



ALGORITHM OF SIGNALS CARRYING VISUAL INFORMATION AS A PROBLEM OF OBJECT RECOGNITION IMAGE

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ABSTRACT

In the field of artificial intelligence, automatic processing of visual information is one of the urgent tasks. The article presents new software and technical methods for processing visual information, also gives modern problems of image processing and analysis and their solutions.

Key words: *visual information, analog-to-digital converter, OpenCV, XMLHttpRequest, CSS, automated video monitoring system, Machine Learning Library (MLL)*

INTRODUCTION

Many modern methods of processing visual information (images) in such branches of science and technology as radiolocation, robotics, optical holography and many others are based on the use of pattern recognition methods. At the same time, in order to create efficient technologies, the developed methods and algorithms must satisfy a number of requirements for speed and accuracy. Usually, each algorithm, having certain characteristics, “specializes” in its type of image. This paper describes in detail the processing of signals carrying visual information, as the task of object recognition.

Practice shows that the expansion of their functionality and productivity can be achieved through further development of sensory devices and increasing the level of software (algorithms). The purpose of this chapter is a structural analysis of the system of automatic classification used in the tasks of processing visual information.

MAIN PART

Figure 1 shows the block diagram of the automatic classification system, which is often used in the processing of visual information. Sensor 1 converts the physical quantity, coming to its input, into a signal intended for block 2 preliminary processing (usually the output signals of the sensors are electrical signals) [1].

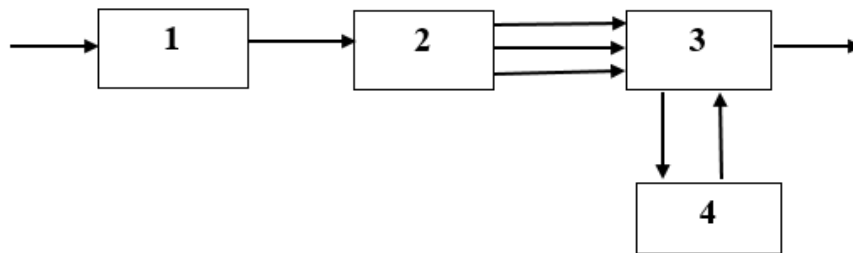


Figure 1

- 1 - Primary measuring transducer (sensor);
- 2 - Preprocessing unit;
- 3 - Classification unit;
- 4 - Memory.

This makes it possible to use sensors of various types. For digital systems, either sensors with a digital output are used, or an analog-to-digital converter is turned on after the analog sensor. For devices operating in real time, the characteristics of this particular node determine the characteristics of the entire system as a whole.

An example of an image signal sensor can serve as a photodiode array, each element of which in itself acts as an elementary sensor. Due to the mosaic structure of the photosensitive surface, the optical image is subjected to spatial sampling, which manifests itself in the output signals of the sensor [2, 3].

An important task in creating an algorithm and software for the automated design of an integrated video surveillance system is the task of recognizing an object, the image of which is transmitted through a video camera. Since the image of virtually any object depends on many factors: its orientation with respect to the camera, illumination, recorder parameters, static and dynamic parameters of the object itself, it is difficult to formalize and represent the image as a specific mathematical model. Therefore, the methods of implementing computer vision substantially depend on the tasks being solved and are rarely generalizable; most of these methods are non-linear, which affects the need to increase the computing power of computers and the complexity of algorithms for processing the image obtained through

technical channels. This work is devoted to the study of visual recognition of objects and the implementation of the resulting algorithm in the form of a software application that operates in real time.

For recognition problems, several standard tools can be integrated into the software of a standard computing system. One such tool is the open-source computer vision library OpenCV, which is implemented using C and C++ programming languages and can work with many popular operating systems (Linux, windows and Mac OS X). The library contains more than 500 functions that cover areas such as monitoring conveyor production, medical imaging, security, user interfaces, camera calibration, and vision for robotics. Computer vision and decision recognition tasks are directly related to the training procedures of the software complex. OpenCV contains a comprehensive Machine Learning Library (MLL). This subsystem is focused on the statistical recognition of images, including the faces of people, and their subsequent classification. The methodology is based on AdaBoost (adaptive boosting) adaptive amplification algorithm. The adaptability of the algorithm lies in the fact that each subsequent classifier is obtained from objects that were incorrectly classified based on previous classifiers. To select a particular attribute for classification, it is necessary to describe an image, for which it is proposed to use a set of simplest elements called Hara primitives.

