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SMART CAMERA FOR SIMPLE SORTING TASKS

Urgency of the research. *Attendance time places great emphasis on the production cavity. No manufacturing enterprise can afford to neglect the automation and modernization of its processes. That's why a company focused on manufacturing automotive accessories has turned to us.*

Target setting. *Output checkboxes prepared at the end of the production process were made by people. This control was unreliable and its reliability was diminishing with the increasing working time. An increasing number of claimed cases required the company to choose a new solution to the problem. We were asked to design a workplace using a camera to read the box descriptions so that it could be followed by palletizing. The second goal was to consider the possibility of subsequent robotization.*

Uninvestigated parts of general matters defining. *We do not deal with the basic principles of image processing. Basic image processing performs camera software and uses the higher search features of objects.*

The research objective. *In this article, we are working on implementing the visual system into real-life operation. Design a simple solution that meets customer requirements, whose economic return would be interesting.*

The statement of basic materials. *We use a simple camera with area capture. It captures frames as an area map of pixels. Basic black and white transition detection is selected for basic object recognition. A description made on white paper that is used as a box description makes it easy to recognize objects in the background.*

Conclusions*. The proposed test facility consists of a frame, a camera and a conveyor. The workplace produces only 25 cubes per minute under test conditions. To increase productivity, it is advisable to extend the number of posts. The camera was also selected for its ability to communicate with the robot interface. The program creates code that is compatible with the robot's control program and defines the position of the goods in the space. This makes it easy to connect and then robotize the workstation if the company decides for this solution.*

Keywords: *camera; cognex; area scan; in-sight.*
Fig.: 7. Table: 1. References: 7.

Visual system. For our purposes, a camera was selected IS 8402M-373-50. The camera is one of Cognex's latest assortment of visual systems. It is a compact camera capable of performing operations without additional equipment. The camera is predestined to fit in so-called intelligent camera systems. The software located on the camera allows the camera to handle normal industrial operations. At the same time, the camera software is engineered to provide the highest possible communication speed between the camera and the PC. [1]

Fig. 1. Camera IS 8402M [1]

The greatest advantage of the IS 8402M is its small size. The camera dimensions are shown in Figure 1. The camera itself consists of two parts. The first part is the body of the camera, which has a square shape with a square base [2]. In the body of the camera there is hardware that processes the image captured by the camera. On the underside of the camera there are mounting holes with a thread for attaching the camera. On the back of the camera are two connectors and LED indicators. One of the connectors is used to connect the camera to a PC using ENET. The second connector serves to control inputs and outputs with the camera.

The biggest advantage of the camera is the size, especially because it is the smallest camera capable of continuous image recording. Thanks to these small dimensions, the camera is suitable for space-intensive applications. Separately functioning visual system capable of scanning images in VGA, 1MP, 2MP and 5MP resolution. Other benefits tools included in implemented libraries are the new PatMax RedLine tool. The undisputed advantage that the camera manufacturer offers to its users is to create an application using EasyBuilder. This program makes it easy to add new commands using tables and scripts. The last but significant advantage of this camera is the data rate because it supports communication with Gigabit Ethernet.

The camera has been selected for its undeniable benefits as outlined above. The camera is constructively designed as compact devices. However, this is not the only condition for successful deployment and broad application in technical practice [1]. We chose this camera because the camera makes it easy to create programs. In-Sight Explorer software is used to create these programs. In-Sight Explorer provides a simple step-by-step setup of EasyBuilder. It offers the ability to control and customize application data. It also allows creating scripts built on Java standards. This extension offers a significant simplification of the resolution of demanding tasks in image recognition such as geometric analysis of hundreds of points, analysis and comparison of scanned text or ID codes, or complex logic of finite results.

