Додаток А

Апробація результатів досліджень

CONTROL SYSTEMS FOR ASSEMBLY UNITS DURING MOVEMENT ALONG THE CONVEYOR LINE

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Introduction. Assembly unit control systems are widely used in production as systems to support assembly processes when using conveyor lines.

The use of conveyor lines allows the organization of flow production – a progressive method of organizing production, characterized by the division of the production process into separate, relatively short operations performed on specially equipped, sequentially located workplaces – flow lines [1,2].

Types of conveyors. Ensuring the automatic movement of assembly units along lines is called a conveyor, and production is called conveyorized [1,2].

The main element of such production is a conveyor – a continuous transport machine designed to move bulk, lumpy or piece cargo.

Depending on the direction of movement of objects, conveyors are divided into horizontal, vertical and inclined.

Depending on the type of cargo – bulk and piece.

Depending on the functions performed – transportation, assembly and sorting.

Depending on the location of the conveyor itself or parts – floor and suspended.

Depending on the traction device – belt, chain, rope and without a traction device: gravity, inertial and screw.

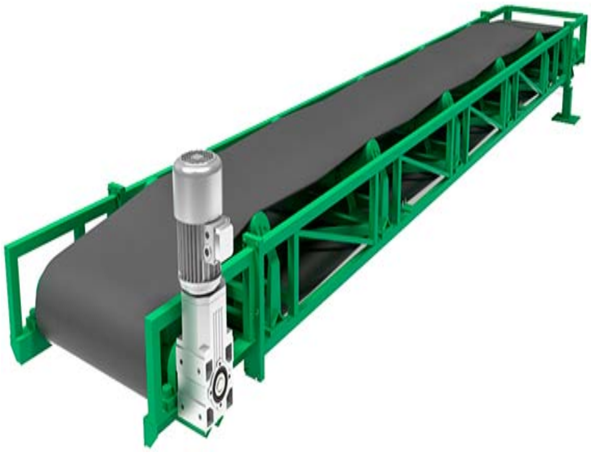
Depending on the load-carrying structure (with a traction body) – belt, smooth, profiled, pocket, plate, cradle, scraper, bucket.

Depending on the location of the employee's workplace:

– working (the employee's workplace is located on the conveyor – it moves with the conveyor),

– distribution (fixed workplace).

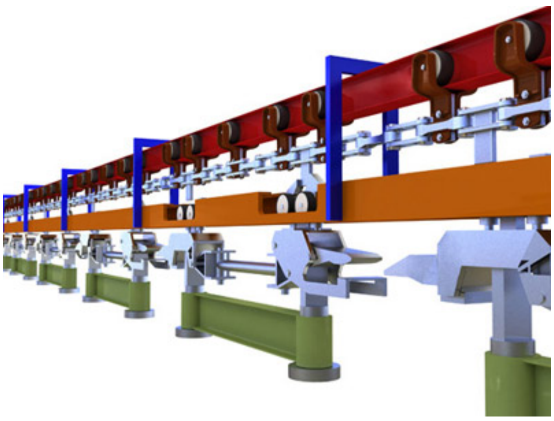
Some types of conveyors are shown in Fig. 1.



a

b

c



d

a – belt conveyor; b – scraper conveyor; c – bucket conveyor;

d – overhead conveyor

Fig, 1. Examples of conveyors

Means of process control subsystems. Objects on a conveyor line can be monitored using a variety of process control subsystems. Contact (pressure type sensors) and non-contact sensors are used as cargo presence sensors in this subsystem. Non-contact sensors include inductive, radioactive, capacitive and photoelectric sensors [3].

The presence of cargo on the belt conveyors is controlled by sensors that close the electrical circuit when the pulse device deviates from the mass of the transported cargo. The pulse element can be made in the form of a blade or roller in a particular case. At a certain load, the sagging branch of the moving belt drives the rotor of the sensor, turns on the alarm and disconnects the conveyor drive. When transporting piece goods, if they are reloaded from one conveyor to another, the minimum permissible intervals between individual loads are monitored.

Non-destructive testing equipment. The analysis of the movement of assembly units on conveyors can be performed using non-destructive testing equipment.

The types and methods of non-destructive testing are classified according to the following criteria [3]:

– the nature of the interaction of physical fields or substances with the controlled object;

– primary informative parameters;

– methods of obtaining primary information;

– ways of presenting the final information.

The main types of non-destructive testing include the following.

The magnetic type of non-destructive testing is based on the registration of magnetic fields of defect scattering or magnetic properties of the controlled object. It is used to control objects made of ferromagnetic materials.

The process of magnetization and demagnetization of ferromagnetic material is accompanied by hysteresis phenomena. The properties to be monitored (chemical composition, structure, presence of defects, etc.) are usually associated with the parameters of the magnetization process and the hysteresis loop, measuring which one can conclude that there are certain deviations from the specified parameters of the product.

