

PRESENT SITUATION AND PROSPECTS OF FUJI VIDEO SENSORS

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1. INTRODUCTION

Twelve years have passed since the first machine of "Fuji video sensors" was sent out to the market and their range of applications has also expanded and large changes have taken place in their type composition.

The first generation of Fuji video sensors was the age of dedicated apparatus up to the 1980s. Video sensors were mainly the image pick up tubes and entire apparatus were manufactured for each usage objective and it is not too much to say that the number of image processing circuits and judgement algorithm was as many as that of application apparatus.

Today is the age of the second generation and general purpose apparatus incorporating an image processing circuit, basic judgement algorithm and man-machine interface are the mainstream. Building of a system by adding the peripheral sections necessary for each application field has become possible and video sensors have become systems whose inspection area and test level setting can be programmed by the user.

The development progress and newest advances and prospects of Fuji video sensors are outlined here.

2. FUJI VIDEO SENSORS DEVELOPMENT PROGRESS

In relation to the visual inspection performed by various industries, the problem of the difficulty of securing and training capable inspectors is highlighted in association with the problems of long simple work, and eye strain.

On the other hand, automation of inspection is desired to aim at improvement of productivity by speeding up of the production line and by saving labour, and at the prevention of careless mistakes and stabilization of inspection accuracy.

Moreover, to improve the accuracy of production control, the rapid collection of data related to inspection and production has become necessary and automation of inspection and connection to a data network are desirable.

When numerical controlled machines and robots have

come into wide use, human eyesight is being reviewed. This is since human intervened in the process, there were a lot of examples in which not only the posture, shape, position, etc. of the objects were checked, but scratches, stains, etc. on and in the objects were observed and removed during handling and moving objects. In this way, various utilization of the visual facility of humans became clear and the introduction of the video sensor became a keen theme in going on with automation of the line.

Against this background, in the beginning, only a small number of video sensors for special application were used in in-house facilities by each user. Fuji Electric started to send the automatic appearance inspection equipment to the market in 1976 and with the popularity of the microcomputer, planned function upgrading and cost reduction and developed various dedicated apparatus and contributed to improvement of saving labour and inspection reliability.

The transition of video sensors keeps pace with the progress of the semiconductor from the standpoints of performance and economy. The use of solid image pick up elements, advanced functions microprocessors, large capacity memories, and gate arrays has become possible, and a substantial lowering of hardware cost and speeding up of processing have been realized. At this time, Fuji Electric commenced the sale of Fuji video sensor general-purpose apparatus, that is multiwindow series and robot vision series.

The Fuji video sensor development progress is shown in *Table 1*.

3. NEWEST ADVANCES

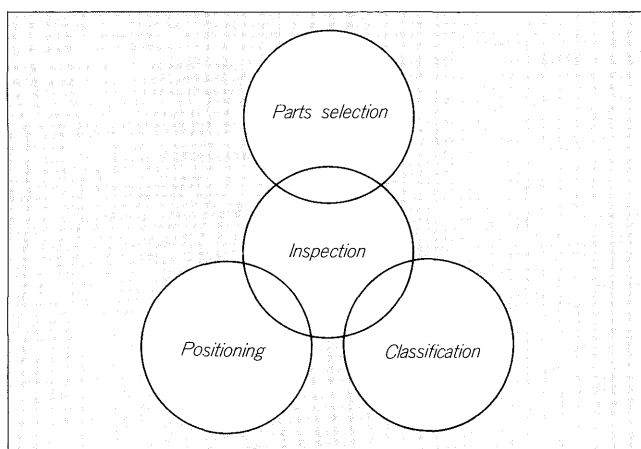
As shown in *Fig. 12*, the fields of application of video sensors are expanding not only to automation of visual inspection, but also to automation of positioning, classification, sorting, and other visual decision work.

Therefore, not only the development of strengthening image processing function and recognition ability, but also the development of low priced apparatus which simplify functions according to the usage purpose and reduce the engineering burden, are desired. How to meet these needs is planned.

Table 1 Fuji video sensor development progress

Year	1975	76	77	78	79	80	81	82	83	84	85	86	87	88
Class														
Dedicated apparatus	Electronic parts inspection, transistor chips, keyboards, LSI mounting													
	Pharmaceuticals inspection, pills, capsules, PTP, capsules with mark													
	Agricultural and fisheries products inspection, melons, apples, eggplants													
	Food container inspection labels, bottle caps													
	Automotive parts inspection, engines, meters, compressors													
	Others													
General-purpose apparatus	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; border-radius: 15px; padding: 2px 10px;">Multiwindow</div> <div style="text-align: center;"> <div style="border-bottom: 1px solid black; width: 100%;"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> MW-2000 MW-2100 MW-2600 MW-2200 MWP-3000 </div> </div> <div style="border: 1px solid black; border-radius: 15px; padding: 2px 10px;">FA visual unit</div> <div style="border: 1px solid black; border-radius: 15px; padding: 2px 10px;">VR-F</div> </div>													
	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; border-radius: 15px; padding: 2px 10px;">Robot vision</div> <div style="text-align: center;"> <div style="border-bottom: 1px solid black; width: 100%;"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> VR-1000 VR-1000Z </div> </div> </div>													

Fig. 1 Video sensor applications



3.1 Strengthening of the multiwindow 2000 series

A menu has been provided by adding functions matched to the needs of the market to the basic multiwindow function which is the strong point of inspection of moving objects.

The MW-2600, in particular, was developed by leading the needs from many users and has standard patterns of up to 16 frames and inspection of various kinds of work can be switched instantly to meet changes of the work flowing on the line.

MW-2000: Standard model

MW-2100: Classification and sorting model

MW-2200: High-speed judgement model

MW-2600: Multicamera, multiframe model

3.2 Multiwindow 3000 series

To make the multiwindow 2000 series easier to use,

Table 2 Video sensor technical topics

Hardware	Software
High resolution semiconductor camera	Practical recognition algorithm
Color semiconductor camera	Three-dimensional processing
Image processing dedicated processor	AI application
	Fuzzy application
High speed multivalue image processing, color image processing, neurocomputer	

improvement of the performance of the following points was planned and the multiwindow 3000 series MWP-3000 (see "General-purpose video sensor multiwindow MWP-3000 and its application" article of this special issued) was developed.

- (1) Digitizing method was strengthened so that the effect of lighting changes was not received.
- (2) A rotation compensation function was added and work position deviation compensation was strengthened.
- (3) Speeding up of processing was realized. (Approximately 2.5 to 3 times that of the 2000 series)
- (4) A pattern matching function was added and standard pattern generation was simplified by showing.

3.3 FA visual unit VR-F

Our experience with multiwindow and robot vision and their functions was incorporated and an inexpensive apparatus with mainly a positioning function was developed.

VR-F is easy to use and has a lot of FA functions such as network function, expanded I/O, and BASIC language with visual commands. It is expected to be applied to a wide range of fields, for example, using for accessory of machinery.

3.4 Industrial character reader VR-1000Z

This is an apparatus which reads the data printed on a product or unit at a later process and transmits the result to a controller for production control. It is offered as a system in which the VR-1000Z reads the characters marked by a Fuji Electric lasermate.

4. FUTURE PROSPECT

The role of the video sensor is to see and then to judge.

It is necessary to have good eyes and software with skillful judgement. The main technical topics to improve the functions of the video sensor are shown in *Table 2*.

The fields of application of the video sensor are steadily expanding and great things are expected, such as

- (1) Application to the high tech field in which humans cannot intervene
- (2) Application to the "eyes of FA" which can be harmonized with humans.