Table

Parameters of camera

MODEL	In-Sight 8402
GUI Interface	Table a EasyBuild
Firmware	In-Sight Explorer 5.1.1
Memory	512 MB SDRAM
Type of sensor	1/1.8´´ CMOS
Parameters of sensor	9mm diagonal, 4,5 x 4,5 μm
Maximum resolution (pixels)	1600 x 1200
Max. frames per second	53
LED indicators	network status, 2 user settings
Network communication	10/100/1000 BaseT
Power supply	Class 2, PoE
Type of connectors	M12 pre PoE, M8 for I/O
Coverage	IP 40

Connecting the camera. Working with the camera is relatively simple. Connecting the camera to your computer is easy and you only have to connect two cables to connect the camera to the computer. The camera connects to the PoE adapter. This adapter connects to the network router on which your computer is connected. The control of the connection can be verified on the power adapters is detected by three light indicators. These indicate the connection of the camera to the adapter, connecting the adapter to the network and the fault indicator.

The connection of the camera to the computer is also shown when launching In-Sight Explorer. After running the above software, the program environment opens. However, this does not allow any operations or program creation. You must have a camera connected to your PC to use the program. To connect the camera, you need to focus on the window shown in Figure 6 in the bottom right corner. This window offers several options. After connecting, the camera should show us automatically. If this does not happen, you must use the Refresh button. As soon as the network is found, the device will appear in the selected IS sensor window.

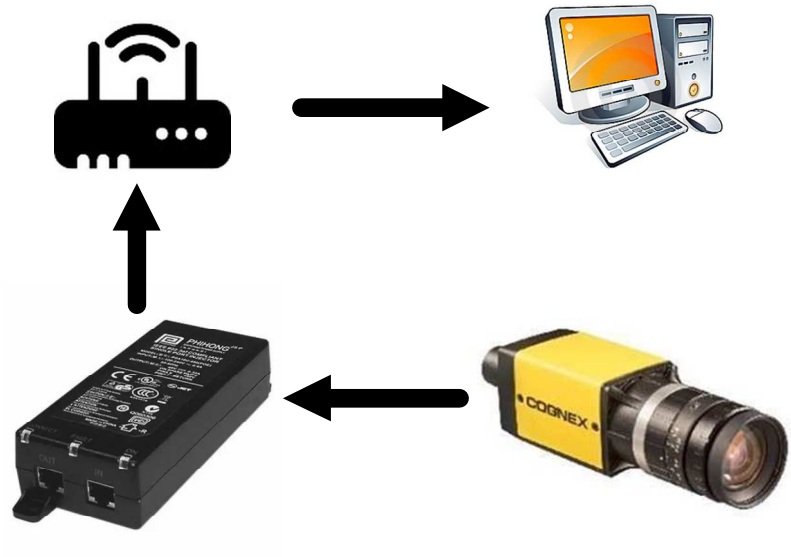

Fig. 2. Connecting the camera to a PC

We mark the selected sensor, the IS 8402 camera, and select the Connect button. This button will connect the camera to the IS Explorer program. At the same time, we'll see information on the sensor. As seen from the above image, the program is also capable of detecting basic camera information. Common device network credentials such as network device name, device type, firmware version, MAC address, IP address, device serial number, and the name of the recorded and running program. If you cannot connect us with a simple connection using IS Explorer, you can use another option [3].

