Abstract: In the process of dying a yarn, there are various steps being followed in which few processes are still being done with the help of human hands and need to be automated. One such process is shielding of the stainless-steel bobbin with a nano paper and winding it with thread. This shielding is for filtering the dye during the boiling of the yarn in die-boiler process. Hence, this is the problem to which a solution has been framed by using appropriate mechanism. In this process, the sewing machine mechanism is also used to increase the stiffness on the nano paper. The counter will help the operator to predefine the number of bobbin to be wined. This provides the data to the organization about the production rate and capacity to do parallel. In the process of shielding, adhesives are not being used which paves a way for contamination of the dye during boiling process. Water as an alternative adhesive which sticks to the paper and to the thread as well this does not contaminate the dye.

KEYWORDS: Automation, Textile process, Machine design

1. INTRODUCTION
The Automation in textile industry is rapidly and consistently growing. Dress is one of the basic needs of all human offer to have the dresses that we wear must hold uniform colors. The depth of the color must be monitored properly for distribution of colors. To reach the rising demand of the cloths the industry must increase the working shifts hence they could achieve the target. Based on the output of particular sensing devise the processor process the data and the information is being sent to the desired field devices to perform a task that is performed manually before. Dyeing in textiles is a process in which color is transferred to a finished textile or textile material (like fibers and yarns) to add permanent and long-lasting color. It can be done by hand or by machine. The process uses stainless-steel bobbin, as shown in figure 1.1, for efficiently transferring die on the yarn.

Figure 1.1 yarn wined stainless-steel bobbin

Around which a shielding is provided for filtering of the dye as well as to increase the grip of yarn over the bobbin. The shielding is done in two ways either by using a Socks or by using a nano paper. In which the usage of nano paper is much more cost efficient and used widely among the dyeing units. A manual unit is employed for the process of winding of the stainless-steel bobbin with nano paper, where they produce around 800 units, but for the growing need of the industry this units are not sufficient hence an automated system is developed to overcome this rising need.

2 REVIEW OF EXISTING SYSTEM
A Typical textile yarn winding practice, yarn is delivered from a spinning, drawing or other zone at a preselected speed to a take-up bobbin operatively driven by conventional means at a constantly variable rate of speed but maintaining a constant peripheral rate of speed for collecting the yarn at a constant rate of speed [4], the efficiency of printing or coating processes for paper products the velocity of the web and the roller width can be increased. However, these measures bring about deformations of the rollers, heating effects and streak print defects due to undesirable oscillations. The sensors are applied underneath the elastomeric covering of the rollers and must be applied without affecting mechanical features or causing a falloff in the quality of the product. The sensors are integrated into a test rig simulating the rollers of a printing or coating machine [3]. A printing device having an auto sheet feeder comprising one or more rollers to engage and feed paper sheets into the printer device and a substrate feed opening for a substrate having a thickness different than the paper sheets and for directing the substrate directly into and through the printer, the substrate feed opening being disposed in a generally horizontal position and being configured to permit the substrate to bypass the auto sheet feeder [2].

3 PROBLEM DEFINITION
3.1 Existing System
A manual operation is being carried out to shield with nano paper on stainless-steel bobbin, a stainless less bobbin is a type of a bobbin made of spring wounded with metal wire as shown in figure 3.1.
Figure 3.1 Stainless-steel bobbin

That is used in the process of dying on which the nano paper is winded and thread is being rolled to hold the paper rigidly this process is done for filtering of the dye and providing an additional grip for the yarn as shown in figure 3.2

Figure 3.2 Shielded bobbins

The bobbin is shielded with the help of nano paper of dimensions 15cm x 25cm of width and length respectively. This process of shielding is done by manual labor and production rate in this manual process is around 800 units per shift. It costs around INR.400 for per head for the process of shielding. After which bobbin is winded with yarn as shown in figure 1.1 with machine followed by dyeing the yarn.

3.2 Draw backs
- Time consumption for shielding per bobbin is toil
- It increases the manual work
- The idle down time of the yarning machine is too long to meet the demand

4 WORKING PRINCIPLE

Once the bobbin is placed in the desired position between the two rollers the bobbin is being sensed by the proximity sensor that enables a virtual signal for the system activation this signal is sent to the controller here Microcontroller, that act as the brain of the system. The electrical connection is being carried out based on the circuit diagram shown in figure 9.1. It sends a signal to the relay that switches the power supply to the higher voltage rate that ignites the motor. Since the motor shaft is directly coupled to the pulley later to the rollers and hence the rollers start to run which helps the bobbin to rotate. On the other hand, microcontroller sends a signal to actuate to pick up the next paper to roller and successive rollers through which the paper is directly fed to the adjacent of bobbin. Once the paper is fed the rotating bobbin pulls the paper under the rollers and turns the paper with the help of rotating mechanism. The turning mechanism is to turn the paper around the bobbin while bobbin rotates. Once after the paper rotates the next section comes into action, in the next section water is been pumped in a required direction so that the paper and water interacts which leads to the sticking of paper over the bobbin, simultaneously the thread is been fed from the threading mechanism that is been located in the vertically upward direction on the edge of the linear actuator.

