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Improvement in Fettling Process Using Image Processing Techniques

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Abstract*:*

Image processing is a form of signal processing where the input are image and processed to get a better quality image or a set of characteristics (or) parameters related to image. It was broadly divided into two major categories as (i) Improving the visual appearance of image and (ii) Preparing images to study about its features and structural arrangement. The Image processing techniques consist of Image Acquisition, Image Enhancement, Image segmentation and Image measurement. The conversion of analog images into digital image was also possible in image processing. The digital image processing was preferred when compared to processing of analog image due to its flexibility, storage and processing speeds etc. The image processing in fettling process tends to complex because of variety in geometrical shapes and structures of casting parts. The casting manufacturing industry comprises of different types of process as moulding , melting , knock out , core removal , gate removal , grinding and fettling process , finally castings are bring to its actual dimension and painted if necessary. The overall process like moulding, melting and knock out are easily automated or semi automated but the fettling process involves human effort for removal of excess materials in casting processes. In addition hotspot areas are covered with chills and feeders to produce casting defect free. To eliminate possible human effort in fettling process a computer controlled machine with image processing and proper cutting tools at variable speed are mandatory. The machine with cutting tool comprises of high degree of freedom and flexibility to adopt different motions and orientations for effective fettling process. The control of entire motions and orientation was completely depending on captured image and its processing methods. This paper, discuss about the fettling process using image processing techniques and the factors affecting the performance of fettling processes. The main objective of this research is to eliminate the human efforts in manufacturing industry by using adaptive methods and techniques in fettling processes.

Keywords - Casting, Image processing techniques, Fettling, Manufacturing Industry , Human effort, Human effort Interface etc.,

I. INTRODUCTION

Image processing generally refers to processing of two dimensional images and IR sensors are used commonly in mobile phones for face identification. Image processing techniques are divided into three types as (i) image to image transformation (ii) image to information transformation (iii) Information to image transformation. The image to image transformation includes Enhancement of images, Restoration of images (deburring and grid line removal) and geometry (Scale, Size, Zoom etc...).The image to information transformation consists of image statistics, Image compression, Image analysis (Segmentation, extraction and recognition) and Computer Aided detection and diagnosis. The information to image transformation includes decompression of images, Reconstruction

of images from raw data and Projection of images in computer graphics, animations and visual reality. Image sensors convert the detected images in the form of electrical signals which are used for digital processing. The digital processing techniques convert the image into digital numbers which are processed with the help of computers.

The casting manufacturing industry involves different process where the fettling process comprises of removal of excess material from casting parts. The one of cost effective methods to produce components and parts was achieved through casting manufacturing process. The fettling process was almost done using human effort incorporated with power tools (Pneumatic and electric motors with cutting tool) and the Non conventional / Un conventional machining process are costly and processing time gets increased to produce final dimension of parts and components. As compared in terms of cost with labor and robot, robots are accurate, effective and work continuously, which need high investment and skilled professional to control and monitor the entire process.

II. LITERATURE REVIEW

Wilson R. Nyemba [1], states that the optimization of casting technologies and sustainable manufacturing in 100mm grinding balls for the mining sector. This paper focus on the simulation of gating system to produce grinding balls accurately. The methodology of the research is done by investigating the entire process and simulating using solid works with turbulent flow and Bernoulli's principle. The amount of material reduced was found to be 24% from actual material wasted, which saves time and energy even though the material is recyclable.

Mathew Thomas [2], analysis on the performance of fettling process in manufacturing sector using arena software for simulation and bottleneck technique for identifying problem associated with time. The modules are arranged in sequence and investigated the possible way to improve the performance in fettling process. The methodology includes identification of variables and performance measures then modeled a simulation of current system with improved system to determine the average time of the fettling process in handling and processing.

Rukmani P [3], research based on industrial automation to monitor and control the parameters like temperature, gas without human intervention. The research was divided into three phases as providing access to control through internet, software for image recognition to assure authority access to employees and finally data storage and retrieval for analysis. This paper deals with how IoT and sensors are used to control the process in industrial automation and authority access to employees by image recognition.

Radu Adrian ciora [4], deals with the normal industrial vision system and sequence of steps to be followed. The sequences include image acquisition, processing, segmentation, feature extraction and decision making. The application of image processing in food industry, medical printed circuits, RGC (Robotic Guidance and Control) and steel inspection are explained. This paper also concludes that a separate datasheet using CIM (Computer Integrated Manufacturing) is sufficient to implement the normal visual inspection in industrial automation.

Ali Hussein Humod [5], brief about the improvement of productivity and quality in manufacturing sector using computer vision system. The MATLAB software was used for simulation and a sample analysis was made on plastic industry. The major problem was identified as orientation and color of plastic component. The image processing system detects the orientation of the item and correct to the required orientation before reaching coloring department. The GUI detects the color of item by using RGB color sensor to sort out in conveyor system. Thus the color mixing of components and dimension mixing was eliminated automatically without human intervention.

