Design of Doyo Leaf Softener Machine

Dwi Cahyadi, Ratna Wulaningrum, Imam Rojiki, Suparno Suparno, Ferry Bayu Setiawan

Politeknik Negeri Samarinda,
Samarinda, Indonesia

dwicahyadi@polnes.ac.id

Abstract. Handicraft products are made from materials and tools that are around the craftsmen. One of the handicraft products in Indonesia is *Doyo* weaving. The current increase in sales of *Doyo* weaving makes it difficult for craftsmen to meet market needs. This is because the process of making *Doyo* weaving is done manually by hand so it takes quite a long time. The softening and spinning process in making *Doyo* woven thread takes the longest of all the woven fabric production processes. The aim of this research is to create a machine to speed up the production process of making *Doyo* weaving in the process of softening dry *Doyo* leaf fibers. This research contributes to the effectiveness and efficiency of the softening process of *Doyo* leaf fibers so that they are easily twisted into yarn. So that *Doyo* weaving craftsmen can carry out the production process faster than before. The result of designing the machine using the Vinod Goel method is that the target market for this machine is *Doyo* weaving craftsmen, aged 17-50 years, male and female. The machine configuration has a power button, emergency button, transparent mica, a *Doyo* fiber entry point at the top and a *Doyo* fiber exit point at the bottom. This machine is designed in a box shape and has a transparent cover so that workers can see how the machine is working. The materials widely used to make this machine are iron pipes and plates, while the machine colors are natural colors, namely green and white.

Keywords: design, doyo, softener machine.

1. INTRODUCTION

Handicraft products are the work of craftsmen to make products that can function and be used for daily needs. Handicrafts highlight cultural and artistic elements in their products which are expressed in motifs, colors and shapes.

Handicraft products are made from materials and tools that are around the craftsmen. Handicraft products continue to be developed today without abandoning the aesthetic and cultural elements in them. The use of materials from natural materials is also emphasized in these handicraft products as their trademark.

One of the handicraft products using natural materials is woven cloth. One of the woven fabrics in Indonesia is *Doyo* weaving. *Doyo* weaving is woven made from the leaves of the *Doyo* plant (*Curliglia Latifolia*) which grows in the Kalimantan region,

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Indonesia, made by the *Dayak* tribe. This *Doyo* weaving can be used as a fashion product and handicraft [1-3].

The increase in buyers of *Doyo* weaving has made *Doyo* weaving craftsmen experience problems in meeting the many market needs. This is because the process of making *Doyo* weaving is done manually by hand so it takes quite a long time.

The softening and spinning process in making *Doyo* woven thread takes the longest of all the woven fabric production processes. To make *Doyo* leaf fiber into just one roll of thread takes 3 days. All of these processes are still done manually by *Doyo* weaving craftsmen.

The problem in this research is how to make the process of making *Doyo* weaving productive than before. One of the things that will be done is to speed up the softening process of the *Doyo* leaf fiber before twisting it into thread.

For this reason, the aim of this research is to create a tool to speed up the production process of making *Doyo* weaving in the process of softening dry *Doyo* leaf fibers. This research contributes to the effectiveness and efficiency of the softening process of *Doyo* leaf fibers so that they are easily twisted into yarn. So that *Doyo* weaving craftsmen can carry out the production process faster than before.

2. LITERATURE REVIEW

Doyo weaving comes from the leaf fibers of the *Doyo* plant which has the Latin name (*Curliglia Latifolia*), which is a type of *Pandan* plant whose fibers are strong and grows wild in the interior of Kalimantan as the main material for *Doyo* weaving.

The process of making *Doyo* weaving has several stages. Figure 1 is an illustration of the general process of making *Doyo* weaving. This process begins with taking the *Doyo* leaves, then washing the leaves and taking the fiber by rinsing while combing it with water.

Fig 1. Illustration of the general process of making *Doyo* weaving.

Furthermore, the leaves are then dried in the sun to dry. After the *Doyo* leaf fiber has dried, the process of softening and spinning the dry *Doyo* leaf fiber into yarn is carried out. This softening and spinning process takes the longest of all processes, to become a skein of yarn takes 2 to 3 days [4,5]. All of these processes are still done manually by *Doyo* weaving craftsmen [6].

The machine created in this research is a *Doyo* leaf fiber softening machine with softening rollers using an integrated manual and automatic system equipped with a spacer.

