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Development of Semi-Automatic Gauge Cloth Winding and Rolling Machine

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Abstract

In medical industry, gauze cloth plays a very important role. The job of winding the gauze cloth is very tiresome. Also the time required for the winding varies largely from worker to worker, thus making process time unpredictable. So, manufacturers are having difficulty to meet the huge demand. Conventional machines which are manufactured in India needs more labor and human attention. The aim of this work is to develop semi-automatic gauze cloth winding machine to reduce the time for the winding and wrapping of gauze cloth. The mechanical structure was modelled using Creo software. The electrical components were selected based upon the requirement and integrated with mechanical structure. A Programmable Logic Controller controls all the sequence and feedback devices allows proper tracking and provide guidance to the sequential operation. This developed machine has increased process efficiency, reduces human effort, bring uniformity in gauze cloth winding and increases the productivity. This machine also assists in controlling the length of rolling/folding action of gauze cloth in any form of input with unknown length and the machine has high demand in medical/surgical bandage manufacturing industries.

Keywords— Gauge cloth, Winding machine, Semi-Automatic machine, Medical industry.

I. INTRODUCTION

In medical industry, gauze cloth is an essential product. Gauze is a thin, translucent fabric with a loose open weave and it is called as bandage cloth commercially in the market [1-2]. In technical terms gauze is a weave structure in which the weft yarns are arranged in combination and are crossed initially and after each wrap yarn keeping the weft firmly in place. This weave structure is used to increase stability to fabric, which is necessary when using fine yarns which are loosely spaced. This weave structure can be used with any weight of yarn, and can be seen in rustic textiles made from coarse hand-spun plant fibre yarns. Some of the nonwoven fabrics are used similarly. The folded form and roll form of gauze cloth are shown in Fig 1.

Fig. 1 Surgical gauge cloth

Till now starching, bleaching, drying, winding, wrapping and cutting of gauze cloth are done manually or with conventional machines. So, manufacturers are having difficulty to meet the huge demand. Conventional machines which are manufactured in India needs more labour and human attention. This proposed machine can increase the process efficiency, decrease the human effort, bring uniformity in gauze cloth winding and increasing the productivity. This machine also assists in controlling the length of rolling/folding action of gauze cloth in any form of input with unknown length. This machine has high demand in medical/surgical bandage manufacturing industries and the approximate cost of building this machine is around 2 lakhs INR. This paper reports the development stages of semi-automatic gauge cloth winding and rolling machine.

II. ARCHITECTURE

A. *Mechanical Architecture*

Architecture focuses on the arrangement of mechanical components assembled over the structure. Fig 2 illustrates the model of the machine drawn using Creo software.

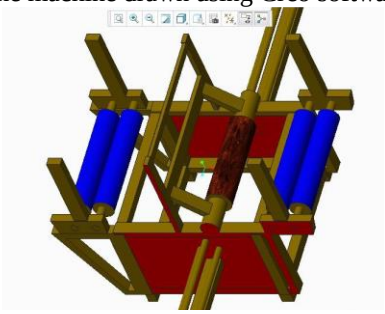

Fig. 2 Model of the machine

In the machine, two idler rollers are fixed where cloth is inserted for winding in any form. Next to idlers there will be a fixed roller where cloth is to be fixed manually before starting the sequence. There are two individual cores mounted perpendicular to the winding zone and parallel to the idler rollers which has an angular degree of freedom and this is activated by a pneumatic cylinder. Core is adjusted linearly by a pneumatic actuator. In the machine, both linear actuation and angular actuation are performed parallelly. Winding is smoothly performed by a pneumatic press. Wrap holder and wrap rollers are constructed at the end of the machine frame. Gripper roller is fabricated around all the rollers for having better cloth movement over the path. Wrapping press is constructed to ensure proper wrapping of rolled gauze cloth. End cutter is mounted across the winding section which has spring return configuration. Fig. 3 shows the arrangement of mechanical subsystems in a machine.

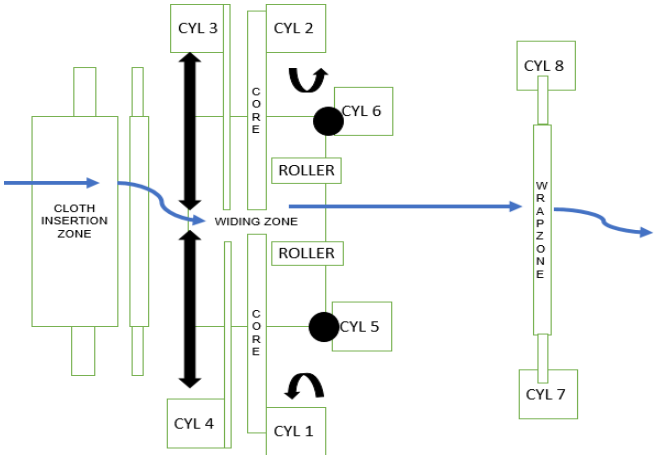

Fig. 3 Mechanical Architecture

B. *Electrical Architecture*

Electrical architecture focuses on the communication between electrical and electronic devices. The electrical architecture of the machine is illustrated in Fig 4.3. All the operation involved in winding and rolling of gauze cloth is controlled by a Programmable logic controller.

