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ERROR ANALYSIS USING MACHINE VISION SYSTEM

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ABSTRACT

Flexible automatic inspection system become useful automation system for large quantity production line. This research was aim to design the primary prototype of the automated machine vision system. Using different electrical components like microprocessor, relay for programming the required function. The design includes the elimination of the defected components in the flowing conveyor belt using pneumatic systems.

KEYWORDS: PSG, Microprocessor

Nowadays the customer demand keeps increasing day by day for all the products, therefore the product should meet the market more quickly. At the same time the quality should not be compensated which required some change in the conventional methods. Automated inspection using machine vision system has the following advantage compared to conventional method of inspection such as the time to inspect, complete inspection of the all the components unlike taking samples and inspect in conventional manual inspection process. Through this advantage, we get great assurance for the quality if the product.

Meanwhile, computer programs in the automated inspection reduces the lead time, labour cost and human errors. In conventional manual inspection, it is not possible to rework or modify the defected components as the defect is identified at last the process ends while in machine vision system it is possible to identify and eliminate when its in the production stage.

PRODUCT SELECTION AND METHODOLOGY

6 inch submersible pump stage casing is selected for the inspection in this work is shown in figure 2.3. It is made of cast iron. It is manufactured in PSG FOUNDRY DIVISION using sand casting process. It may include several defects as because of its difficulty in manufacturing process. The defect includes geometry defects, shrinkage defects, gas porosity, pouring metal defects, metallurgical defects.

The outer shell of the pump which protects most of the components from the outside elements. The casing of the pump should be of materials suitable to withstand the environmental conditions of the application. The exploded view is shown in the figure 2.2. Impeller and other components assembled with these stage casing, The defect may leads to decrease in performance, leakage etc..

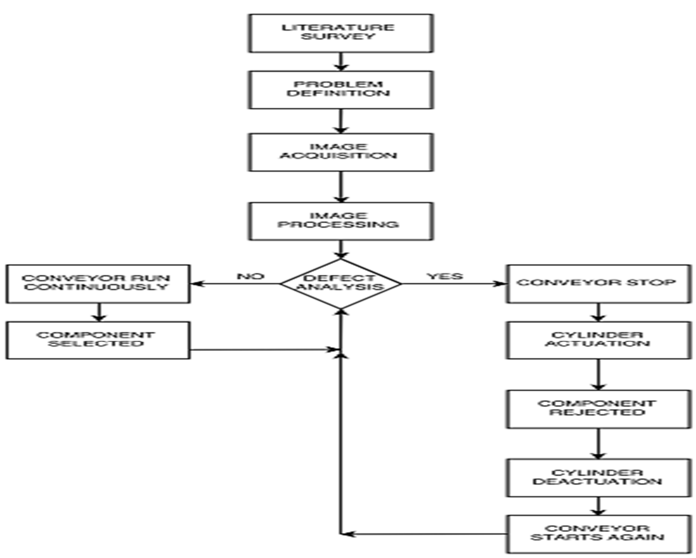

Figure 2.1: Flow chart of methodology

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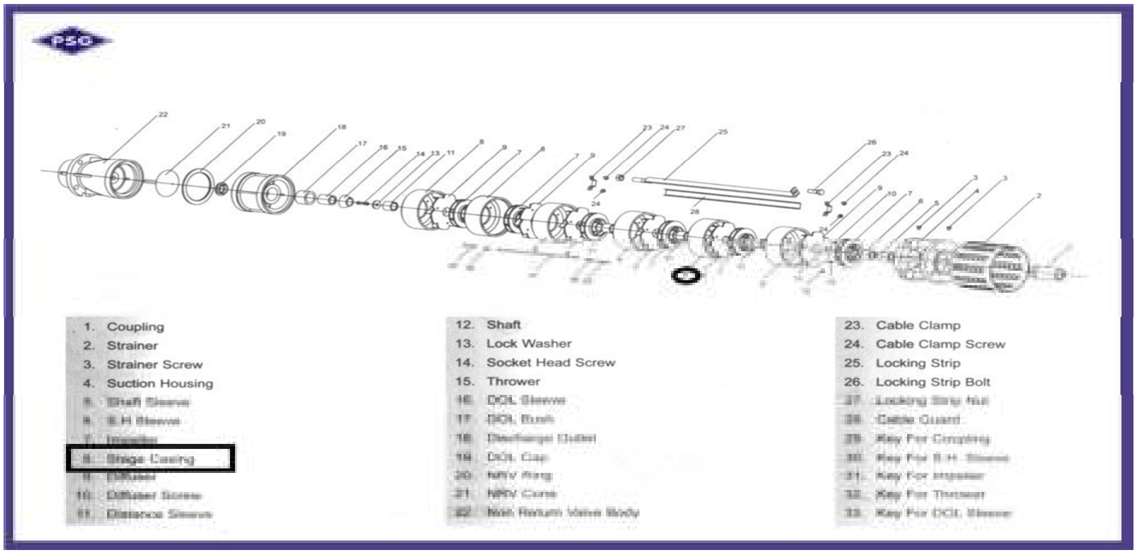