Good product design and development must pay attention to the safety and comfort of its users. To provide a feeling of safety and comfort, the product designed must be in accordance with the ergonomics and anthropometry of the user. Anthropometric data are measurements of the human body that are used in ergonomics to determine physical dimensions [7-11].

The working principle of the *Doyo* leaf fiber softening process is almost similar to patent No. S00202108003 which relates to a machine used to form square iron pipes to produce curved shapes, and patent no. P00201506117 a basic dyeing machine for batik cloth for dyeing cloth in which there are two rolls rotating simultaneously, located above and one below in the container coloring. The difference is that this *Doyo* leaf fiber softener requires two rolls that are parallel and have a certain density to suppress and soften the dry *Doyo* leaf fibers [12-13].

The purpose of making this *Doyo* leaf fiber softener machine is to facilitate the process of making the woven yarn. Machines for making thread from plants such as hemp, and sisal can be done using mechanical processes. Therefore, it becomes important to explore all spinning technologies for low cost yarn production. In the process of making a single yarn, it can be assisted by coating several materials to improve some of the properties of threads and fabrics such as fur, strength, elongation, evenness and resistance to abrasion [14-16].

The design of the machine is part of product development through the design process. The product design development process includes steps from planning which consists of introduction to finding a problem, objectives and research contributions which are then used as a basis for analysis to find solutions. One of the product design methodologies used in product design is the design methodology developed by Vinod Goel.

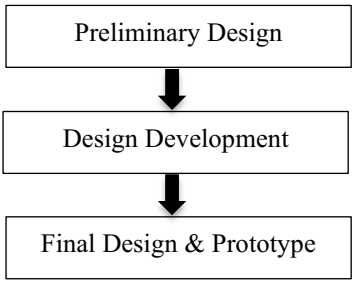

Fig 2. Design methodology developed by Vinod Goel.

This method consists of three main stages, namely preliminary design, design development, and final design & prototype (Figure 2). Preliminary design contains problem formulation, objectives, data collection and literature data analysis. Design development is the start of the process of creating machine product designs according to needs. Final design and prototype is the final result of machine development activities which can be a product prototype [17-19].

3. RESEARCH METHOD

This research uses the product design design and development method developed by Vinod Goel. In this method generally there are three main stages. These stages are initial design, design development, and final design and prototype. Some of the analyzes in this method include market analysis, configuration analysis, ergonomic and anthropometric analysis, system analysis, material analysis, and color analysis. The final stage of this method is the prototype of the *Doyo* leaf fiber softener machine [20].

4. FINDING RESULTS

The analysis and discussion carried out in designing this *Doyo* leaf fiber softening machine product are :

Market Analysis
Market analysis is determining groups of buyers based on several criteria including their needs, characteristics and behavior. Market analysis is needed to find out the target market for buyers of this *Doyo* leaf fiber softener machine. Users of this machine are *Doyo* weaving craftsmen in the province of East Kalimantan, Indonesia, with male and female workers aged between 17-50 years.

Configuration analysis
Configuration is used to determine what attributes are needed and the placement of these attributes on the machine. In designing this machine, the required attributes are a power button to turn the machine off and on, an emergency button to stop the machine suddenly if an error or problem occurs with the machine during production. Place the entry hole for the *Doyo* leaf fiber material above, and the hole where the *Doyo* leaf fiber exits after processing (Figure 3 and Figure 4).

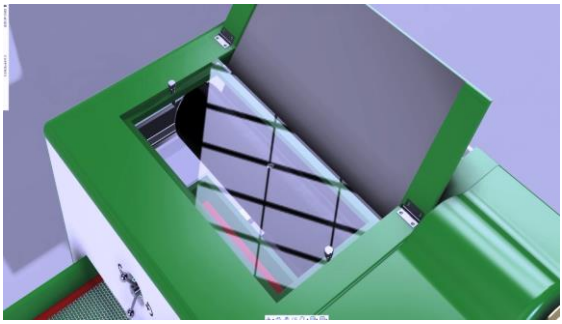

Fig 3. The entrance to the doyo leaf fiber.

