Development of the "SANMOTION C" Series Image Processing Device and Display with Touch Panel

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1. Introduction

Motion controller "SANMOTION C" was designed for servo motor control in applications such as a variety of industrial machinery and industrial robots and as such has a built-in programmable logic controller (sequence controller) function, motion function, robot function, etc. Optional features include a field network module and digital/analog I/O module for various industries, a serial interface module, encoder module, hand-held terminal and so forth, making it possible for customers to choose the optimal system configuration for their equipment requirements.

This time we have enhanced our system lineup even further by developing an image processing device which substitutes the human visual function and a display with touch panel which plays the role of a human-machine interface (HMI). This document introduces an overview of the features of the product.

2. Background of the Development

In the advancement of automation of production processes, image processing technology plays a significant role as a substitute for the visual function of humans. In the past it was difficult to automate processes that included factors which were difficult or uncertain to control and these were reliant on the flexible work capacity of humans, however technological advancements have made it possible to gradually automate processes such as these. Image processing technology, in processes such as assembly and inspection, has compensated for the flexible work capacity of humans to contribute to automation of equipment as a means of locating workpieces, detection, identification and posture information.

Furthermore, there are an increasing number of cases where displays with touch panel are adopted in various devices such as manufacturing and inspection equipment, medical equipment, vending machines and the ticketing machines of public transport companies. HMI is a device for humans to operate equipment or to inform humans of the current status or results of equipment operation. In recent years, thanks to various computer technology, there are many products on which the displays and operation screens can be easily programmed and customized at will.

A wide variety of image processing devices and HMI products are sold by several companies, however when these products are used embedded in systems, there is the issue of increased connection costs due to differences in communication methods between manufacturers or affinity against the protocol. Today, with image processing devices and HMI products being an indispensable item of control systems, there is a preference from consumers for system products with high affinity which can provide a total service and enable easy connection and data communication between devices.

3. Image Processing Devices

3.1 Overview of the image processing device

The image processing device is configured from the main unit which computes the captured images, a camera, lens, LED light for capturing images and other peripherals. This time we have developed two image processing device main units; the model number is "VS-AS" and "VS-EV". Figures 1 and 2 are external views of "VS-AS" and "VS-EV". Table 1 shows the basic specifications.

Fig. 1: Main unit of the "VS-AS"

Fig. 2: Main unit of the "VS-EV"

Table 1: Basic specifications of the image processing device

Item			"VS-AS"	"VS-EV"
main unit	Dimensional outline drawing [mm]		125 (W) x 50 (H) x 87 (D)	219.2 (W) x 52.8 (H) x 181.2 (D)
	Mass [g]		Approx. 290	Approx. 1500
	Rated power		24 V DC ±10% / 0.5 A	24 V DC ±10% / 2 A
	I/O port		5 inputs, 5 outputs	4 inputs, 4 outputs
	Camera input		1 port (dedicated camera)	2 ports (dedicated camera)
	LED light output		1 point (max. 300 mA)	2 points (Total 1 A or less)
	Monitor display output		1 port (analog VGA output)	
	USB		1 port (For dedicated mouse connection)	4 ports (USB2.0)
	PS2		-	1 port
	LAN		1 port (10/100 Mbps)	1 port (10/100/1000 Mbps)
Camera	Dimensional outline drawing [mm]		23 (W) x 23 (H) x 30 (D) (excluding lens)	
	Mass [g]		Approx. 140	
	Mounting method		C mount	
	Cable length [mm]		5000	
	Image sensors	Type	Monochrome / CMOS / 1/3 inch / Global shutter method	
		Pixels	640 (H) x 480 (V)	
Common	Operating environment	Ambient temperature	0 to ±50°C	
		Ambient humidity	20 to 80% (non-condensing)	
	Applicable regulations	RoHS	compliant	
		EMC directive	EN61000-6-4: 2007+A 1: 2011 EN61000-6-2: 2005	

Peripherals such as the camera, lens and LED light are common items which can be used on either main unit. The camera is 640 (H) x 480 (V) pixels, monochrome, CMOS, and adopts the global shutter method with 1/3 inch sensors. The camera is compact and lightweight, measuring 23 (W) x 23 (H) x 30 (D) mm, and weighing 140 grams. It can be fitted with a lens using the C mount method. Fig. 3 is an external diagram of the camera.

