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ANALYSIS OF COMPUTER VISION SYSTEMS FOR ECONOMIC PROBLEMS

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Abstract: As you know, in the development of most measuring systems, the problem arises of converting analog signals of various sensors into digital form and their subsequent processing. Signal processing is present in many processes in the manufacturing industry, the food industry, and in the agro-industrial enterprises. Anywhere, where it is necessary to sort products according to specified criteria. In some cases, all data processing is performed by the computer. However, if the market demand for a measurement system is high, then it is more convenient to use systems with an embedded microcontroller. The controller takes on many tasks related to both digitization and subsequent data processing. At the same time, due to mass production, the cost of the system is significantly reduced. The result is a complete device that solves the problem effectively and at minimal cost. The purpose of this work was to design and implement a hardware module with a sorting function by various parameters. That is, it was required to create an analogue of a factory sorter, but suitable for sorting different objects and with a large number of input parameters.

Key words: automation, microcontroller, hardware module, sorting function, processing of data, computer vision.

Introduction: Automation of technological processes is one of the key links in the overall system of functioning and development of any modern enterprise. Significant factor that stimulates the use of computers in the automation of technological processes is that the computerization of this area is the determining prerequisite for the integrated automation of production as a whole.

The role of computer support systems for the automation of technological processes in the conditions of modern domestic production and taking into account the factors of both political-economic and information-technical nature is becoming more and more significant. This is due to a number of reasons, among which we can single out the following: the need to create new samples of high technology and high-tech products with minimal costs; The need to form a single information space at all stages of the product life cycle; Aspiration to increase the level of training of engineering, technical and managerial personnel in the field of modern information technologies.

Projected hardware module will be very useful, for example, in a factory where parts are made that are close in size. So instead of several pipelines for which there are different products, you can dispense with one conveyor, at the end of which you can install a sorter. Such optimization will require less human resources, time, and also significantly reduce energy consumption.

The main requirements assigned to this hardware module:

1.The system of external quality control must accurately identify objects and explicit rejection.

2.The module's equipment must ensure gentle sorting (the products should not lose quality during sorting).

3.The sorter equipment should have a modular system (for easy replacement of parts, upgrading old ones and adding new sorter functions).

Methods of research

The methodological basis is the methods of functional programming of AVR microcontrollers in C language, as well as methods for object recognition based on the OpenCV library.

It was necessary to decide the following:

- design of the system of the software and hardware module of the robot-sorter.
- design of the robot-sorter's hardware module.
- the implementation of the program module for object recognition.

Analysis of existing information systems, applications: Currently, the optimization of production processes is everywhere and is an integral stage of the work of any enterprise. Such management implies minimal human intervention. The employee does not exert physical efforts, but only controls the production process. Usually, with this approach to the organization of the production process, an automated process control system (automated process control system) is formed [1].

To achieve the set goals, it is necessary to solve tasks specific to the automation of production:

• improving the quality of the regulatory process;

• an increase in the coefficient, in terms of which you can judge the availability of equipment to work;

• Preservation of information resources containing reports on the technological process

Within the framework of this work, computer vision is necessary to achieve the set goals. Computer vision is the theory and technology of creating machines that can detect, track and classify objects. As a scientific discipline, computer vision refers to the theory and technology of creating artificial systems that receive information from images. The video data can be represented in a variety of forms, such as a video sequence, images from different cameras or 3D data, for example from a Kinect device or a medical scanner.As a technological discipline, computer vision seeks to apply theories and models of computer vision to the creation of computer vision systems [2].

Examples of such systems can be:

• Process control systems (industrial robots, autonomous vehicles);

• Systems of video observation;

• Information management systems (for example, for indexing image databases);

• Systems for modeling objects or the environment (analysis of medical images, topographic modeling);

• Interaction systems (for example, input devices for the human-machine interaction system);

• Augmented reality systems;

