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AUTOMATING *BATIK* COLOURING PROCESS : A PROPOSAL

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RINGKASAN: *Walaupun terdapat kemajuan teknologi dalam pelbagai bidang penghasilan tekstil di seluruh dunia, industri Batik di Malaysia masih lagi banyak menggunakan tenaga buruh yang intensif. Proses otomasi yang diperkenalkan dalam pembuatan Batik adalah satu langkah penting untuk mengurangkan kelemahan industri ini. Walau bagaimanapun, masih terdapat proses-proses yang perlu di perbaiki. Dalam artikel ini, satu sistem otomasi untuk proses mewarna batik dibentangkan. Perkakasan dan isian sistem juga di paparkan. Objektif utama artikel ini adalah untuk memberi gambaran mengenai sistem dan membincangkan bagaimana sistem itu boleh dibangunkan.*

ABSTRACT: Despite the technological advances in many areas of textile production world wide, the *Batik* industry in Malaysia is still predominantly labour intensive. The recent introduction of automation in one of the *Batik* processes is an important step toward overcoming the many shortcomings of the industry. However, there are still many processes that need to be upgraded. In this paper, an attempt to develop a system for automating the *Batik* colouring process is presented. Possible hardware and software of the system are outlined. The main objective of the paper is to offer an overall view of the system and to initiate a discussion about how such a system may be developed.

KEY WORDS: *Batik*, colouring, machine, software, controller.

INTRODUCTION

The renowned scholar of Indian and Indonesian textiles, Alfred Buhler (Arney, 1987), defined *Batik* as 'resist dyeing by covering a fabric with paste or liquid material like mud, gum, or wax, which when becomes hard, serves as a screen that resists the dye'. A similar definition is given by the Oxford Dictionary of Current English (Thompson, 1993); it states *Batik* as 'method of dyeing textiles by applying wax to parts to be left uncovered'. In Malaysia, *Batik* is well known amongst the populace. The production of *Batik* is largely traditional. It is mostly carried out by artisans and it is quite labour intensive.

Generally, there are two main types of *Batik*, i.e., *lukis* (also known as *tulis*) and *terap* (also known as *cap*) which differ in both process and technique. This paper focuses on *Batik Lukis*. In this technique, a small tool known as *tjanting* tool is used by artisans to outline *Batik* patterns on cloth with melted mixture of paraffin wax and resin. The *tjanting* tool is essentially a small metal bowl with a spout, on the end of a wooden stick.

Batik lukis involves various processes such as design, tjanting, colouring, internal drying, fixation, dewaxing and external drying. These stages are illustrated in Figure 1.

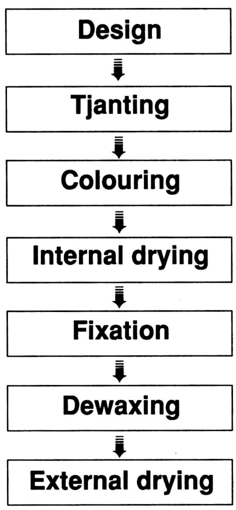

Figure 1: *The Batik Lukis Production Process*

At the design stage, a designer draws out the *Batik* pattern on paper. Various changes are made until a final version is given to the tjanting artist to work on the next process. The tjanting artist will carry out tjanting on a fabric using the design on paper as a guide. Then, the tjanted fabric is selectively coloured with water-based dyes (usually reactive type and not pigment type). The dyes are applied with brushes by touching the fabric and this allows it to absorb and spread the dye. Even though different colours are applied on the specific areas separated by wax, there are instances where they can also be allowed to meet and mix within a given area to produce shades of smooth transition from one colour to another. The next stage is the internal drying, where the coloured fabric is left on the wooden frame to be dried. The dye is then securely embedded by soaking the dried fabric in a sodium silicate solution. The fabric is soaked for about 8 hours before it is ready for the next process. In the dewaxing process, the resist material is removed by boiling the fabric in water for a certain period, usually about 5 minutes. The dewaxed fabric is then dried in open space; this then completes the production of the *Batik* fabric.