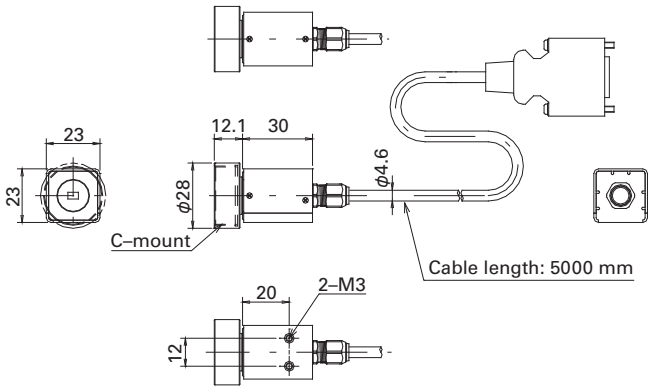

Fig. 3: External diagram of the camera

There are several lenses to choose from to suit the focal distance and required viewing angle. We have also prepared a close-up ring set as an accessory. Fig. 4 is an example external diagram of the lens.

If there is insufficient light where the image is being captured, the LED light can be used as an auxiliary light. The control circuit for the lighting is built into the main unit of the image processing device and 10 levels of modulated light are possible depending on the setting. There is the ring type and flat type of LED lights available. Fig. 5 is an external diagram of the flat type, while Fig. 6 is an external diagram of the ring type.