• Computing photography, for example, for mobile devices with cameras

The field of computer vision can be characterized as young, diverse and dynamically developing. And although there are earlier works, it can be said that only from the late 1970s began an intensive study of this problem, when computers were able to manage the processing of large data sets, such as images. However, these studies usually began with other areas, and therefore there is no standard formulation of the problem of computer vision. Also, and even more importantly, there is no standard formulation of how the problem of computer vision should be addressed. Instead, there are many methods for solving various strictly defined tasks of computer vision, where methods often depend on tasks and can rarely be generalized for a wide range of applications. Many of the methods and applications are still in the stage of basic research, but more and more methods are used in commercial products, where they often form part of a larger system that can solve complex tasks (for example, in the field of medical imaging or measurement and quality control in Manufacturing processes). In most practical applications of computer vision, computers are pre-programmed to solve individual problems, but knowledge-based methods are becoming more common. An important part in the field of artificial intelligence is automatic planning or decision making in systems that can perform mechanical actions, such as moving the robot through some medium. This type of processing usually requires input data provided by computer vision systems acting as a video sensor and providing high-level information about the environment and the robot. Other areas that are sometimes described as belonging to artificial intelligence and which are used in relation to

computer vision are pattern recognition and teaching methods. As a result, computer vision is sometimes viewed as part of the field of artificial intelligence or the field of computer science in general [3].

The object of research in this work are methods of recognition and sorting of different products. Object recognition is the area of artificial intelligence (AI) concerned with the abilities of robots and other AI implementations to recognize various things and entities. Object recognition allows robots and AI programs to pick out and identify objects from inputs like video and still camera images. Methods used for object identification include 3D models, component identification, edge detection and analysis of appearances from different angles [4].

Object recognition is at the convergence points of robotics, machine vision, neural networks and AI. Google and Microsoft are among the companies working in the area -- Google's driverless car and Microsoft's Kinect system both use object recognition.

Robots that understand their environments can perform more complex tasks better. Major advances of object recognition stand to revolutionize AI and robotics:

- MIT has created neural networks, based on our understanding of how the brain works, that allow software to identify objects almost as quickly as primates do.
- Gathered visual data from cloud robotics can allow multiple robots to learn tasks associated with object recognition faster. Robots can also reference massive databases of known objects and that knowledge can be shared among all connected robots.
- Scientists at Brigham Young University have developed an object recognition algorithm that can learn to identify objects on its own. The Evolution-Constructed Features algorithm, as it's called, can make decisions about what characteristics of an object are relevant to its identification.

When recognizing patterns, the task is to determine the belonging of the initial data to a certain class, while it is necessary to select from the set, to determine the essential features from the general data [5].

System methods: The organization of a computer vision system is highly application dependent. Some systems are stand-alone applications which solve a specific measurement or detection problem, while others constitute a sub-system of a larger design which, for example, also contains sub-systems for control of mechanical actuators, planning, information databases, man-machine interfaces, etc. The specific implementation of a computer vision system also depends on if its functionality is pre-specified or if some part of it can be learned or modified during operation. Many functions are unique to the application. There are, however, typical functions which are found in many computer vision systems [6].

- Image acquisition – A digital image is produced by one or several image sensors, which, besides various types of light-sensitive cameras, include range sensors, tomography devices, radar, ultra-sonic cameras, etc. Depending on the type of sensor, the resulting image data is an ordinary 2D image, a 3D volume, or an image sequence [7].
- The pixel values typically correspond to light intensity in one or several spectral bands (gray images or colour images), but can also be related to various physical measures, such as depth, absorption or reflectance of sonic or electromagnetic waves, or nuclear magnetic resonance.
- Pre-processing – Before a computer vision method can be applied to image data in order to extract some specific piece of information, it is usually necessary to process the data in order to assure that it satisfies certain assumptions implied by the method. Examples are Re-sampling in order to assure that the image coordinate system is correct [8].
- Scale space representation to enhance image structures at locally appropriate scales.

In fact, we consider what kind of functional we want to get from the robot, what hardware equipment are needed to provide it's work and how our software should manage this process (figure 1).