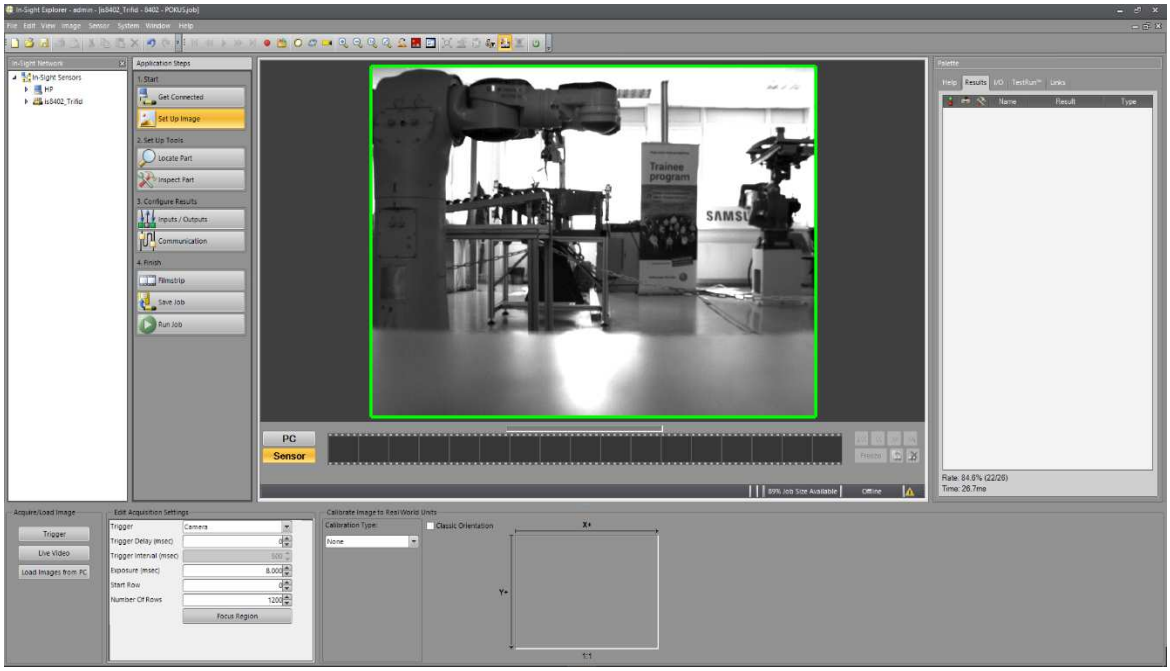

Fig. 3. Workspace In-Sight Explorer

Pressing the Add button gives us the option to set specific camera parameters and manually define it. After successful connection, our sensor or camera will appear in the tree structure at the top left of the screen in the In-Sight window. There is a computer running the emulator job automatically. After pairing with IS Explorer, it is necessary to create a new program. Programs in the camera are labelled Job. After creating a new Job, new options will be made

available in the Application Steps window next to the IS window. This brings us to the first step of adjusting the image to get it done in the best possible way in order to maximize accuracy and minimize flaws caused by glare, changing light conditions and other possible risks that can complicate image recognition and subsequent misinterpretation.

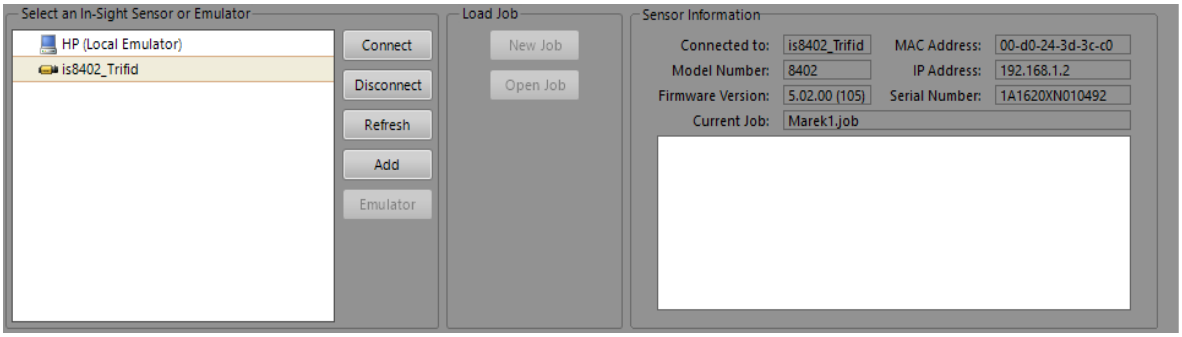

Fig. 4. Device connection window

Image Adjustment and Correction. The first step in working with the image is to set the picture. Here you can upload an image from either the camera using the Trigger Button or upload an image stored on the PC. We recommend that you use the live video option to set up a camera that adjusts the focus of the lens and the amount of light transmitted. This feature lets you watch in real-time what the camera is shooting and what the image looks like. The image from the camera is in the middle window. Below the picture, we have the ability to switch between camera image and PC image. We recommend that you use the live video option to set up a camera that adjusts the focus of the lens and the amount of light transmitted. v We need to be offline when the image is being processed, when the image is static and we can set the required parameters. At the beginning, it's a good idea to choose the area we want to focus on. This is achieved by the Focus Region feature.