The procedure for using primitives is to overlay them on the reference image and determine the generalized anisotropy characteristic of the selected area N

$$N = Q_w - Q_{bl},$$

here Q_w, Q_{bl} - the total number of white and black pixels, respectively, in primitives located in the selected image area. Based on classifiers with the most efficient primitives, a cascade is built, each subsequent element of which contains a greater number of primitives listed there at the machine learning stage.

The task of designing a visual recognition module is directly related to the creation of software, the prototype of which can be represented as a diagram (Figure 2). To create an application, it is proposed to use a web environment, since it allows using various programming languages and can be used to create a distributed information system that will work both on the server side and on the user side. The interaction between the user web-application, which is started by the administrator of the video monitoring system or the building guard, and the recognition module takes place through a specialized application on the user side, which will control the reception and transmission of data [3, 4, 5]. According to

this approach, a web application can function independently of the entire system, and the recognition module can operate continuously, without stopping during session updates of web pages.

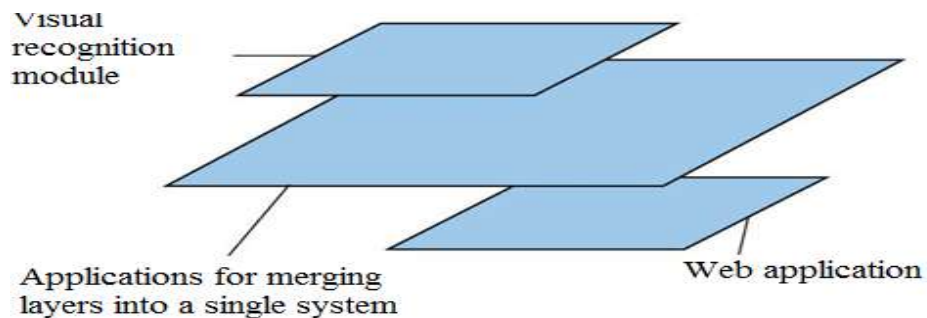


Figure 2. Scheme of the prototype recognition system.

In the diagram of data exchange between the prototype levels of Figure 3, it can be seen that the main data flow between the client and server parts passes through the middle linking level, the implementation of which is performed on the user's side. The recognition module is initially loaded from the server and then functions independently on the user's side, interacting only with the middle level. Data flows for a web application are governed by an average level, which itself does not participate in the operation of the application, but only ensures data exchange with the server and the loading of modules of the web application itself.

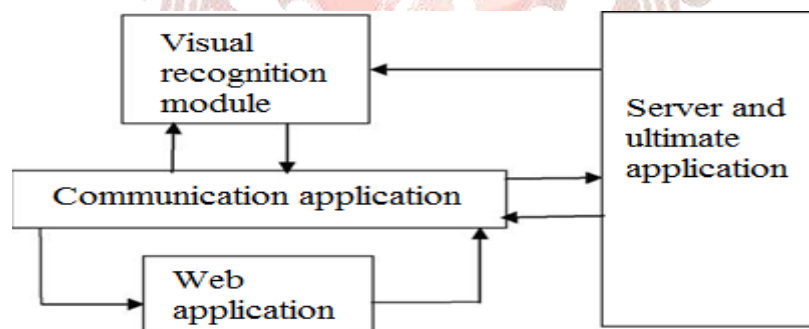


Figure 3. Data exchange scheme of the prototype elements

For the organization of continuous operation of the recognition module and the middle-level application without refreshing the page in the browser and simultaneously operating the custom web application. It is proposed to use the Ajax software package, which combines technologies of standardized presentation of information using XHTML and CSS, dynamic display and interaction with using the Document Object Model (DOM), exchanging and managing data through XML and XSLT, asynchronously retrieving data using XMLHttpRequest, and writing language with scripts of JavaScript, which allows you to link together all the previous components.