Figure 2.2: Exploded view of 6-inch submersible pump

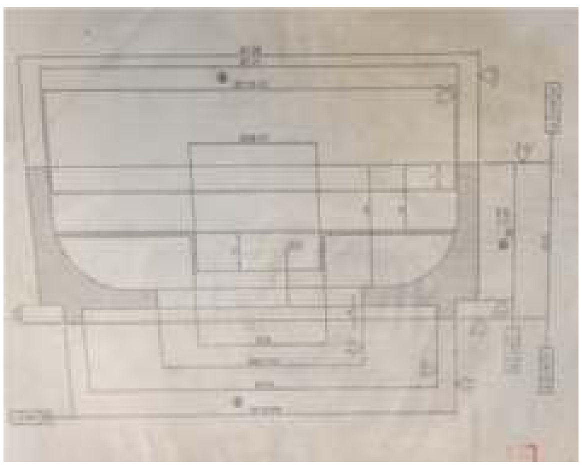

Figure 2.3: Stage casing drawing

An image sensor sense the image and gets information by converting light waves into signals and with the application of current information from the image can be extracted. Image acquisition is the taking photographic image of the structures (internal or external) and processing the image, storing the respective data. The stage casing is sensed with machine vision camera is shown in figure 2.4.

In the development of this process lightening is one of the best results of this process, in which data is extracted not by analysing the object directly but by analysing the reflecting light from the object. In this technique, the main setup is that the light source should be placed with respect to the part and the camera. The lightening is shown in the figure 2.5.

Figure 2.4: Image sensing and acquisition

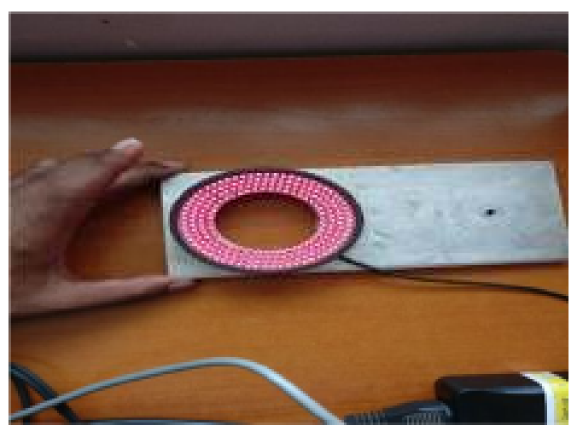

Figure 2.5: Lightening of stage casing

The next step after the image capturing is the image analysis where the features required are obtained by algorithms and conclusions based on this are drawn. The feature generally implies the required information such as dimensions. Here the algorithm is given as a function and in some cases the image needs pre-processing using digital filters. The component with void is analysed with the Sherlock software is shown in figure 2.6

Pattern matching is the recognition of the pattern that is previously recognized in an image. This process can be done only if the object to be inspected and the reference object should be identical to the reference. Pattern making can be used for locating and verifying shapes of an object. The diameter of the non-defective component is measured with the software is shown in figure 2.7