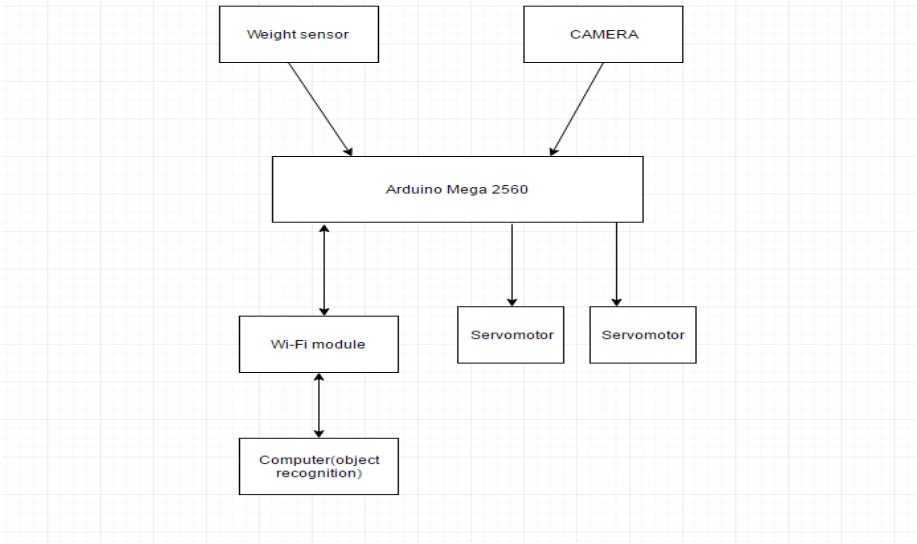

Figure 1 - Scheme of module

From this scheme we see what equipment the robot-sorter will consist of (I did not include in this circuit such transient devices as ADCs or device with the RS232 interface). Now, let's look at how all this will interact with each other.

The weight sensor is only needed to determine when to read data from the camera. Accordingly, we need to arrange the weight sensor and the camera perpendicular to each other. After Arduino receives the data from the weight sensor, it will begin to read the data from the camera and then send them to the Wi-Fi module simultaneously. Further, Arduino sends the desired signal to the servo motor, which sort products.

Conclusions

The designed the hardware-software module of the robot-sorter will perform the following functions:

- Sorting products by color;
- Sorting of products by weight;
- Sorting products according to the form;
- Detection of rejects

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Түйін: Өздеріңіз білетіндей, көптеген өлшеу жүйелерін дамытуда әр түрлі датчиктердің аналогтық сигналдарын сандық түрге ауыстыру және оларды кейіннен өңдеу проблемасы туындайды. Сгиналдарды өңдеу агроөнеркәсіптік кәсіпорындарда, тамақ өнеркәсібінде, қңдеуші өнеркәсіптерде көптеген процестерде бар. Өнімдерді берілген белгілері бойынша сұрыптау қажет

болған барлық жерде керек. Кейбір жағдайларда барлық мәліметтерді өңдеуді компьютер орындайды. Алайда, егер өлшеу жүйесіне нарықтағы сұраныс жоғары болса, онда ендірілген микроконтроллері бар жүйелерді қолдану ыңғайлы. Контроллер цифрландырумен де, кейінгі деректерді өңдеумен де байланысты көптеген тапсырмаларды орындайды. Сонымен қатар, жаппай өндірістің арқасында жүйенің құны айтарлықтай төмендейді. Нәтижесінде мәселені тиімді және үнемді шешетін толық құрылғы пайда болады. Бұл жұмыстың мақсаты әр түрлі параметрлер бойынша сұрыптау функциясы бар аппараттық модульді жобалау және енгізу болды. Яғни зауыт сұрыптауышының аналогын жасау қажет болды, бірақ әр түрлі объектілерді сұрыптауға жарамды және көптеген кіріс параметрлері бар.

Аннотация: Как известно, при разработке большинства измерительных систем возникает проблема преобразования аналоговых сигналов различных датчиков в цифровую форму и их последующей обработки. Обработка сигналов присутствуют во многих процессах обрабатывающей промышленности, пищевой промышленности, на агропромышленных предприятиях. Везде, где необходима сортировка продуктов по заданным признакам. В некоторых случаях вся обработка данных возлагается на компьютер. Однако если рыночная потребность в измерительной системе высока, то удобнее использовать системы с встроенным микроконтроллером. Контроллер берет на себя множество задач, связанных как с оцифровкой, так и с последующей обработкой данных. При этом за счет массового производства стоимость системы значительно снижается. В результате получается законченное устройство, которое решает проблему эффективно и с минимальными затратами. Целью данной работы было проектирование и реализация аппаратного модуля с функцией сортировки по различным параметрам. То есть требовалось создать аналог заводского сортировщика, но подходящий для сортировки разных объектов и с большим количеством входных параметров.