MATERIAL METHOD

In the traditional approach to the implementation of Web technologies, much time is lost in waiting for the user to respond to the server; An application created using Ajax technology at the beginning of a user session loads a set of scripts via a browser, implemented in JavaScript and hidden in a special frame that interacts with the user independently of the interaction with the server, that is, asynchronously.

Creating an object recognition system (images of which are obtained via video recorders), which functions in real time, can be viewed only as a complex task consisting of several subtasks, each of which is a separate problem. The first such task is to develop a module for visual recognition and authentication, and then you need to create a middle-level application that will integrate the recognition unit into a Web application and, finally, develop a Web application itself that can be accessed remotely and can function as in the local computing network, and in the environment of the Internet.

If the projected distributed video monitoring system will be implemented based on a relatively small organization, then it makes sense to create client and server parts on a single workstation, for example, a workstation of a security station or video monitoring.

During the entire time that a person is in the camera's field of view, the module determines and recognizes the presence of a face in the webcam's field of view. When a person moves around the building, a virtual tag is attached to it, which is transmitted from camera to camera, with its help, the anchor points of the route are marked. The main displacements of the building and adjacent corridors and halls are marked by different coefficients, showing the level of access. Each person from the existing database for the clients and staff contributed has its own access level, defined as a numerical factor. As soon as the identified object enters the part of the building that has an access factor higher than that of the observed person, a danger message is displayed on the monitor and the reason for it is indicated. The same applies to unidentified people, whose parameters for persons are placed in new cells of the database, expanding its values if they fall into parts of the building that are not intended for public visits [5, 6].

The issue of recognition of a specific object (for example, a person) and the appearance of a warning about the danger should be treated carefully enough, since none of the modern authentication algorithms provide unambiguous recognition. Thus, it is proposed to launch alarm scenarios not immediately after the appearance of the first incident, but when a critical mass of erroneous situations reaches a previously specified value. The application proposes

to use a state band, which is filled in with successful recognition events and empty in the absence of those.

A block diagram of the operation of the module of visual recognition and authentication is shown in Figure 4.