We create a window on the screen and we are able to select the area we want to focus on. We will confirm the selection in the lower left corner. At the same time, the program offers several calibration options. Calibration with X, Y axis, edge-to-edge calibration is the first calibration method. Other options are the combination of X, Y and Edge to edge. Other less commonly used round-edge calibration types with nine points, grid and imported shape. When we've adjusted the image to the required quality, we can go into creating a search algorithm. For detecting objects, edges, and text. This allows features that are included under the name of Set up Tools. These tools include localization features. They include PatMax. This tool allows us to search all edges in the selected part of the screen. At the same time, our IS 8402 camera also features PatMax Redline support, which allows several times faster playback detection speeds than the PatMax. The manufacturer has reported the disc recognition rate ten times higher. It also offers other ways of detecting edges like Pattern, Edge, Edge Intersection, Blob, Blobs, Circle and Computer Fixture. All of these methods can be used depending on the type of search objects. After choosing a suitable edge detection method, in our case we have chosen the classic and the recommended PatMax RedLine method. By selecting the area we want to search for, we have the result shown in Figure 6. n the figure we see the text that is bounded by green lines. Green lines border the found edges, places with a significant change in colour pixels. At the same time, a command was executed in the Palette window. In the edit window at the bottom, you can change the properties of the selected command.

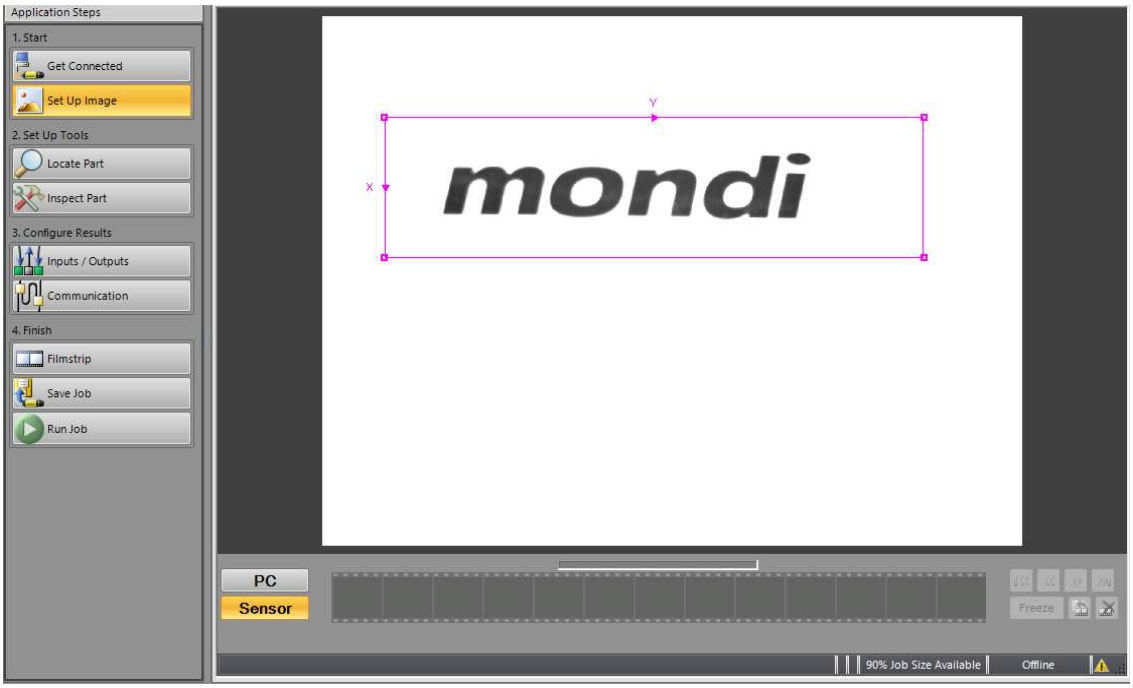

Fig. 5. Select the focus region

When the Settings tab is expanded, the expanded menu allows us to set tolerances when searching for objects. Adjustable tolerances include circularity, contrast, and many others. At the same time, we can verify and review the area that is selected. This area will display the right lower window after you have opened the Trained Image tab. At the same time, we will later show the dependence of the individual steps employed on each other.

