Introduction To Vision Inspection
Introduction To Automatic Vision Inspection
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4.1 Product Advantages

The Itran 8000 offers the user:

- 100% inspection at production rates
- Rugged industrial construction
- Built-in diagnostics
- Advanced vision imaging techniques
- Gray scale imaging
- Portable programming panel
- Discrete I/O interfacing
- Menu oriented programming language

Typical applications include:

- Inspection for proper assembly
- Inspection of machined surfaces and shapes
- Instrument calibration
- Inspection of wire bonds
- Inspection of printed circuit boards
- Packaging and content inspection

4.2 System Overview

The Itran vision inspection system block diagram shown in figure 1 consists of five components:

- Vision controller
- Portable programmer
- Camera(s)
- Discrete I/O
- Monitor

Vision Inspection System Block Diagram

Figure 1
4.3 Vision Controller

The vision controller is the heart of the system. It is comprised of six major subassemblies:

- Interface subassembly card
- Video input card
- Video output card
- Central processor card
- Array processor card
- Power supply subassembly

Shown in figure 2 is a generalized block diagram of signal flow into and out of the controller.

![Vision Controller Block Diagram](image)

**Vision Controller Block Diagram**

**Figure 2**

4.4 Portable Programmer

The portable programmer inputs the characteristics of the inspection to the vision controller. It can also be used to monitor the inspection process.

The portable programmer consists of a nine inch color CRT and a cartridge tape drive. The operator interface to the programming panel is via a light sensitive pen. Using the light sensitive pen, a user selects a series of vision oriented "menus."

These menus logically guide the user through an inspection application with minimum effort.

4.5 Camera(s)

The camera is the connection between the application and the vision controller. It electronically converts the scene in its field of view into an analog signal. This analog signal is then converted into a digital equivalent and stored in the controller's memory.
The "CAMERA SELECT" menu, shown in Figure 5, is used to select one of the eight cameras you will be using to view the part. Pressing the lightpen tip to the appropriate camera number and then to "ENTER" advances the programming sequence to the next menu.
The programmer now displays the part as seen by the selected camera. This display, shown in Figure 6, will be used to adjust the lens to give the clearest picture to the vision controller. When all lens adjustments have been made, depressing the lightpen tip to the "ENTER" box advances the controller menus to the next logical step.

Image of the part seen by the camera

Figure 6
The next menu, shown in Figure 11, is a synopsis of the programming steps completed. These steps have defined all the information needed to perform the "FIND" phase of the inspection. Also shown on this menu are the "tools" available to perform the "MEASURE" phase of the inspection.

"Tools" are Itran representations of the instruments an inspector would use to perform a manual inspection. An example would be a Defect Finder. In this application example, the defect finder will be used to outline the area supposed to contain the slot.

Using the lightpen, select from the menu shown in Figure 11 the "TOOL" entitled "Defect Finder." The selection of this tool is done by touching the lightpen to any portion of the words entitled "Defect Finder" and then touching the "ENTER" box. The next picture appearing is entitled "POSITION DEFECT FINDER" and is shown in Figure 12. A "Defect Finder" is the tool used to define the area of the part the inspection system is going to "examine" for defects. The words along the bottom of the screen control the placement and shape of the defect finder tool. When the shape and placement of the defect finder is complete, placing the lightpen tip on the "ENTER" box will complete the programming of this measurement. The defect finder is shown in Figure 13 completely programmed.
Positioning the defect finder
Figure 12

Defect finder positioned
Figure 13
The next picture appearing on the program panel, in Figure 14, displays the inspection system's ability to define characteristics of the area contained within the defect finder. These characteristics will provide the controller with all the information needed to differentiate a good part from a bad one. The edge pixel count and the measured intensity are the two characteristics programmed here.

Referring to Figure 14, there are a maximum of four parameters to program:
1. EDGE PIXEL high tolerance
2. EDGE PIXEL low tolerance
3. INTENSITY high tolerance
4. INTENSITY low tolerance

Using the lightpen and the numeric keypad, a user would individually select those options which are pertinent to the inspection process, then program the allowable pixel or intensity tolerance for each option. Figure 15 shows the result of programming two of the four possible options. These tolerance figures establish the range between good and bad (as it pertains to edge pixel quantity and intensity value) for the area contained within the defect finder.
The part shown in Figure 13 contained 222 edge pixels and an intensity value of 6806 within the defect finder shown. The edge pixel low tolerance value is shown programmed to allow a part to pass if 1, the edge pixel count remains above 200 pixels or 2, has an intensity value equal to no more than 9000 units.

Completion of the menu of Figure 15 is done by depressing the lightpen tip on the “ENTER” area in the lower right hand corner.

This completes the “MEASURE” phase of the vision inspection system and selects the first menu for the “REPORT” phase.