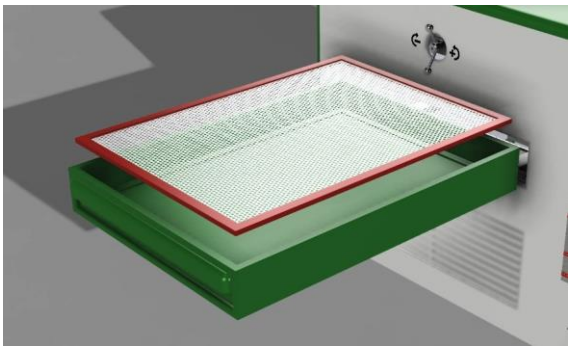

Fig 4. Storage for the final product of doyo leaf fiber

Ergonomic and anthropometric analysis

Ergonomic analysis will discuss safety, and user comfort when using the machine. Machine ergonomics will emphasize machine design by avoiding sharp corners on the machine surface, using materials that are not harmful to the user's health. Apart from that, it is also important to pay attention to user comfort by making machines that are easy to operate.

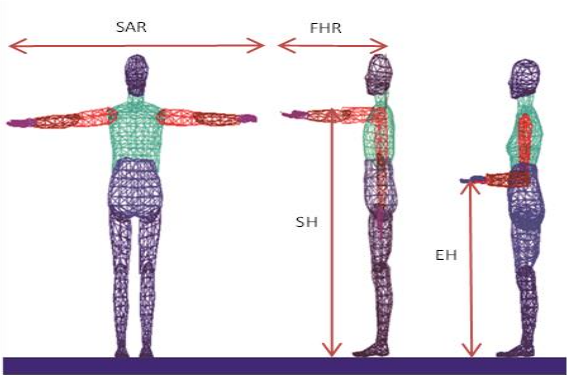

Fig 5. The anthropometric data

Anthropometric analysis will discuss the size of the machine that provides user comfort. Anthropometrics is analysis using data in anthropometric tables based on age, gender, ethnicity, type of work and percentile. In designing this machine, the anthropometric data used is shoulder height (SH), forward arm reach (FHR), side arm span (SAR), and elbow height (EH). Figure 5 is the anthropometric data that will be used in this research. From the results of anthropometric analysis, it was found that the height of the ergonomic *Doyo* leaf fiber softening machine is 100 cm, with a width of 100 cm and a machine height of 70 cm. This machine is designed in a box shape and has a transparent cover so that workers can see the machine working.

Systems analysis
System analysis in the design of the *Doyo* leaf fiber softener machine is to determine a unity of interconnected parts that are in the product of the machine (Figure 6).

Fig 6. Design system analysis

System analysis is carried out to find out and explain what systems are needed in the product design of the *Doyo* leaf fiber softener machine so that it can work properly. The use of the existing engine drive system in the product is adjusted to the calculation of the drive engine on the gears and pulleys connected to the drive motor.
The connection system on the machine frame uses a welding connection. The connection system on the engine cover uses a screw connection system so that the cover is easy to open and close again to see and check if there is a problem with the engine

Material analysis
Material analysis is used to select and determine the material of the *Doyo* leaf fiber softener machine. The main material of this machine is plate iron and iron pipe as the engine frame and engine protector. For the material driving machine, it is according to the needs of the *Doyo* fiber softening process such as iron rolls, gear boxes, pulleys and so on. Transparent mica is used as an upper protective material as well as to observe the machine production process by looking from above without worrying about particles flying into the eyes or being inhaled through the nose from the softening of *Doyo* leaf fibers. These materials are combined in stages so that they become machine prototype products.

Color Analysis
Color analysis is carried out to select a color according to the needs and functions of the machine product. The color used will be displayed on the engine protection plate and its frame. In color analysis, a search for combinations of several colors that will be displayed on the product is also carried out. The colors displayed are adapted to a minimalist design style, with only a few colors. The selected colors are green and white. This color is associated as a natural color because this machine is used for the process of making weaving from natural materials, namely *Doyo* leaf fiber.

After carrying out several analyses, the next step is designing the machine design by producing several alternative designs and drawings. After that, the results of the selected machine designs were selected and developed. The results of this research are prototypes which can be seen in the figure 7.

Fig 7. Color analysis on the machine

5. CONCLUSIONS

The result of designing the machine using the Vinod Goel method is that the target market for this machine is *Doyo* weaving craftsmen, aged 17-50 years, male and female. The machine configuration has a power button, emergency button, transparent mica, a *Doyo* fiber entry point at the top and a *Doyo* fiber exit point at the bottom.
the height of the ergonomic *Doyo* leaf fiber softening machine is 100 cm, with a width of 100 cm and a machine height of 70 cm. This machine is designed in a box shape and has a transparent cover so that workers can see how the machine is working. Materials that are widely used are iron pipes and plate pipes. The color chosen is natural color.
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