PREVIOUS WORK

The traditional operation has many shortcomings such as low quality due to line inconsistency, low productivity and difficulty in finding suitably skilled workers due to the industrial boom in other sectors in Malaysia. In view of this, SIRIM Berhad in Malaysia embarked on a project and produced in 1995 a prototype Tjanting system known as Integrated Computer Aided Tjanting System (ICATS) to address the above mentioned shortcomings (SIRIM, 1995).

Some previous work in computer graphics has relevance to the dyeing process. Haase and Mayer (1992) have proposed a model for mixing pigments to generate colours for painting objects in synthesised images. Bartz (1995) has presented a process modelling approach as a viable method of creating two-dimensional imagery with computer graphics. Dai *et al* (1995) have devised a new and effective procedural texture generation method for fractal generation. However, these discussions are limited to graphics generation in the computer.

According to Cook (1995), screen printing technologies dominate the fabric printing production world-wide at present with about 60% conducted with rotary screens and another 18% by flat bed screens. He also points out that there are a number of colour printing technologies capable of producing colour hard copy from electronic sources - electrophotographic inkjet (bubble jet printer) or a thermal transfer printer. These give high quality, continuous tone prints, but the hardcopy is normally on paper. The two commercial textile adaptations of a type of ink-jet technology are the Miliken Co.'s Militron system and the Chromojet system from Zimmer of Austria for carpet printing. In February 1993, Kanebo of Japan, a large Japanese paper-copier giant, formed a consortium to develop and market the first commercial jet printing machine based on Canon's bubble-jet technology for continuous patterning of textiles. The author contends that little is known about this since then.

Provost (1995) highlights recent research focused on the area of fine-resolution, ink-jet printers. These printers can produce up to 300 lines per inch using either drop-on demand (DOD) or continuous stream (CS) technologies for printing textiles. The Stork Trucolor jet printer introduced at ITMA in 1991 is based on the CS technology. The machine uses high purity reactive dyes which allow the resulting print to be processed in the same manner as a conventional screen or roller print. Scatizzi (1993) introduces a device for continuously printing polychromatic designs on fabric.

Rys and Sperb (1989) give a short summary of the three main dyeing processes used for applying reactive dyes for cellulosic fibres, i.e., batchwise, semi-continuous, and continuous. A brief description of the Sclavos Appolon Twin Soft Flow jet dyeing machine is given in Textile Month (1994). Warren and Reddy (1994) discuss the real-time system that was developed for monitoring and control of batch dyeing processes.

However, reported work to date has yet to single out any specific systems or machines which are able to carry out the unique colouring process in the *Batik lukis* production. The present authors are searching for an approach to automate the colouring process. The following sections propose a possible solution to the colouring process which is presently the subject of continuing research.

STAGES IN SYSTEM DEVELOPMENT

The development of an automated colouring system can be divided into the following stages :

- researching into the behaviour of reactive dyes on different types of fabrics used in *Batik* production.
- deriving a reliable model for reactive dye recipes for various types of fabrics on a computer.
- implementing the above into an interactive user-friendly software.
- designing and acquiring the required hardware system.
- integrating the hardware and software systems into a demonstrator system which then can be developed further into real world application system.

During any system proposal, system requirements must be first established before proceeding to design and implementation stages. The outcome of an integrated approach is the design and selection of the hardware and software subsystems or modules including their hierarchical dependencies, their refinements to smaller components and their interfaces among each other and their environment. It must be emphasised that the original description of both the requirement analysis and the system design are usually incomplete, and will expand during the development process. They will change during the complete system lifetime, and they are incomplete in many details. Therefore, the proposal presented here is not an exhaustive one and is expected to undergo changes.

It is envisaged that the *Batik* Colouring System will comprise of three major sub-systems similar to ICATS (SIRIM, 1995). They are likely to be Colouring Machine, Colouring Software and Controller System.

COLOURING MACHINE

The Colouring Machine will consist mainly of a computer, x-y motion system, applicator and dye-stuff drums as shown in Figure 2. The computer contains the colouring and control software and has additional input devices such as a tablet and cordless electronic pen. It is linked to the control hardware sub-system which in turn is connected to the x-y motion system.