Acoustic non-destructive testing is based on recording the parameters of elastic vibrations excited in the object under test. This type of inspection is applicable to all materials that conduct acoustic waves well enough: metals, plastics, ceramics, concrete, etc. The most widespread is the ultrasonic method, which, along with flaw detection, allows you to detect structural inhomogeneities, determine the mechanical characteristics of materials, analyze the stress state and solve a wide range of production control and diagnostic problems. In addition to the ultrasonic method, there is the acoustic emission method, the vibration control method, and others.

Capillary control (control of penetrating substances) is based on the capillary penetration of indicator liquids in the cavity of surface defects and the registration of an indicator pattern (color, luminescent, contrast). It is used to detect invisible and weakly visible surface defects with the naked eye.

Radiation type of non-destructive testing is based on the interaction of penetrating ionizing radiation with the object under test. Depending on the nature of the ionizing radiation, the types of control are divided into subtypes: X-ray, gamma, beta (electron flow), neutron control methods. This type of non-destructive testing is applicable to any material. The main method of radiation (X-ray and gamma) inspection is the passing method. There are good results on the use of this method with one-way access to the object.

The radio wave type of non-destructive testing is based on recording changes in the parameters of electromagnetic oscillations interacting with the controlled object. Usually, waves of the ultra-high frequency range with a length of 1-100 mm are used and products made of materials where radio waves are not very strongly attenuated are controlled: dielectrics (plastics, ceramics, fiberglass), magnetodielectrics (ferrites), semiconductors, thin-walled metal objects.

The eddy current type of non-destructive testing is based on recording changes in the interaction of the coil's own electromagnetic field with the electromagnetic field of eddy currents induced by this coil in the object under test. The intensity and distribution of eddy currents in an object depend on its geometric dimensions, electrical and magnetic properties of the material, the presence of disturbances in the material, and the relative position of the transducer and the object. Eddy current type of non-destructive testing in various variants is used to detect surface and subsurface continuity defects, control geometric dimensions, chemical composition, structure, internal voltage of conductive materials only.

Thermal non-destructive testing is based on the registration of thermal fields, temperature or thermal contrast of the controlled object. It is applicable to objects made of any materials. The most effective means of non-contact surveillance, registration of temperature fields and heat fluxes is a scanning thermal imager.

Leak detection is used to detect only through defects in parts and partitions. A penetrating substance enters the defect cavity either under the influence of a pressure difference or under the influence of capillary forces.

The electrical type of non-destructive testing is based on the recording of electric fields and electrical parameters of the controlled object (the electrical method itself) or fields arising in the controlled object as a result of external influences (thermoelectric and triboelectric methods). The primary informative parameters are electrical capacitance or potential.

Optical non-destructive testing is one of the most versatile inspection methods. It is the simplest method of quality control in conjunction with part recognition control. It is based on the interaction of light radiation with the controlled object. The use of tools (visual-optical control) such as magnifying glasses, microscopes, endoscopes for inspection of internal cavities, projection devices for controlling the shape of products projected in an enlarged form on the screen significantly expands the capabilities of the optical method. Most often, optical methods are widely used to control transparent objects. They detect macro- and micro-defects, structural inhomogeneities, and internal stress (along the rotation of the polarization plane). The use of flexible light guides, lasers, optical holography, and television technology expands the scope of optical methods and increases the measurement accuracy.

Optical inspection systems are the most adaptive. The principle of operation of such systems is based on the recognition and subsequent processing of images, which in turn is based on the theory of pattern recognition, which develops the basics and methods of classification and identification of objects, phenomena, processes, signals, situations of objects characterized by a finite set of certain properties and features.

Conclusions. The definition of conveyors and conveyor lines is given. Examples of conveyors are given. The control of objects on the conveyor line is considered, which is carried out using various means of technological control subsystems. The types and methods of non-destructive testing are considered and presented.

REFERENCES

1. Невлюдов І.Ш. Основи виробництва електронних апаратів. – Харків: Компанія СМІТ, 2005. – 592 с.

2. Невлюдов І.Ш. Виробничі процеси та обладнання об’єктів автоматизації: Підручник для студентів вищих навчальних закладів. – Кривий Ріг: Криворізький коледж НАУ, 2017. – 444 с.

3. Невлюдов І.Ш. Технічні засоби автоматизації: Підручник. І.Ш. Невлюдов, А.О. Андрусевич, О.І. Филипенко, Н.П. Демська, С.П. Новоселов. – Кривий Ріг: Криворізький коледж НАУ, 2019. – 366 с.