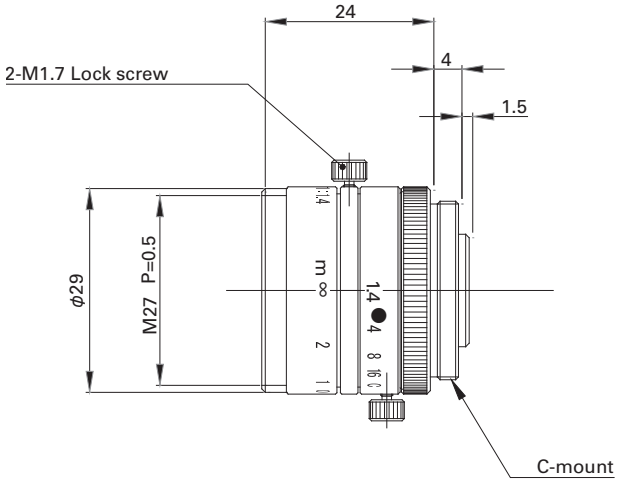

Fig. 4: External diagram of the lens

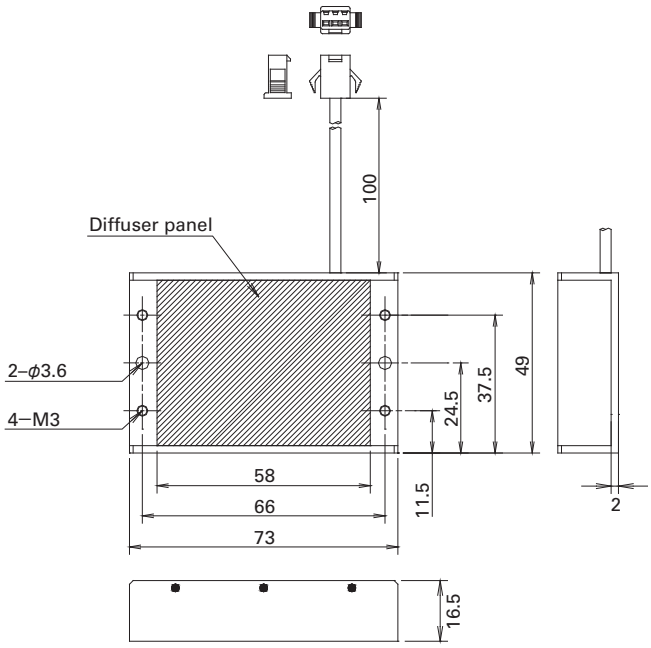

Fig. 5: External diagram of the flat-type LED light

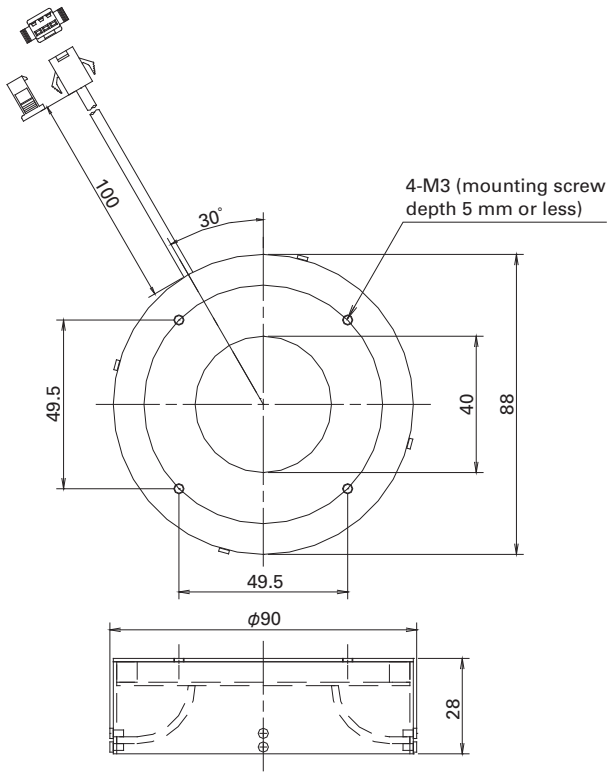

Fig. 6: External diagram of the ring type

3.2 Features of the “VS-AS”

The dimensions are 125 (W) x 50 (H) x 87 (D) mm and its weight is 290 grams. Compared to the “VS-EV”, which will be discussed later in this report, it is compact and lightweight, taking up only around half of the installation space and weighing only around one-fifth of the weight of VS-EV. Fig. 7 shows an example of system connection for the “VS-AS”.

This device has two operation modes - “Settings Mode” and “Automatic Measurement Mode”. When the device is turned on, it will be in automatic measurement mode. To change to settings mode, press down the right-hand side button of the dedicated mouse rather long. In settings mode it is possible to register reference images, set parameters, set output data and so on. The menu is available in Japanese and English. Fig. 8 is an example of the setting menu screen.

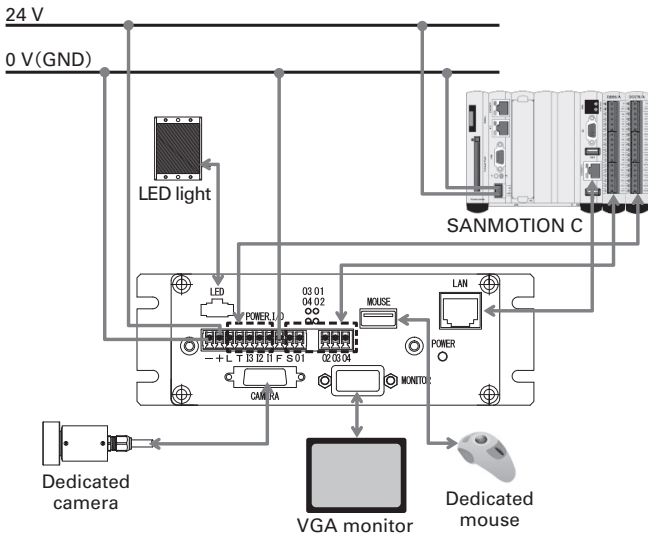

Fig. 7: Example of system connection for the “VS-AS”

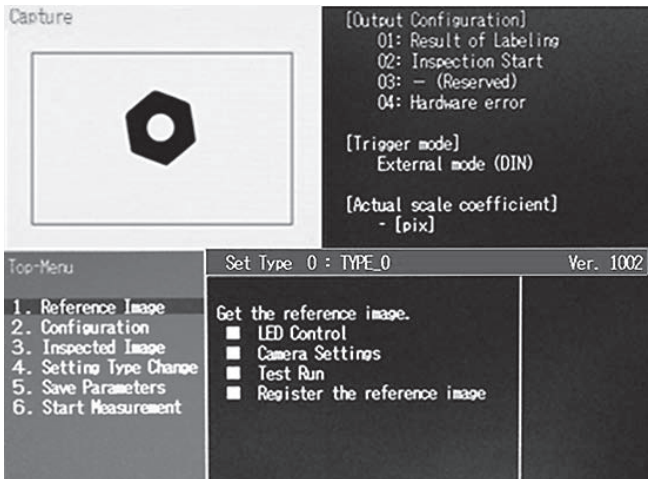

Fig. 8: Example of the setting menu screen

The “Automatic Measurement Mode” performs measuring by labeling based on the measurement parameter setting.

In labeling measurement, if a cluster of pixels in the captured image are within the area specified for that cluster then it is detected as a valid element. A label number is allocated in the order of detection or sorting and it is possible to output a maximum of 10 data items, center of gravity for each label and main axis angle.