Fig. 6. Edge detection using PatMax

After editing the image to such a quality until we can uniquely define individual letters is another option to create an operation that will be performed after the required objects have been detected. The Outputs and Communication functions are used for this operation. Thanks to it, we are able to define outputs that we can use for PLC control. The IS 8402 camera provides 2 LED outputs and 2 digital outputs. We can use these outputs in the management process to perform the following activities. Using the Communication button, we have a choice of 3 types of communication types. One of these is the OPC. This type of communication serves to transmit information on HMI elements. Suitable if the customer asks for a visualization of the scanning process. Another defined communication protocol is EasyView. The focus is on simple communication between Cognex devices. The third type is FTP. We also have the option to add a device. Several types of devices can be added here. Here you can choose from PLC, robot or other. We will use the robot option for our application. Since Cognex cameras are compatible with different robots from different manufacturers, they automatically offer us a selection of manufacturers such as ABB, Fanuc, Denso, Mitsubishi, Staubli, and of course we will also find the option of wherever we can define our own robot. We chose ABB because we have the opportunity to try this communication and ABB robot training at the lab.

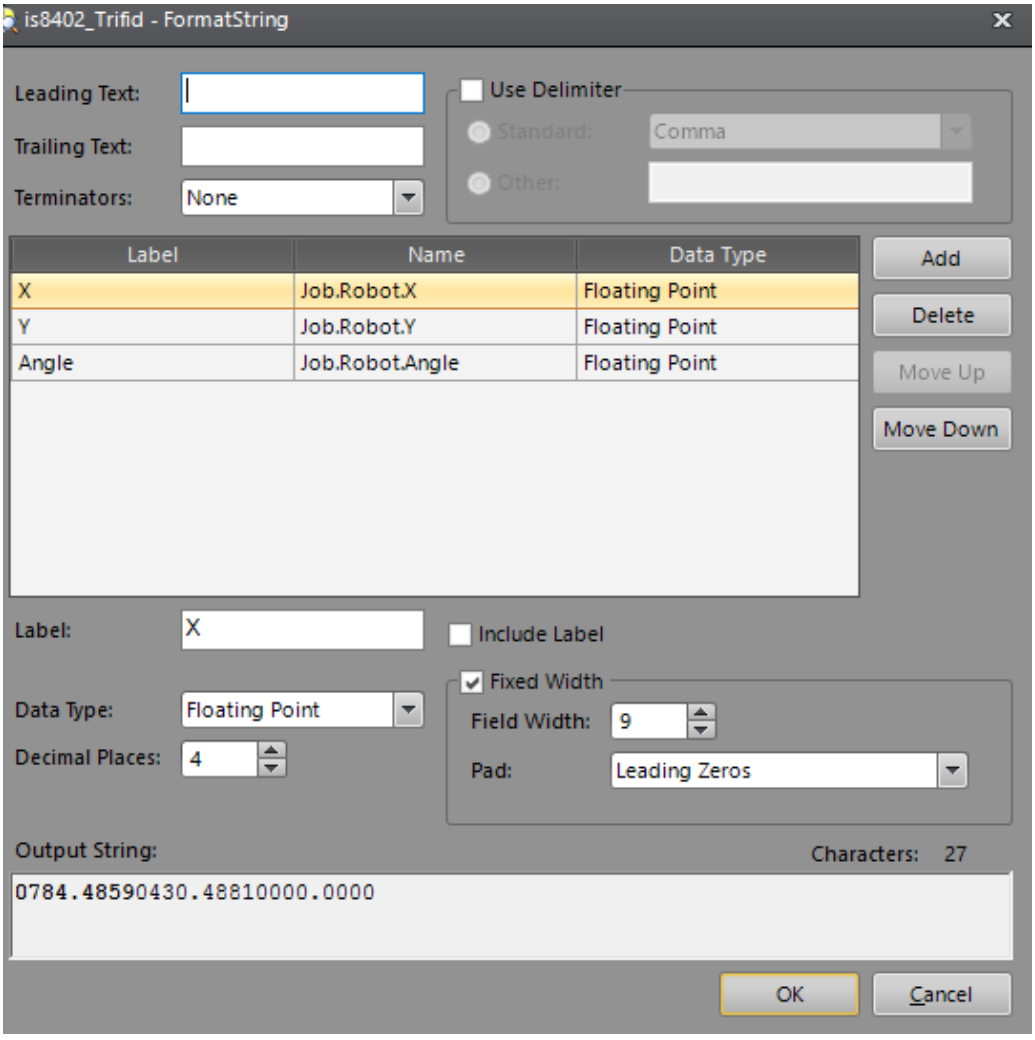

Fig. 7. Parameter setting when controlling the robot

Conclusions. The proposed test facility consists of a frame, a camera and a conveyor. The workplace produces only 25 cubes per minute under test conditions. To increase productivity, it is advisable to extend the number of posts. The camera was also selected for its ability to communicate with the robot interface. Cognex supports collaboration with ABB robots. The program creates code that is compatible with the robot's control program and defines the posi-

tion of the goods in the space. This makes it easy to connect and then robotize the workstation if the company decides for this solution.

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РОЗУМНА КАМЕРА ДЛЯ ПРОСТИХ ЗАДАЧ СОРТУВАННЯ