The “reporting” menus are used to “connect” the results of the individual inspections to the Input/Output points described in section 4.6.4. Using the lightpen, the user selects from a list of one line statements acceptable tolerance values for each inspection. These tolerance values will determine the presence or absence of the slot (i.e. not enough edge pixels means no slot).
The first of these several menus is shown in Figure 16 entitled DEFECT TOOL EDGE I/O ASSIGN. This menu is used to assign the contact numbers associated with either a “high” a “low” or a “nominal” tolerance value of edge pixels found within the DEFECT FINDER tool. The last statement of this menu, entitled “Number of EDGE PIXELS found” is used when it is necessary to know the exact quantity of edge pixels found by each inspection. This information would be stored in the REGISTER number shown programmed with the number 4002.

The contact numbers or register value are selected by first touching the lightpen to any letter in the statement row and then to the number desired. The numeric keypad shown is used to select the numbers required.

Each snapshot used in the inspection process would be defined using menus similar to the one shown in figure 16.

Completion of this menu occurs when the lightpen tip is pressed against the “ENTER” box in the lower right corner.

The next menu to appear is shown in figure 17 and is a synopsis of the menus completed for the part entitled FRONT PLATE.
Using this menu, the programmer can conveniently choose any menu already programmed and change or observe the statements contained on that menu. If there are no editing changes required, the programmer would select the statement "RETURN TO THE CENTRAL MENU," and then depress the lightpen tip against the "ENTER" box; the central menu will then appear and (shown in yellow) will be the statement "Create/Modify a job." This menu is shown in figure 18.
A "job" is the Itran name for the complete inspection task consisting of: FIND, MEASURE and REPORT. Touching the lightpen to the "ENTER" box will display the picture shown in figure 19.
This phase of the vision inspection program is used to control the synchronization of the inspection system with the material handling system. The two bars across the screen mark the beginning and end of the control program. As shown, the control program does not contain any statements. Located across the bottom of the screen are the menu selection statements. The next step will be to “INSERT” a line in the control program. The programmer will first depress the lightpen tip against the word “INSERT” and then against “ENTER.”

The next menu to appear is entitled “JOB INSERT LINE” and is shown in figure 20.
The job insert menu is broken down into two types:

1. Function block types
2. Logic block types

In this programming example, assume that the part to be inspected has been advanced by the material handling system to a position beneath camera number 1 and the inspection system must find it, take a picture of it, turn on contact number 3 when the inspection is done and report the quantity of edge pixels found to register number 2.

There are two basic operations the control logic must perform:

1. Control the sequencing of the part for the controller (assumed complete for this example)
2. Snap the image of the part for the controller to process (analogous to taking a photograph)

Each control logic statement is broken up into sections requiring programming information. The control statement shown in Figure 21 is used to perform the “Snap” function. This statement has six areas to program:

1. A snap contact number
2. A find contact number
3. The part name
4. The snap number
5. The done contact number
6. The ok contact number
The programmer selects any of the six areas with the lightpen tip. All possible choices for the area will appear in the lower section of the screen.

Figure 21 shows the SNAP statement partially programmed with only the "done" contact number and the "ok" contact number still to be programmed. Using the lightpen and the numeric keypad, the programmer chooses the appropriate values for the remaining two areas. Once these steps are complete, the snap statement is completely programmed as shown in Figure 22.
The final step in programming the snap statement is to "ENTER" it into the control program. Figure 23 shows the completed control program.
The inspection job is now ready to run. Pressing the lightpen tip to “ENTER” on Figure 24 returns the program panel display to the central menu.

The central menu will be shown with the active statement reading:

Run the inspection job

Pressing the lightpen tip against the “ENTER” box commences the inspection cycle.

Figure 24 shows the inspection process being performed.

![Picture shows inspection process being performed](image)

Figure 24

The above programming example typifies the simplicity of programming an Itran Vision System. Although this application was a simple one, the use of a menu based programming language can simplify the most difficult of applications.
6.0 Maintainability

The Itran vision inspection system design includes extensive diagnostic features. These features include modular construction, built-in modem for direct communications to Itran service personnel and an alpha-numeric readout on the vision controller which displays the status of diagnostics routines. These features, as well as extensive internal diagnostics, reduce mean time to repair by providing simple on-site maintenance tools. These routines are designed for use by maintenance personnel or Itran customer service people.

Diagnostic routines usually consist of two types:

- Self-testing
- User initiated

Self-testing routines consist of integrated circuit checks, memory checks, power checks, etc. These self-testing routines are automatically performed by the controller to execute inspection programs when the CPU is not being used.

User initiated routines provide convenient ways for checking color monitors, lightpens, tape drives, cameras and other aspects of the system. These diagnostics are performed on an "as required basis" by the user. The combined internal and user initiated diagnostics routines provide the user with a highly available system.

7.0 Conclusions

This document has presented an overview of the Itran Vision Inspection System. This product is designed for use in the industrial environment by factory floor personnel.

Itran is dedicated to continually evolving its products to provide industry with the latest in vision technology.

8.0 Specifications

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