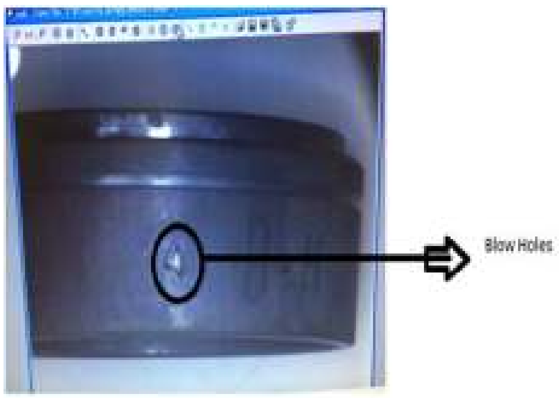

Figure 2.6: Component with void is analysed with the Sherlock software

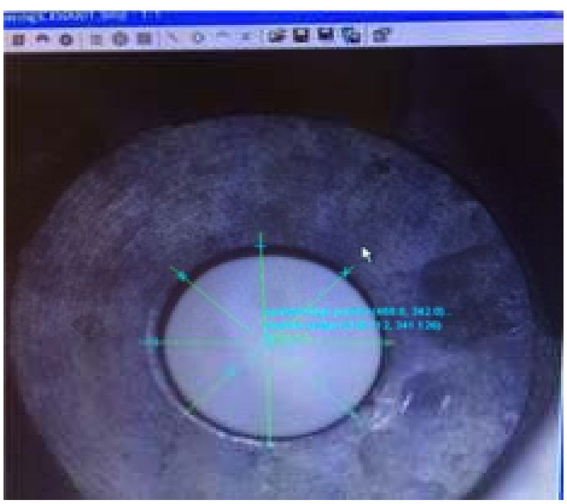

Figure 2.7: Diameter of the non defective component is measured

Defects in Stage Casing

Shrinkage defects occur when feed metal is not available for compensating the shrinkage as the metal solidifies, for this purpose proper runner setup should be provided.

Sink mark result from localized shrinkage of the material at thick sections, this occurs due to insufficient compensation.

Voids/blow hole are single or group of small holes present inside a part. Voids are caused when the outer skin of the part resist the shrinkage forces due to their stiffness. Thus, the material core will shrink, creating voids on the part. The void is shown in figure 5.8.

Fins are the extra projections caused due to the gap formed due to the failure of flow of molten metal in some areas.

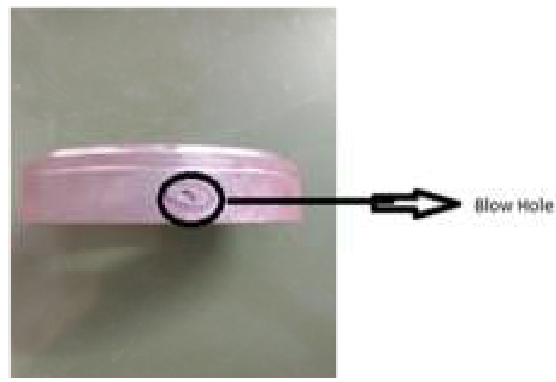

Figure 2.8: component with blow hole defect

EXPERIMENTAL PROCEDURES

The stage casing are placed over the conveyor, which is run by a 24v D.C motor. The aim is to run the conveyor with stage casing, the machine vision to sense each and every casing. when a casing enters the image is sensed, processed and then compared with the image of the defect free casing which was taken earlier. When there is no change in dimension or there is no surface defect the component is free to flow. When there is any defect against the already taken defect free component, the conveyor should stop and the component must be thrown away from the conveyor by a pneumatically operated cylinder.

Sequence of Operation

During defect analysis if the stage casing with surface defect or dimensional error is identified the motor stops, so that the conveyor stops. As soon as the conveyor stops the cylinder is actuated and the stage casing in the conveyor gets rejected. After that the cylinder is deactuated and the motor runs. This sequence is repeated for the further operation.

Construction

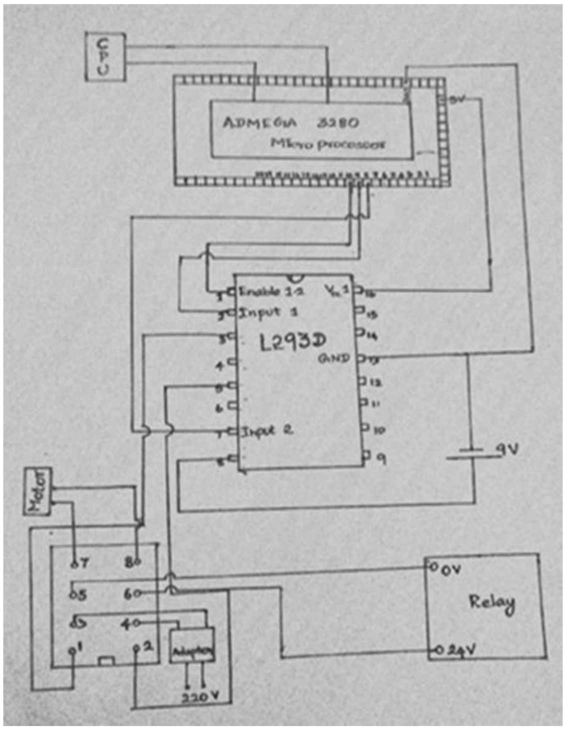

Figure 3.1: Sequential circuit

The components are;