III. METHODOLOGY

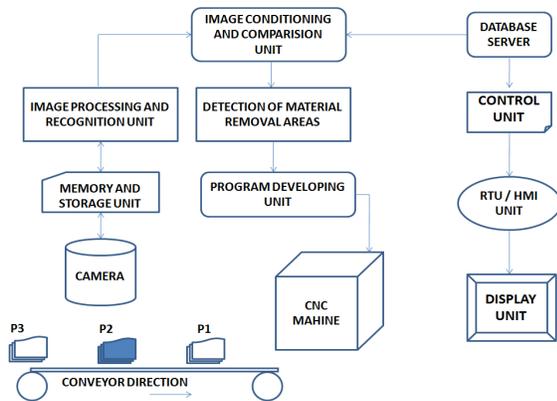Methodology of image processing techniques in fettling process of casting manufacturing industry was given in figure 1.

Figure 1. Methodology for image procrssing in fettling operation

IV. FETTLING PROCESS IN MANUFACTURING SECTOR

Casting manufacturing units comprises of various processes where fettling process consumes more time and requires human effort to perform material removal process. Since complex design and various material thickness are still exists even with robust design on pattern making itself. The entire fettling process depends on human effort and power handling tools, the absence or unavailability of human resource or power tool makes the production loss and delay the delivery time of product to reach the customer end. For effective just in time delivery the supply of products and components are in continuous flow.

The common power tools used and chisel-hammer method are also used for material removal processes which are small in size and less thickness. The mount point tools which are made up of abrasive materials are used to smooth the casting surface and also to remove materials in complex area. The unconventional machines are used in complex and precision shape and size requirements.

V. IMAGE PROCESSING ON FETTLING PROCESS

Image processing is a method to convert image into digital form and performs some operations like enhanced image or to extract some useful information form. It is a type of signal dispensing in which input was image and output is associated with characteristics of image. The image processing is divided into two types as analog and digital images. This paper focus on capturing digital image from the casting components / parts and convert them into digital form to compare with the actual image with appropriate dimensions, shape and size. The camera used to capture the parts was controlled by a automatic conveyor. The servomotor was used to move the conveyor belt and capacitive sensor are placed to stop the conveyor where the camera focuses the location.

The illumination and texture are done through additional peripheral devices where the 3-D camera gets focus to capture the image and compared with the image processing and recognition unit to conform the dimension and its characteristics of captured image. The image comparison and conditioning unit compared the conditioned detection image to the actual pre defined or required image and indicate the excess material in the detection imgae.

The program developing unit reads the information from excess material removal from detected image and programming code for the material is developed automatically. After the program constructed using program developing unit, the programs are feed into CNC (Computer Numerical Machine). The control unit is used to control the entire unit with the wireless techniques and display unit are used to monitor the trend charts and histogram of the process. The alarm sound and warning light are also used for immediate attention on the process.

VI. FACTORS AFFECTING PERFORMANCE OF FETTLING PROCESS

There are various factors which affects the fettling process, which are commonly categorized as primary and secondary. The primary factors include cutting speed, coolant type, feed rate, part mix and material hardness and secondary are performance of machine, environmental condition and industry size. The cutting speed and feed rate are optimized based on the material grade and material removal thickness

and spindle speed. The part mix is the major drawback in automated fettling process where the detection and programming time takes much more time than manual fettling but the precision of material surface is achieved more in automated fettling process compared with manual fettling.

The Space consideration plays a predominant role in implementing automated fettling process since the conveyor method is used to transfer parts from one place to other place because of simple and cost efficient considerations. The performance of machine is un-altered unless upgraded to new technologies and environmental conditions of automated fettling process are clean and neat with ambient temperature without moisture. This helps machine to perform better and prevent casting from rust.

VII. RESULT AND DISCUSSION

By using Flexsim software simulation is carried out between actual and improved method in fettling process and found that the OEE increases from 71.6% into 84.6%. This method eliminates the complete human effort in fettling process and ROI of this image processing in fettling industry is about 8 years for medium scale industry. The entire data is stored in database servers which are retrieved back for reverse investigation and performance measure. Since the entire process is controlled in server which has a HMI (Human Machine Interface) and RTU (Remote Terminal Unit) which are connected as wireless network. Real time monitoring of data like programming, material handling control was possible through database server data.

VIII. CONCLUSION

The Image processing techniques in fettling process reduces the human effort involved and automates the entire manufacturing unit to deliver the product effectively. The actual material handling time of a product at different stage were analyzed and automated fettling process consist of conveyor belt which totally eliminates human effort in transferring parts and components from manufactured to fettling areas. The each part are assembled in a single line and performed fettling operation continuously for 24*7*365 where the manual fettling process is not possible to achieve the automated fettling process efficiency and precision. The image recogation, conditioning and program developed are stored in database server which differs to each and every product and components so back tracking are easily possible and process is entirely transparent at every stage. The data extractions are used for performance analysis and capacity planning are added advantage. The main advantage is it is entirely controlled with remote so human intervention is needed to control the process.

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