Figure 4.1 Block diagram the process

After the thread is vertically dropped, the thread comes into action with the water and the thread sticks due to the stiffness. Due to the rotation of bobbin the thread directly winds the bobbin and the pumping system is been switched off with the timed signal from the controller. Now a linear actuator is being actuated with constant lower speed of the bobbin hence enabling the thread winding around the bobbin. The simplified flow of the process is shown in the figure 4.1

4.1 Advantages
- It helps in achieving the demand of the yarn process
- The output of the machine is at higher rate than the manual process
- It can be adapted for the mass production

5 FEASIBILITY STUDY

5.1 Economic Feasibility

The cost of the production of the machine in parallel with the cost is being achieved during the manual process is reduced and hence the machine has a payback period of once after a year. The various component that is used in the project are of lower cost hence the overall cost of the product is been reduced.

5.2 Operation Feasibility

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6 DESIGN CALCULATION

6.1 Electrical Design

6.1.1 Motor Power Calculation
Power of the motor can be calculated as,
\[ P = I^2 R \]
\[ P = \text{power} \]
\[ I = \text{current} = -0.5A \]
\[ R = \text{coil resistance} = -100 \text{ KΩ} \]
Therefore \( P = I^2 R \)
\[ P = (0.5)^2 \times 100 \]
\[ P = 25 \text{W} \]

DC MOTOR

The specifications of the DC motor is
\[ N = 60 \text{ rpm} \]
\[ V = 1 \text{V} \]
\[ P = 2 \text{W} \]

Torque = \( (P \times 60) / (2 \times 3.14 \times N) \)
Torque = \( (25 \times 60) / (2 \times 3.14 \times 60) \)
Torque = 3.98 N\( \cdot \)m

The shaft is made of MS and its allowable shear stress = 42 MPa
\[ \text{Torque} = 3.14 \times fs \times d^3 / 16 \]
3.98 = \( 3.14 \times 42 \times d^3 / 16 \)
d = 4.82 mm
The nearest standard size is \( d = 5 \) mm.

6.2 Mechanical Design

6.2.1 Pump Calculation:
- Water horsepower = minimum power required to run water pump
- TDH = Total Dynamic Head = Vertical distance liquid travels (in feet) + friction loss from pipe
- \( Q = \) flow rate of liquid in liters per minute
- \( SG = \) specific gravity of liquid (this equals 1 if you are pumping water)

Required water horse power = \( (TDH \times Q \times SG) / (3960) \)
\[ = (0.49 \times 0.1 \times 1) / 3960 \]
\[ = 1.23 \times 10^{-5} \text{ hp} \]

6.2.1 Roller Calculation:
Roller diameter = 5cm Bobbin diameter = 7cm
Separation distance = \( 2(\text{radius of roller}) + \text{required gap between roller} \)
\[ = (5/2) + (5/2) + 5 = 10 \text{cm} \]

As shown in the figure 7.1 the required gap is being decided
9 Electrical Circuit Diagram

![Electrical circuit diagram](image)

**Figure 9.1** Electrical circuit diagram

10 Process Description

10.1 Bobbin Rolling Section:
Once the proximity sensor senses the stainless-steel bobbin the signal is sent to the micro controller here Arduino acts as the controller.

![Bobbin rolling section](image)

**Figure 10.1** Bobbin rolling section

Later it actuates the motor coupled to the roller with the help of pulley as shown in fig 4.1, the bobbin which is placed in between the roller due to the friction on the roller rotates smoothly which helps in winding the nano paper around it.

10.2 Paper Feeding Section:
On the other hand, when the proximity senses the signal, paper Pick up roller gets actuated based on which the paper gets feed at the constant rate at which the bobbin rotates so that a synchronization is maintained due to which paper smoothly slides on the turner which is kept at the bottom of two rollers.

10.3 Water Spraying Section:
After turning of the paper water is sprayed on the paper so that paper sticks to the roller and papers rolls completely.

11 Conclusion
Automation in the industry is the key of reduction of the downtime of the production and this is project will play a vital role in implanting this practically in the industry. Thus, the low cost of automation can be achieved with the help of the proposed methodology. This increases the befit of implanting the machine compared to that of the manual labor and the timing of production of the product is now reduced making easy installation of the product.

12 References