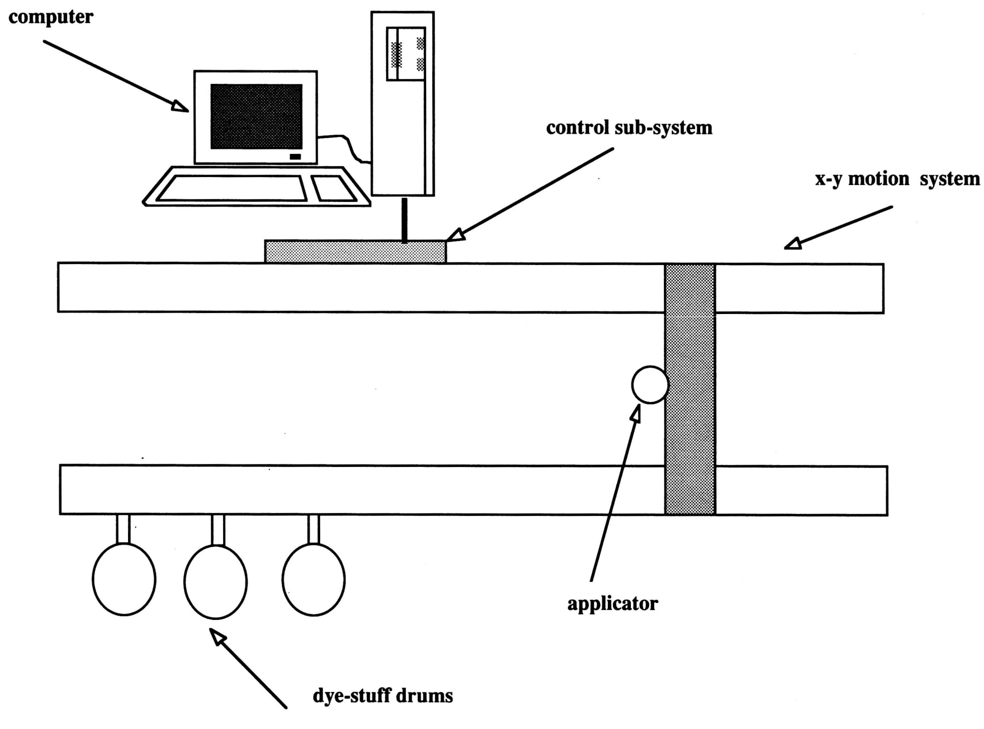

Fig. 2: *Schematic Of The Batik Colouring System*

The x-y motion system is to provide the continuous movement in the x and y direction to effect a free path motion. In this configuration, the movement along x-y axes effects the travel of the applicator within the entire travel area, with the fabric being stationery underneath the applicator. Each of the three drums stores different liquid dyes, and they are connected to separate jets in the applicator via three separate flexible plastic tubes. The applicator draws predetermined amounts of red, yellow and blue liquid dyes from the corresponding drums by means of pumps and transmits the dyes to the appropriate jet. The jets, which comprise of a electro-valves, are able to inject the appropriate amount of dye onto the fabric according to the signal provided by the control unit.

COLOURING SOFTWARE

The proposed Colouring Software will not only constitute of 2D-Profile Editor but a Colour Editor will also be incorporated as shown in Figure 3. The 2D-Profile Editor would be vector based software which contains features that are quite standard in commercial graphics or CAD packages such as design, edit and view functions. It will be primarily used for generating 2D free form graphics design. An interactive editing facility will be provided in the Colouring Editor that supports key functions such as storage/retrieval, colour selection and parameter selection. The Colouring Editor would also allow the user to specify various parameters and constraints used in calculating a colour match that is required to be deposited.