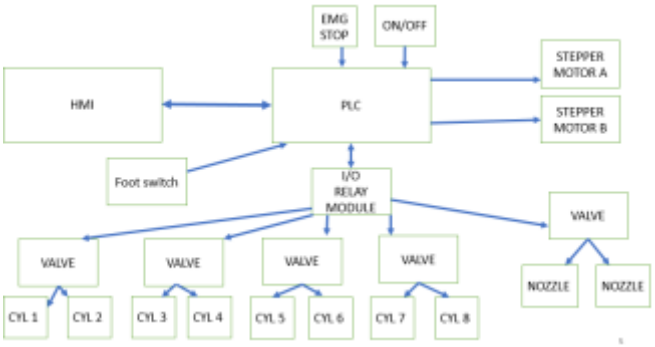

Fig. 4 Electrical Architecture

A Human Machine Interface (HMI) is configured and communication is established with the PLC. Pneumatic cylinders for core activation/deactivation, core adjustment, winding holder and wrap holder is controlled by a solenoid valve which is triggered through PLC. Air blowing is activated for 2 sec when core activation is done and this is triggered by proximity sensor to the controller as a feedback signal. PLC is connected to the output devices through a relay module which acts as an intermediate device between controller and output devices. Foot switch is interfaced with the controller to enable and disable the wrap holder. Stepper motor for winding is turned on automatically based upon feedback signal from the proximity sensor and stepper motor for wrapping is controlled manually controlled via switch.

III. OPEARTION SEQUENCE IN MACHINE

There are seven stages involved in winding and wrapping of gauze cloth which includes

1. Cloth insertion
2. Core activation
3. Blowing
4. Winding
5. Core deactivation
6. Cutting
7. Paper wrapping

A PLC controls all the sequence and feedback devices allows proper tracking and provide guidance to the sequential operation. In input stage the cloth is fed into the roller which uniforms the unevenly distributed cloth. The cloth is locked by a pneumatic press after the core insertion. Winding takes place and the core is retracted automatically after the process by a pneumatic actuator. An end cutter is used to cut the cloth when the winding motor stops as desired length is achieved. Now the rolled gauze cloth is placed in a wrapping roller section manually where the paper is introduced to wrap the gauze cloth roll which is the final stage of the process.

IV. FIELD DEVICE PLACEMENT AND LOGIC

A. *Placement of Sensor*

Inductive proximity sensor is used as feedback device for detecting the position of assistive core and pneumatic press. Placement of sensors are shown in Fig. 5 and Fig. 6.

- Inductive proximity sensor A - Winding hold position sensing
- Inductive proximity sensor B - Winding hold position sensing

- Inductive proximity sensor C - Wrap assistance holder sensing
- Inductive proximity sensor D - Wrap assistance holder sensing
- Inductive proximity sensor E – Core A final position sensing
- Inductive proximity sensor F – Core B final position sensing
- Inductive proximity sensor G – Core A initial position sensing
- Inductive proximity sensor H – Core B final position sensing

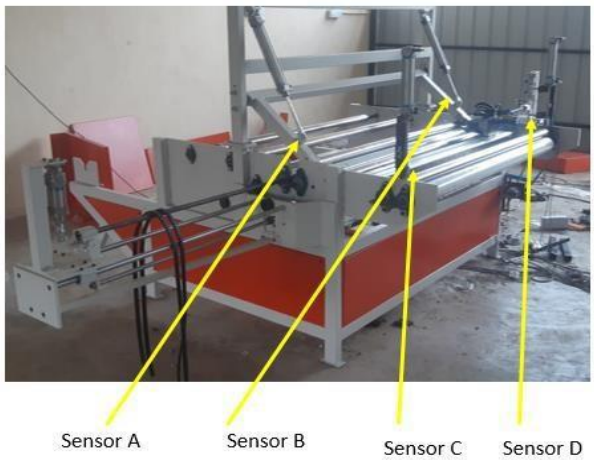

Fig. 5 Sensor placement 1

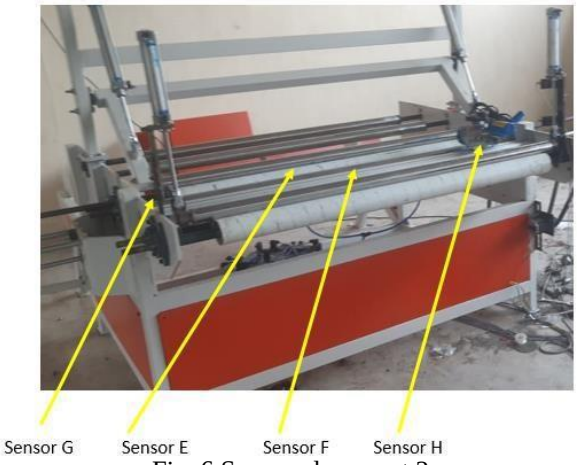

Fig. 6 Sensor placement 2

B. Placement of motor

Motors are used to provide the rotary motion to the cylinders in order to roll the gauge cloth as per the requirement. There are two motors used in this machine. Motor A is used for cloth winding and motor B is used for wrapping of gauge cloth. Placement of motors are shown in Fig. 7 and Fig. 8.

Fig. 7 Motor placement 1

Fig. 8 Motor placement 2

CONCLUSION

Manual winding is quite tedious job to do and it depends completely on the skills of worker. But the machine can be used by any other person without much knowledge of the rolling techniques. Human interaction is needed only at the time of cloth insertion and wrapping in semi-automatic machine. Thus increases human comfort. This machine will be more effective way of reducing the disadvantages of the conventional method of gauze cloth winding and wrapping. It reduces human effort during the process of the winding which is very easy and effective. Precision winding is obtained in this machine and desired output is achieved. So, the machine will be beneficial for the small industries, handloom workers, and medical and other textile industries. The most interesting modification can be brought in this system in future by integrating vision system to make it fully automated.

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