IMPLEMENTATION OF BATIK MACHINE TO IMPROVE HAND-DRAWN BATIK PRODUCTION TIME

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Abstract

Batik is Indonesian artwork that has become hereditary culture from generation to generation. By UNESCO, batik has been designated as a Masterpiece of the Oral and Intangible Heritage of Humanity on October 2nd, 2009. One of the problems faced by batik industry recently is increasing demand of batik products. Nowadays, overall processing time of batik from sketches to batik products may take around 2 to 3 days, where the batik process itself may take one full day to complete. On the other hand, the number of batik craftsmen is increasingly limited, many young people are less interested in becoming batik craftsmen.

This paper describes how to increase batik production using Computer Numerical Control (CNC)-based batik machine. Manual hand-drawn batik is copied and then applied to the batik machine to generate optimal routing path, and hence to minimize production time. Focus of this paper is on the primary batik process (known as klowong) using batik machine. This process may take around 75% of overall processing time, so this technology hopefully reduces production time to increase productivity. The experiment results are then compared between machine and manual batik processes.

The experiment results prove that the drawings design must be taken into account and then adjusted by the feedrate, because the higher feedrate tends to reduce processing time. However, feedrate also has affects on product quality. The experiments results of klowong processing time for manual batik is around 170 minutes and processing time using batik machine is only around 72 minutes with the same motif. The results show klowong proccesing time has been reduced by 57.65% using batik machine.

Keywords: *hand-drawn batik, batik machine, klowong, production time, CNC.*

JEL Classification: O3, O4, L6

INTRODUCTION

Manufacturing process can be defined as the application of physical and chemical processes to transform the geometry, properties and appearance of a raw material in making components or products; the manufacturing process also includes merging some components to make the product assembled (Groover, 2001). In the last decade, batik became a growing industry and one of the icons in Indonesia. By UNESCO, batik has been designated as a Masterpiece of the Oral and Intangible Heritage of Humanity on October 2th, 2009. One of batik industry problems is increasing demand of batik products. On the other side, overall batik processing time from sketches into finished products may take approximately 2-3 days, where the batik process itseft may take one full day.

The use of technology in industry is inevitably condition. Computer Numerical Control (CNC) machine has started being used in batik industry because of the need to improve batik production time to cope with the increasing demand and the lack of batik craftsmen as many young people are less interested in becoming batik craftsmen.

Design batik pattern was developed by Nurhaida et al (2015) to create automatic Indonesian's batik pattern recognition using the Scale Invariant Feature Transform (SIFT) approach as a feature extraction method. The main reason is difficulty of weaving detailed and irregular ornamental compositions into the cloth. Despite many batik pattern has the same motif, they may be different in terms of position, size, and direction. This research has main objective to evaluate SIFT features based on Hough transform for object recognition in batik pattern. The main idea is to find extreme points in image and then to construct regional point descriptors. The proposed method gains better performance over the original SIFT matching method with 8,47% equal error rate.

Related to design processes and production of batik, a model of batik design was developed by Arsiwi (2016) to design batik motifs based on Bezier curves. Batik motifs have been created using vector-based programming (HTML, JavaScript, and php) with the output of Scalable Vector Graphics (SVG). This research used Bezier curves approach for generating motifs to made them not identical between one another to keep the character from hand-drawn batik, with the level of deviation is around 10%. Adiguna (2013) developed the design of canting mechanism on CNC machines. The method that used for optimization is Design of Experiment (DoE) Taguchi method. Canting prototype that produced in the research is used valve and spring mechanism. On the experiment, using wax temperatures above 100°C, nozzle cannot hold the heat load, so the design has changed become a straight pipe with nozzle diameter is 0.8 mm.

Hanif (2017) conducted research by developing automated stamp batik machines that moves stamp module where the movement of CNC machines automatically set by G-codes and inputted via ArtSoft Mach3 software. The method is done by observing batik stamp processes manually in a batik industry. The results of the research stated that the batik quality using CNC machines is almost the same as the quality of manual batik processes, with the wax temperature is around 138°C with 0.2 s for delay. The production time of 10 meters of fabric on the CNC machine is 66 minutes, whereas the manual batik process is 70 minutes. The research only optimized the setup of wax temperature, so the production time between CNC machines and the manual batik processes are not much different.