Актуальність теми дослідження. *Час відвідування має велике значення у виробничій сфері. Жодне виробниче підприємство не може дозволити собі нехтувати автоматизацією й модернізацією своїх процесів. Саме тому компанія, орієнтована на виробництво автомобільних аксесуарів, звернулася до нас.*

Постановка проблеми. *Вихідні позначки робляться наприкінці виробничого процесу людьми. Цей контроль був ненадійним, і його надійність знижувалася зі збільшенням робочого часу. Усе більша кількість заявлених випадків вимагало від компанії вибору нового вирішення проблеми. Нами було запропоновано вирішення щодо проектування робочого місця за допомогою камери, щоб прочитати описи ящиків. Друга мета – розглянути можливість подальшої роботизації.*

Аналіз останніх досліджень і публікацій. *Ми не маємо справу з основними принципами обробки зображень. Основні функції обробки зображень виконує програмне забезпечення камери, використовуючи при цьому більш високі функції пошуку об'єктів.*

Постановка завдання. *У цій статті пропонується впровадження візуальної системи в реальну експлуатацію. Створено просте рішення, що відповідає вимогам клієнтів, чия економічна віддача буде більш цікавою.*

Виклад основного матеріалу. *Використовується звичайна камера з захопленням області. Вона фіксує кадри як карту областей пікселів. Для визначення базового об'єкта вибрано визначення чорного і білого переходу. Опис, зроблений на білому папері, що використовується як опис вікна, дозволяє легко розпізнавати об'єкти у фоновому режимі.*

Висновки відповідно до статті. *Запропонована випробувальна установка складається з рами, камери й конвеєра. Робоче місце випускає тільки 25 кубів за хвилину в умовах випробувань. Для підвищення продуктивності рекомендується збільшити кількість постів. Камера також була обрана завдяки її здатності комуніціювати з інтерфейсом робота. Програма створює код, сумісний із програмою керування роботом і визначає положення товару в просторі. Це полегшує підключення та наступну роботизацію робочої станції, якщо компанія прийме таке рішення.*

Ключові слова: *камера; cognex; сканування області; у полі зору.*

Рис.: 7. Табл.: 1. Бібл.: 7.

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