- CPU – to process the captured image,
- Micro processer-to execute the given program,
- IC L-239 D-to drive the motor according to the program,
- D.C motor –to run the conveyor,
- Adaptor-to convert A.C to D.C,
- Relay-for switching,
- 9v battery to energize the IC..
- Pneumatic switches with limiting switches.

The output of the CPU is connected to the input terminals of the micro processer. The terminals 8,9 and 10 of the micro processer are connected to the terminals 7,2 and 1 of the L-239 IC respectively. Terminals 8 and 9 of IC are connected to the positive and ground of 9v battery .The terminals 16 and 13 are connected to the 5v and ground of the micro processor. The 3 and 5 of the IC are connected to the 1 and 2 of the relay. 3 and 4 of relay are connected to the adaptor. 5 and 6 of relay are connected to the relay that actuates the limiting switches of the pneumatic cylinder. 7 and 8 are connected to the D.C motor. The adaptor is given with the supply of 220v. With this sequence of operation which is shown in the figure 3.1, the rejection of components is done.

Working

The program of the micro processer is,

```
#define E1 10 // Enable Pin for motor 1
#define I1 8 // Control pin 1 for motor 1
#define I2 9 // Control pin 2 for motor 1
 void setup() {
   pinMode(E1, OUTPUT);
   pinMode(I1, OUTPUT);
   pinMode(I2, OUTPUT);
   pinMode(11, INPUT);
   //pinMode(I4, OUTPUT);
}
void loop()
{
   digitalWrite(E1, HIGH);
   digitalWrite(I1, LOW);
   digitalWrite(I2, HIGH);
   delay(5000);
//  if(digitalRead(11)==HIGH)
// {
   digitalWrite(I1, HIGH);
   digitalWrite(I2, LOW);
   delay(5000);
//  }
}
```

Initially the relay is normally closed (1 and 2) since 24v flows from adaptor to the relay it is given to the motor (7 and 8) of conveyor runs. When a defect free component comes it continues when an defected component comes the CPU gives the output signal, it energise the IC, then 9v supply comes to the relay hence it become normally open (5 and 6).The supply for the conveyor motor is delayed for 5 seconds as programmed, at the same time the pneumatic cylinder is actuated by the relay. Hence the defective component is pushed away from the conveyor. The electro pneumatic circuit for the sequence A+A- required for the operation is shown in the figure 3.2.

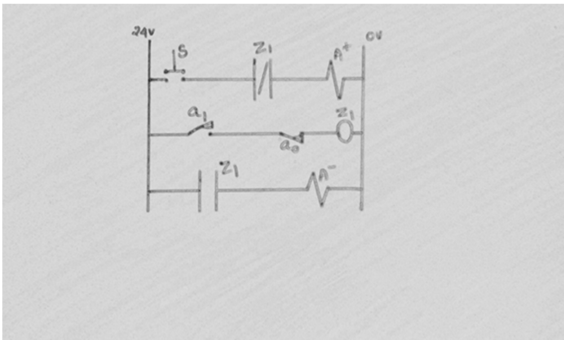

Figure 3.2: Circuit diagram for pneumatic cylinder

CONCLUSION AND RESULTS

Machine vision is the automatic extraction of information from digital images for process or quality control. Most manufacturers use automated machine vision instead of human inspectors because it is better suite to repetitive inspection in tasks. Machine Vision System is faster, more objective. In this work, stage casing of 6 inch submersible pump is selected for the automatic inspection under machine vision system to identify the surface defects and dimensional defects. The defect analysis is done with the help of Sherlock software. The circuit is designed for the conveyor and the pneumatic cylinder based on the application for inspection and successfully applied. Thus the work is completed successfully and the rejection of the defected stage casing of 6 inch submersible pump is done.

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