RESEARCH METHOD

A. Batik Motif

Batik motif is chosen based on interview with batik craftsmen who have had experience more than 10 years. Batik motif used in this research is Kalimantan motif. Batik has been created with manual batik process and documented using a camera which then redrawn using CorelDraw X8 software. Redrawing process of batik motif is carried out to improve the quality of the line on the motif so that the process of creating G-Code is easier to do. Figure 1 shows the redrawing process of batik motif using CorelDraw with a vector format for the *klowong* process. The process began with importing photo jpg into media images of CorelDraw. The image was created using Bezier tool that is used to manually follow each curved line on the batik motif.

B. G-Code Generator

G-Code is made as input parameters of the movement of Mach3 CNC software. The G-Code on this research was created using Inkscape software that had ability to translate vector images into G-Code. The generating of G-Code on Inkscape is done using Gcodetools in Extensions menu. The function of the Path to Gcode to form the G-Code appropriate path or line that has formed batik motif is shown in Figure 2.

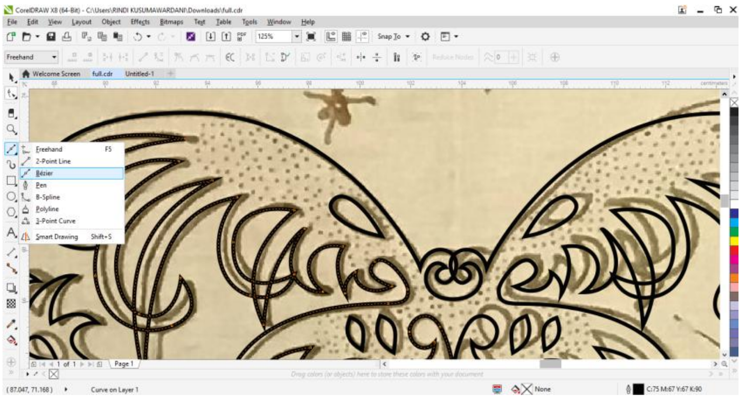


Fig 1. Redrawing process with Bezier tools

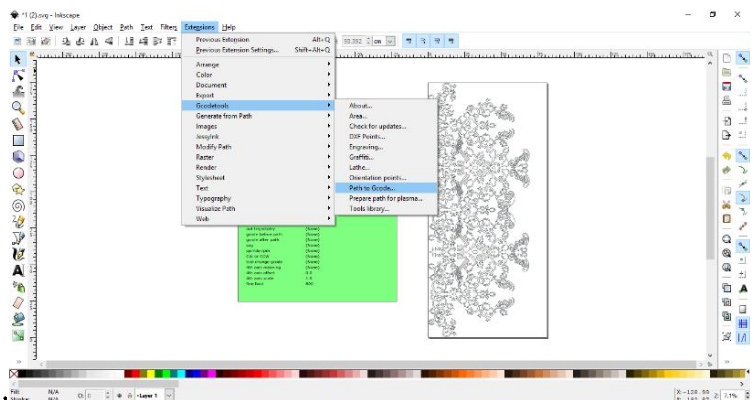


Fig. 2. Inkscape parameter setting

C. Batik Production

The production processes of hand-drawn batik on CNC machine was done at the Production Processes and Systems Laboratory, Department of Mechanical and Industrial Engineering, University Gadjah Mada. The machine is controlled by a computer using Artsoft Mach3 software. Each servo motor of X, Y, and Z-axis are connected by a driver to convert each command from the computer to respective motor movement. On Mach3 interface, there are more panels that can be used for controlling of motor. Figure 3 shows the interface of Mach3 software, with canting position demonstrated by the panel that shows the 3-dimensional coordinates of X, Y, and Z. CNC machine then runs the G-Code program that follows manual batik process of *klowong*. The batik machine used in the experiment is shown in Figure 4.