Додаток Б

Лістинг програми

App.cpp:

```
#include "afxwin.h"
#include <cv.h>
#include <highgui.h>
#include "App.h"
CvCapture *capture;
IplImage *img, *img2, *dst = 0, *dst1 = 0, *dst2 = 0, *dst3 = 0, *gray =0, *small_img;
static CvHaarClassifierCascade* cascade = 0;
//const char* cascade_name = "cascadhaar.xml";
const char* cascade_name = "cascadhaar2.xml";

CvFont im_font;
int i=0, ii = 0, n = 0;
char str[20];
CvMemStorage *storage = 0, *storage2 = 0, *storage3 = 0;// сховище пам'яті \\ Сховище
апроксимованих контурівdouble scale = 1.3;
bool check_object(char*, CvPoint);
BOOL CApp::InitInstance(void)
{
	m_pMainWnd = new CMainWin;
	m_pMainWnd->ShowWindow(m_nCmdShow);
	m_pMainWnd->UpdateWindow();
	return TRUE;
}

CApp App;

CMainWin::CMainWin(void)
{Create(NULL,"Camera example",WS_OVERLAPPEDWINDOW);//знаходження камери
	if(capture=cvCaptureFromCAM(-1))
	{	cvNamedWindow("MainWin",CV_WINDOW_AUTOSIZE);// вимальовується вікно, в якому
і з'являтимуться результати операцій із зображенням та на зображенні.
		cascade = (CvHaarClassifierCascade*)cvLoad(cascade_name, 0, 0,
0);//завантаження класифікатора
		OnCamera();// включення камери

	}
	else MessageBox("Camera reading Error");
}

void CMainWin::OnCamera()
{	char x;
	bool firstFrame=true;// рамка вікна
	storage = cvCreateMemStorage(); //підключення памяті

	while(1)
	{	img=cvQueryFrame(capture);//кадер запису
		cvFlip(img,NULL,1);// відображення кадру вікно
		dst=cvCreateImage(cvGetSize(img),IPL_DEPTH_32F,3);
	dst1=cvCreateImage(cvGetSize(img),IPL_DEPTH_8U,3);
	dst2=cvCreateImage(cvGetSize(img),IPL_DEPTH_8U,1);
	dst3=cvCreateImage(cvGetSize(img),IPL_DEPTH_8U,1);
		small_img = cvCreateImage(cvSize(cvRound(img->width / scale), cvRound(img-
>height / scale)), 8, 1);

		cvShowImage("MainWin",img);
```

```
            gray = cvCreateImage( cvSize(img->width,img->height), 8, 1 );
            cvCvtColor( img, gray, CV_BGR2GRAY );
            cvClearMemStorage( storage );


            if( cascade )
            {

            CvSeq* faces = cvHaarDetectObjects( gray, cascade, storage,// послідовність
            1.1, 2, 0,
            cvSize(20, 20) );

            for(int i = 0; i < (faces ? faces->total : 0); i++ )
            {
            CvRect* r = (CvRect*)cvGetSeqElem( faces, i );
            CvPoint center;
            int radius;
            center.x = cvRound((r->x + r->width*0.5));
            center.y = cvRound((r->y + r->height*0.5));
            radius = cvRound((r->width + r->height)*0.25);

            cvCircle( img, center, radius, CV_RGB(255,255,0), 3, 8, 0 );//рисуэмо круг
            }
            }
            cvShowImage("MainWin", img);



            cvReleaseImage(&dst);
            cvReleaseImage(&dst1);
            cvReleaseImage(&dst2);
            cvReleaseImage(&dst3);
            char x = cvWaitKey(33);
            if(x==27)break;  // нажата ESC
       }
       cvReleaseCapture(&capture);
}

void CMainWin::OnClose()
{      cvReleaseCapture(&capture);
       cvDestroyWindow("MainWin");

       DestroyWindow();
}

BEGIN_MESSAGE_MAP(CMainWin,CFrameWnd)
       ON_WM_CLOSE()
                                    END_MESSAGE_MAP()
```

Додаток В

Демонстраційний матеріал

Формат	Позиція.	ПОЗНАЧЕННЯ	НАЙМЕНУВАННЯ	Кільк.	Примітки
			Текстові документи		
А4	1	ГЮИК. 406200.011ПЗ	Пояснювальна записка	99	с.
			Інші документи		
А4	2		Лістинг програми	2	с.
А4	3		Демонстраційний матеріал	14	*у форматі *.ppt*

Змін	А	№ докум.	Підпи	Дата	ГЮИК. 406200.011ВД		
Розроб.		Худяков Ф.С.			Розроблення програмного забезпечення для модуля розпізнавання фармацевтичних виробів на конвеєрній лінії Відомість кваліфікаційної роботи	Літер	Аркуш	Аркушів
Перевір		Аллахверанов Р.Ю.				Н	1	1
Н.конт.		Демська Н.П.				Кафедра КІТАР ХНУРЕ		
Затв.		Невлюдов І.Ш.						