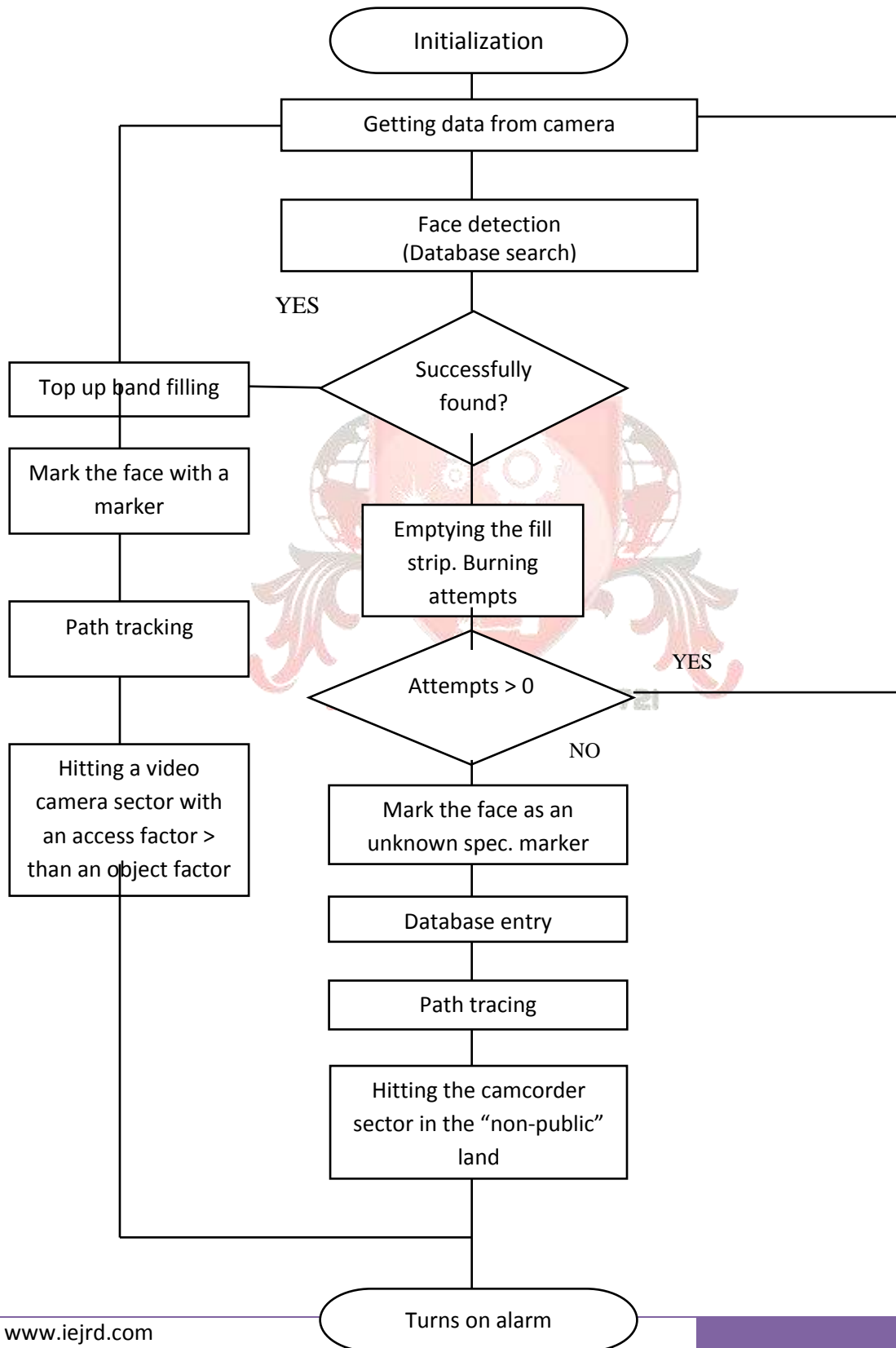


Figure 3.3.3. Algorithm of the recognition module

The operation of the software part of the recognition module will include the following steps: connecting to the camera and initializing the software module, receiving a picture from the recorder, image processing, sending an image to an instance of a specific class, receiving and processing the detection result (in the absence of a positive event, return to the second stage and the execution of the emptying code of the filling area), highlighting the area of the recognized face for visual confirmation (execution of the filling band code), return to the second stage.

CONCLUSION

The linking recognition system application will be used as a container for the recognition module and the target web application and as a channel for exchanging control commands between them. It is advisable to implement a binding application in the form of a single HTML page that contains external design tags, an object of a recognition module and a number of necessary functions implemented in the JavaScript scripting language, which control the behavior of the recognition module and the web application itself. The recognition module is placed on a web page using standard methods for embedding JavaScript scripts [6, 7].

The software part of the connecting module consists of several specialized functions, the first of which function_start () is called by the recognition module immediately after the user allows the camera to be used.

This function loads the start page of the web application into the workspace, which then sends a return signal via the linking module, implemented through the function_test () function.

If the recognition module has detected an erroneous situation and it is necessary to give an alarm, the function function_alarm () is called.

An important part of the software application is the library of recognized objects, as well as the function_load () that uses it, which updates the workspace, causing the web application to work and receiving response data from it asynchronously.

A rather simple Viola-Jones algorithm is used as the recognition algorithm, but in general, the recognition module can be implemented as its own ActiveX-component, which can use more accurate and more resource-intensive recognition algorithms.

The application implemented in this work is only a prototype of the projected system and implements only a fraction of the possible functions of the technology of continuous visual recognition of objects in a distributed video monitoring system. Despite the fact that the created software was tested on a series of images obtained under conditions close to ideal in a well-lit small room from several viewpoints, and the program analyzed all the images for the presence of objects in the database, it can be modified and for use in a real "people's garage" when recognizing people at the entrance with the help of a properly located and selected camera. In general, a designed and partially implemented system allows you to understand the full potential of such object recognition modules for integrated security systems at industrial and public facilities and infrastructure.

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