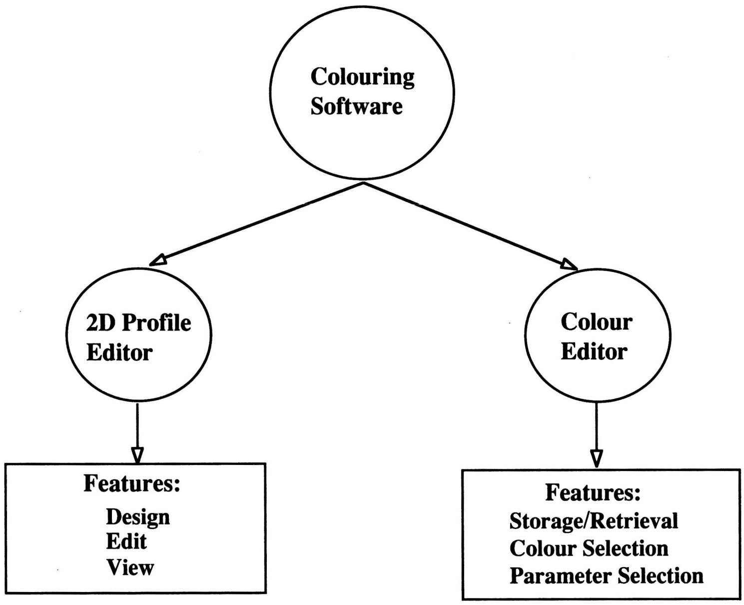

Fig. 3: *Structure Of The Colouring Software*

The problem of constructing a flexible environment for implementing a colour model of real-time system is, clearly, very complex. Thus, choosing an appropriate methodology is important in achieving the desired goal. For this, an Object-Oriented Programming approach is proposed. The advantages of Object-Oriented Programming (OOP) are well known; i.e., when many program modules contain only minor differences, objects allow a very easy code reuse and tailoring. Among OOP languages, C++ presents some features that make it particularly suited for the proposed work, due mostly to its direct derivation from C, and it permits better type checking and modular programming with abstract data types (Winder, 1993).

CONTROL SYSTEM

The control system will constitute of hardware and software subsystems.

Hardware

The use of single or multiple processors offers great possibilities for design of control schemes. Many possible trade-offs between performance goals, computational time, and hardware/ software cost and complexity are possible. The assessment criteria given in Table 1 can be used as a guide for selecting the type of processing system that is required (Anderson, 1992).

Table 1: Selection Criteria For The Processing System

System Requirements	*System Level Attributes*	*Microprocessor Attributes*
Performance	Modular construction	Numeric handling
Cost	Interconnection	Code compatibility
Flexibility	Task allocation	Existing software
Expandability		Development environment
Programmability		Application support
Reliability		

Based on the above information and the need to control xy motion, carry out on-line processing and evaluation of measurement values, some possible considerations include VME, DSP or Transputer family processors and its associated interfaces.

Software

The software subsystem should be able to perform the following tasks:

- ensuring correct data transfer between devices;
- making sure faults and emergencies are handled adequately and that the process performance remains within specified limits;
- updating operator displays and responding to manual inputs;
- logging data reports for inspection.

By proper design, we expect to be able to take advantage of the various off-the-shelf components of the hardware and software subsystems for the control system.

OPERATION

The operation of the colouring system will be as follows:

Since the colouring process is performed after the tjanting process using ICATS, it is only logical that the position of the fabric during the tjanting process is taken into consideration for the colouring process. At the beginning, the tjanted fabric will be fitted onto the fabric frame according to the earlier tjanting home position. Then, the system will be powered on. Meanwhile, the operator will use the Colouring Editor to select the required parameters such as colour and the amount that need to be deposited for the earlier tjanting design that was created using the 2D Profile Editor. Once this has been completed, it will be saved onto a file and the Control Software will then be invoked. The Control software will process the file and activate the machine. Thus, the dyes will be drawn from respective drums and injected onto the fabric via the jets according to the trajectory of the x-y motion system which will be controlled by the signal provided by the Control Software.

CONCLUSION

In this paper, we have presented a proposal as a probable solution in automating the *Batik* Colouring Process. During the future phases of research into the means of implementing this proposal, by designing and using off-the-shelf components and building the interfaces between components, we expect to be able to demonstrate the applicability of this type of system. The realisation of the proposal depends on many factors but it is hoped that continued research in this area will result in a viable system in the near future.

It can be noted that the discussions do not give any specific details for the particular sub-systems. It is anticipated that, as the research progresses, more detailed discussion on the respective areas will be published.

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