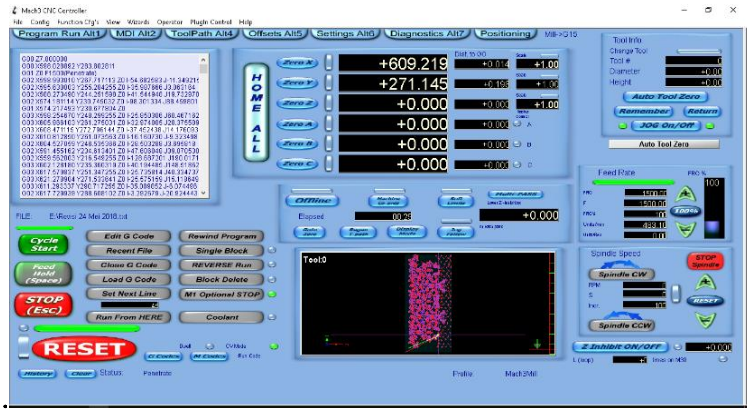


Fig. 3. Mach3 interface

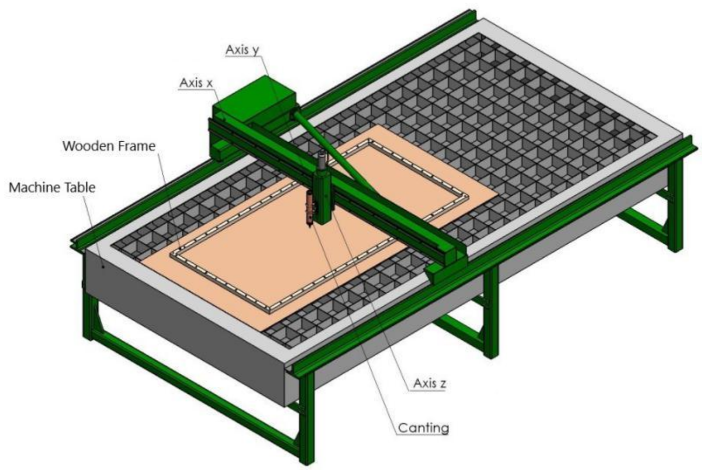


Fig. 4. Batik machine

RESULTS AND DISCUSSION

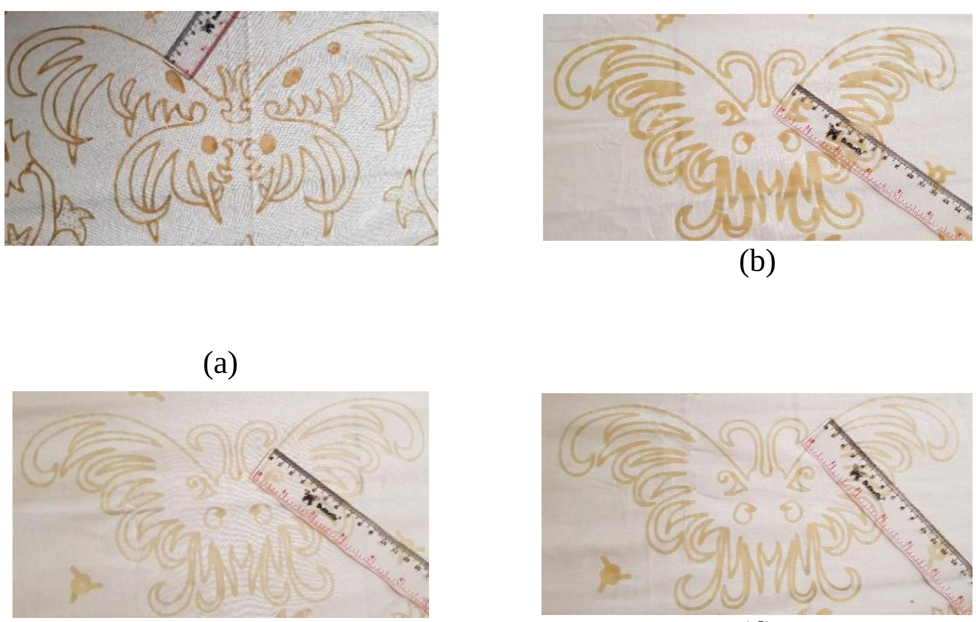
A. Results of Batik Machine

The batik production using CNC machines is done with 3 times experiment, using different feedrate to get the best feedrate on *klowong* process; because in this research only uses canting with single nozzle size, while in manual batik process may use different canting size. The feedrate is selected based on preliminary study by varying the feedrate on a small part of motif to get the similar line size with manual product. The processing time results from Experiment 1 is 97 minutes, Experiment 2 is 89 minutes, and Experiment 3 is 72 minutes. The result is compared with manual batik process. For *klowong*, the line size that is similar to those manual batik is on the Experiment 3 with feedrate 1500 mm/min, processing time 72 minutes, and line width 2.5 mm. Table 1 shows the results of *klowong* process in different feedrates.