With labeling measurement, by sharing information on the position and posture of the target object with the servo system (motion controller), it is possible to apply this information to conveyor tracking control system which picks up the objects being transported on a conveyor with a robot, etc.

3.3 Features of the “VS-EV”

Fig. 9 shows an example of system connection for the “VS-EV”. Two cameras and LED lights can be connected to the main unit, therefore it is possible to capture images of the target object from two different directions with one image processing device, therefore enabling three-dimensional assessment. The dimensions of the “VS-EV” are 219.2 (W) x 52.8 (H) x 181.2 (D) mm and its weight is 1.5 kg.

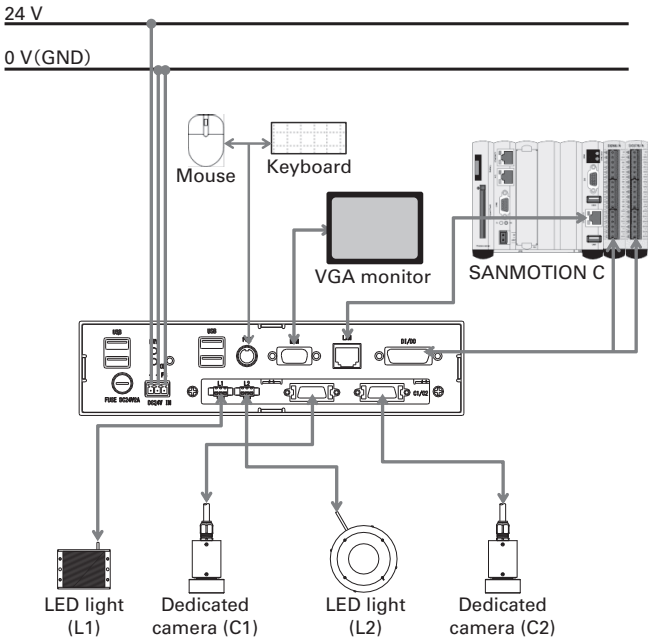

Fig. 9: Example of system connection for the “VS-EV”

This unit comes preinstalled with "EV-Plus"- dedicated image processing software for VS-EV. This software makes it possible to flexibly support various inspection applications.

When "EV-Plus" is run, the screen shown in Fig. 10 will be displayed on the VGA monitor. The screen is configured from the tabs, "Automated Inspection", "Setting Inspection" and "Configuration".

In the "Automated Inspection" tab it is possible to execute and stop inspections in accordance with the inspection settings.

Meanwhile, under the "Setting Inspection" tab, it is possible to perform settings such as the inspection content of Automated Inspection and the device's hardware settings. The inspection function of this device is divided into units called "inspection item" and users can program the flow of Automated Inspection arbitrarily by combining these item. Items are categorized into the following 9 types.

(1) Capture: Capture settings
(2) Delay: Delay time within the inspection flow
(3) Input/output: Input wait, results output settings
(4) Calculation: Calculation of results output
(5) Judgment: Judgment processing
(6) Preprocessing: Preprocessing of input images (filter)
(7) Get image: Acquisition of surface area, center of gravity, main axis tilt and so on
(8) Processing image: Image processing such as matching detection
(9) Function specialization: Labeling, data output

Labeling of the "VS-EV" detects up to 16 elements and outputs data on each of their center-of-gravity positions and main axis angles. Moreover, this unit can perform searches to detect pre-registered image patterns and matching elements from the available images. There are two types of searches which can be performed; a "Feature search" and "Contour shape search". Generally-speaking, if the target object is a simple shape, a "Feature search" can be performed at a relatively higher speed. However, due to the possibility of demerits such as being more easily affected by background texture, it is possible to select the "Contour shape search" as an alternative.

The combination of these inspection items makes it possible to program a wide variety of inspection applications such as counting the number of article, foreign matter, scratches, defect inspection, dimension measurement and position measurement.

