between the concepts of applied television systems and computer vision due to the tendency to integrate previously separate branches of production [1-3].

In general, short circuit systems, like applied TV systems, consist of a photo or video camera, as well as a computer on which image processing and analysis programs run.

If software security image processing is located directly in the camera, such a camera is called a "smart camera". The software (software) can also run on a remote computer or computers, or run in the cloud using the SaaS model (Software as a Service) [4-7].

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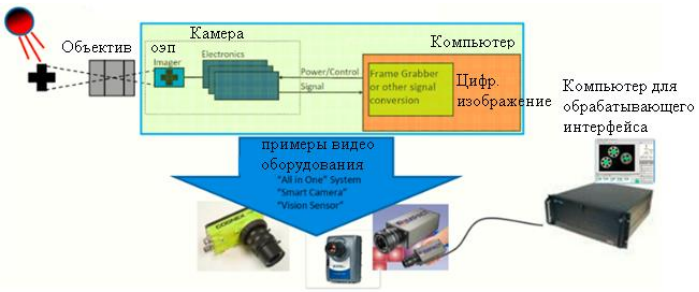

Fig. 1. Structure of a computer vision system with a Smart camera

Computer vision systems include the following main components (Fig. 1):

- object illumination (not always required) and optics (lenses and objectives);
- sensor matrix for image projection;
- systems for processing images obtained from the matrix.

In necessary cases, such as indoors, where the light can be controlled, the part of the object that needs to be inspected can be illuminated so that the desired characteristics of the object are visible to the camera.

The optical system projects the resulting image in the form of a spectrum visible or invisible to the human eye onto the sensor matrix. The camera's sensor matrix converts the image into a digital image, which is then sent to the processor for analysis [8-12].

In most cases, short circuit systems are designed to operate in natural light. In addition, short-circuit systems can operate in ranges invisible to the human eye [13-19].

To work in low-light conditions, cameras with illumination can be used, in which a ring light source provides bright, uniform illumination of the object when it is necessary to highlight the texture of the material, small details, etc. Lighting also helps to get rid of glare, illumination of the object, and is used in difficult conditions, for example, in the fog.

Pixel density (sensor resolution) is very important for the correct operation of a computer vision application. The higher the resolution, the more detail there will be in the image, the more accurate the measurements will be. The required pixel density depends on the size of the object, the working distance of the camera and other parameters.

Types of computer vision systems used in applied TV

There are three main types of short circuit systems:

- one-dimensional (1D),
- two-dimensional (2D),
- volumetric (3D) systems.

Based on the type of lenses in the lens and the number of cameras, a distinction is made between panoramic multi-camera systems and fisheye systems [20-24].

Stereo vision is one of the methods for extracting information about the depth of a scene using images from two cameras (stereo pair). The method is based on the principle of human vision, when the human brain receives information

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about the volume of a picture from two eyes. Similarly, the difference in the arrangement of pixels in the image from the two cameras provides information about depth (Fig. 2.).

Fig. 2. Principle of stereo vision

By adjusting the distance between the cameras of a stereo pair (baseline), you can adjust the required depth of scene recognition.

Spherical (panoramic) fisheye systems are used to emulate panoramic cameras for video surveillance and to integrate broadcast webcams into 2D and 3D geographic information system (GIS) applications such as Google Earth and GoogleMaps [8].

Panoramic fisheye systems working with image processing applications of cloud providers are used, for example, in driver assistance systems (ADAS), self-driving cars, when monitoring large areas and counting the number of people (Fig. 3.)

Fig. 3. Fisheye camera image

Arrays (networks) of cameras are used to track the movement of individuals indoors or in places with limited visibility (warehouses in seaports, factory areas, etc.), as well as for traffic control in intelligent transport systems (ITS).

Systems of small number (2 – 6) cameras are used for areas such as:

- Automation of production,
- Video surveillance from an unmanned aerial vehicle UAV,

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Fig. 4. System of 5 cameras for quality control of products on the conveyor

Methods of functioning of computer vision systems

Computer vision software libraries used to implement tasks in various programming languages and interactive environments:

Open CV (Open Source Computer Vision Library) is a library of computer vision algorithms, image processing and general-purpose numerical algorithms. Implemented in C/ C++, also developed for Python, Java, Ruby, Mat lab, Lua and other languages.

PCL (Point Cloud Library) is a large-scale open source project for processing 2D/3D images and point clouds. The PCL platform contains a variety of algorithms, including filtering, feature estimation, surface reconstruction, registration, model fitting, and segmentation.

ROS (Robot Operating System) – software development platform for robots. It is a set of tools, libraries, and conventions that make it easy to develop complex and efficient programs to control many types of robots.

MATLAB is a high-level language and interactive environment for programming, numerical calculations and visualization of results. Using MATLAB, you can analyze data, develop algorithms, and create models and applications.

Nvidia GPUs.

These packages contain built-in functions for implementing basic approaches to solving problems assigned to this applied TV system. Among them:

– Contour analysis;
– Search By template matching;

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– Search outside patterns, matching By key points (feature detection, description matching);
– Combination of data (Data Fusion).

Computer vision is not limited only to these basic methods; for example, we can distinguish so-called genetic algorithms, used, in particular, for face recognition.

When contour analysis of an image from a video sequence, not the full image of an object is analyzed, but only its contour, which significantly reduces the complexity of algorithms and calculations during processing. An object outline is a curve that corresponds to the boundary of an object in an image. The limitations of the contour analysis method include:

- with the same brightness as the background, the object may not have a clear boundary in the image or it may be "noisy" with interference, which makes it impossible to isolate the contour;
- overlapping objects or their grouping leads to the fact that the outline is highlighted incorrectly and does not correspond to the boundary of the object;
- poor resistance to interference, leading to the fact that any violation of the integrity of the circuit or poor visibility of the object leads to either the impossibility of detection or false alarms.

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