Table 1. ***Klowong*** **process in different feedrates (Kusumawardani, 2018)**

Experiment	**Feedrate (mm/min)**	**Processing Time (minute)**	**Line Width (mm)**
1	1000	97	3
2	1200	89	2.5
3	1500	72	2.5

Table 1 shows that using higher feedrate, the time required to complete *klowong* process is shorter. The resulting line width on feedrate 1000 mm/min is a 3 mm, while a smaller line width i.e. 2.5 mm is obtained at higher feedrate. The comparison of *klowong* between manual batik process and CNC machines from each experiment is shown in Figure 5. Figure 5(a) shows result of *klowong* in manual batik process with 2.5 mm line size. Figure 5(b) shows result of batik machine with feedrate 1000 mm/min that produces line width 3 mm, whereas in Figure 5(c) with feedrate 1200 mm/min that produces a line width 2.5 mm, and in Figure 5(d) with feedrate 1500 mm/min that produces line width 2.5 mm. More results in fabric size of 200 x 115 cm^2 are available in Appendix; include *nglowongi*, *nemboki*, *nyeceki*, and *nglatari* processes.



(a) (b) (c) (d)

Fig. 5. ***Klowong*** **result (a) manual, (b)** ***feedrate*** **1000 mm/min, (c)** ***feedrate*** **1200 mm/min, (d)** ***feedrate*** **1500 mm/min**

B. Comparison Between Manual and CNC Machine

Batik processing time is calculated from the initial process using canting with fabric size 200×115 cm^2 and using the same motif. Table 2 shows the overall processing time comparison table between the manual and CNC machine. Processing time by expert craftsmen to work on *klowong* is 170 minutes, at the best among 3 craftsmen. While using CNC machine, the processing time to made *klowong* motif is 72 minutes, at the best from the experiment. So, in one day at working hour of 8 hours, the batik machine could produce approximately 6-7 pieces for *klowong* for a motif used in this study, and with a process that runs automatically, i.e. the operator only works for the setting and loading at the beginning and unloading at the end of process, so that the operator could work on other processes. Figure 6 shows a graph from Table 2.

Table 2. Comparison of *klowong* processing time (Kusumawardani, 2018)

Experiment	Time (minute)	
	Manual	Batik Machine
1	181	97
2	173	89
3	170	72
Minimum	**170**	**72**
Average	**174.66**	**86**

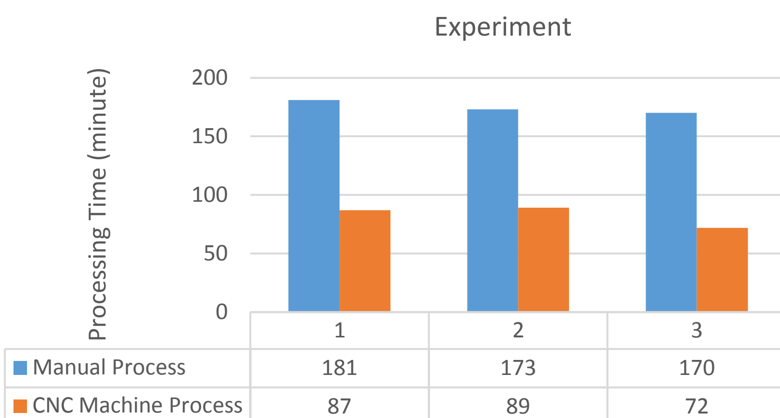


Fig. 6. Comparison of *klowong* processing time

Figure 5 shows comparison of production time of *klowong* between manual batik process and batik machine. Because of the percentage of *klowong* processing time that may account up to 75% of the total batik production time, so the difference of *klowong* production time is very significant. Craftsmen hand movement, tiredness, idle time, etc. may affect the production time of manual batik process.

CONCLUSION

The experiment results prove that the batik drawing design must be taken into account and then adjusted by the feedrate. Higher feedrate tends to reduce processing time, however feedrate also has affects on product quality. The experiment results of klowong processing time for manual batik is 170 minutes and processing time using batik machine is 72 minutes for a chosen motif. The results show proccesing time has been reduced by 57.65% using batik machine.

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APPENDIX

Manual Hand-Drawn Batik

Machine Batik (Before Coloring)

Machine Batik (After Coloring)