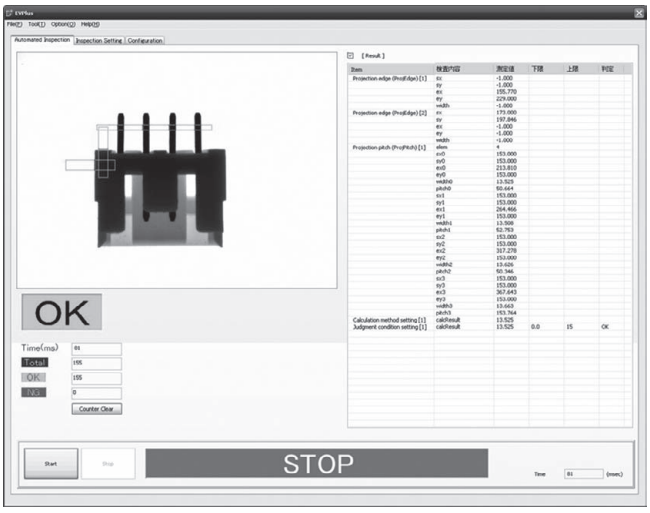

Fig. 10: Screen layout of the EV-Plus software

4. Display with Touch Panel

4.1 Overview of the display with touch panel

This device is a programmable display unit which is mounted on a control panel or operation panel and used as a HMI of the equipment.

The screen size is a 7", TFT wide screen supporting 65536 colors, with a touch panel of the resistance-film analog kind embedded in a WVGA resolution of 800 x 480. There are two serial ports in addition to a 10/100 Mbps Ethernet. The dimension is 212 (W) x 156 (H) x 57 (D) mm, and weighs approximately 1.2 kg. Fig. 11 shows an external view of the display with touch panel and Table 2 gives the basic specifications.

Fig. 11: External view of the display with touch panel

Table 2: Basic specifications of the display with touch panel

Item			Content
Performance	Dimensional outline drawing [mm]		212 (W) x 156 (H) x 57 (D)
	Mass [g]		Approx. 1200
	Power source		11-36 V DC / 1.1 A
	Screen size [inch]		7
	Resolution [pixel]		800 (W) x 480 (H)
	Display type		TFT, wide-touch screen
	Color		65,536
	Protected structure		IP65 front face, IP20 back face
	Backlight		LED
	USB		1 port
	COM1		RS232C only
	COM2		Select from RS232C / RS422 / RS485
	LAN		1 port (10/100 Mbps)
General	Operating environment	Ambient temperature	0 to +50˚C
		Ambient humidity	20 to 80% (non-condensing)
	Applicable regulations	UL	UL508
		RoHS	compliant
		EMC directive	EN61000-6-4: 2007 EN61000-6-2: 2005

The screen supports Japanese, English, simplified Chinese and traditional Chinese. The device can be mounted either horizontally or vertically. The screen display can be set at angles of 0˚, 90˚, 180˚ or 270˚ to suit the direction of installation.

HMI applications operated on the display with touch panel are made using the accompanying software “Studio-PA”. Many basic objects have been prepared for this software, and HMI screens can be created easily by arranging these objects on the screen. When actions such as clicking, pressing or releasing are performed on the objects on the screen, it is possible to define events which communicate data with the connected device via the communication port. Fig. 12 shows a list of basic objects.

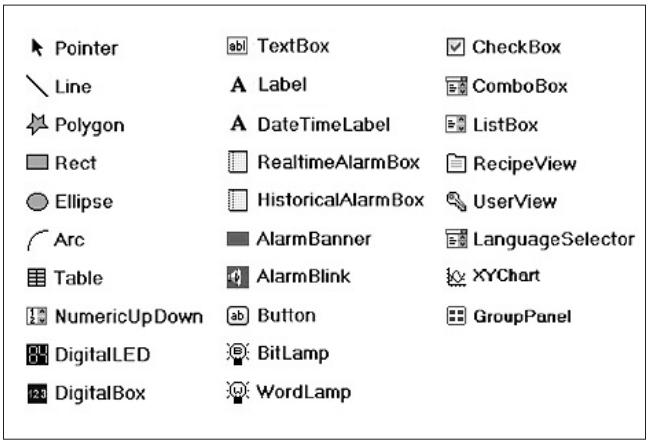

Fig. 12: List of basic objects

5. Conclusion

This report has introduces the features of the image processing device and display with touch panel which have been newly added to the “SANMOTION C” series. These products can easily be connected to the “SANMOTION C” motion controller, making it simple to develop programs using the communication function and significantly improve affinity between equipment. This has made it possible to offer our customers a system product with even better user-friendliness than previously possible. It is now also possible to make system proposals to applications which combine image processing devices and motion/robot control functions. In particular, we believe we can offer a low-cost system to conveyor tracking (tracking control) applications which specifically focuses on labeling processing.

Sanyo Denki will continue to exert all our efforts to improve the functions and performance of the “SANMOTION C” series and enhancing peripheries to offer products which can be used on the global market.

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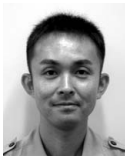

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Memo