

# Industrial Wrapping Machine

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**Abstract**—Wrapping is the process of casing a finished product from the industry which is enclosed inside the boxes. It is the final step process in the production industries when the finished product from the industry has to be transported to various sites of the product requirement. Conventional wrapping machine cases the boxes only on one direction and remaining sides of the box are not wrapped. The efficient wrapping process to cover all the sides cannot be done manually or by using the existing systems. Effective method for box wrapping can be achieved by additional fabrication of two pneumatic cylinders to either side of turn table of existing machine. Hence, our objective is to provide a low cost automatic machine to completely wrap the boxes on all the sides to prevent damages to the products and to reduce the human intervention and work.

**Keywords**—Wrapping, Product enclosed box, human intervention, turn table.

## I. INTRODUCTION

Wrapping is the process of casing a finished product from the industry which is enclosed inside the boxes. Wrap is a thin, plastic sheet on a roll, around the box stacked on a pallet to secure the load. It is the final step process in the production industries, it is done when the finished product from the industry has to be transported to various sites of the product requirement. It must be ensured that the product reaches the destination without any damages or serious effects which may be caused due to any disturbances during the transport. Hence, wrapping the product plays a vital role in industry to prevent the various products from damage during transport or shifting. Wrapping the product using the plastic provides an extra layer of protection for the boxes. There are four different kinds of wrapping process commonly used. They are turntable wrapping, straddle wrapping, ringer or orbital wrapping and ring straddle wrapping. In Industries, initially the boxes were wrapped manually and later machines are used for wrapping the boxes. Semi-automatic wrapping machines cannot provide the complete casing on all the sides. It is an inefficient method

of wrapping and the machine requires human intervention. The efficient wrapping process to cover all the sides cannot be done manually and by using the existing systems.

The overall aim of the project is to provide a low cost automatic machine to completely wrap the boxes on all the sides to prevent damages to the products and to reduce the human intervention and work.

## II. MATERIALS & METHODS

The process of wrapping has a series of operation. For the same the system the components needed are different. All the stages controlled by a microcontroller. Similarly the process in two modes ie., wrapping on one direction and wrapping on other direction after tilting of box.

### A. Hardware

#### 1) DC Wiper Motor and Double acting Cylinder

A machine that converts direct current power into mechanical power is known as D.C Motor. Its generation is based on the principle that when a current carrying conductor is placed in a magnetic field, the conductor experiences a mechanical force. The direction of this force is given by Fleming's left hand rule system. DC Wiper motors are the motors which are used in the automobiles to which the wipers are attached. Wiper motors rotate in a continuous motion (not back-and-forth) and run on DC voltage. Since they run on DC, the motors can be sped up and slowed down based on the voltage level applied to them, and the direction can be reversed by reversing the power leads. Double-acting cylinders (DAC) use the force of air to move in both extend and retract strokes. They have two ports to allow air in, one for outstroke and one for instroke. Stroke length for this design is not limited, however, the piston rod is more vulnerable to buckling and bending. Additional calculations should be performed as well. Material range from nickel-plated brass to

aluminum, and even steel and stainless steel. Three double acting cylinders are used in this system. The figure 1 shows the wiper motor and the double acting pneumatic cylinder.



Fig. 1. DC Wiper Motor & Double Acting Cylinder

## 2) Arduino UNO Microcontroller and 4 Channel Relay Module

A controller used in this system to control the sequence of work flow. This project utilizes an ATMEGA328 microcontroller, with ARDUINO platform, a 28 pin IC. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. The output from the Arduino is connected to a 4 channel relay module.

The 4-Channel Relay Driver Module makes it simple and convenient to drive loads such as 12V relays from simple 5V digital outputs of the Arduino compatible board or other microcontroller. All the four relays of the module are used. One for the wiper motor actuation and the other three for the actuation of the three pneumatic cylinders. The figure 2 shows the Arduino UNO and 4 Channel Relay Module. The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board.

### B. Software

The source code for the IDE is released under the GNU General Public License, version. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.



Fig. 2. Arduino UNO & 4 Channel Relay Module

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub `main()` into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program `avrdude` to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. The Arduino UNO of this system is programmed using this software.

### C. The Technology

There are a lot of systems both mechanical and electrical methods as well as equipments that are used to detect the presence of elephants. Those methods include stretch wrapping, pallet wrapping etc. And also there are many conventional methods of wrapping which are not effective, and it requires human intervention and consumes time.

The mechanical section consists of frame which forms the base of the prototype on which the pneumatic and electronics system can be placed. The mechanical section consists of frame in which a iron plate is welded which holds a DC wiper motor with a small table which is placed perpendicular to its shaft. Another iron plates on the top of the frame is welded in order to hold a pneumatic cylinder vertically such that the piston of the cylinder holds the box placed on the table once its actuated. Two small projections of metal bar on either side of the frame has an iron plated welded to it. The clamps are used to keep tight hold of the other two pneumatic double acting cylinders on either side of the turn table. The three cylinders are actuated using compressed air which reaches the cylinders through Solenoid Actuated Directional control valves.

The setup made is shown in the figure 3. This setup was build for wrapping a box which contains products of mass from 5-7kg. For tilting the box completely the two pneumatic cylinder must have large stroke length. The turn table is also flat and when rotated the box on it should be stable and it should not slid away from the table.



Fig. 3. Overall Setup

The work flow of the system in various steps are:

Step 1: The box is placed on the turn table and a vertical pneumatic cylinder placed above the table holds it

Step 2: The rotation of table with load pulls out the plastic film and wraps over it in one direction

Step 3: After the rotation of the table the two cylinders provided on either side of table flips the box

Step 4: The vertical pneumatic cylinder holds the box again and the box is wrapped again in the other direction

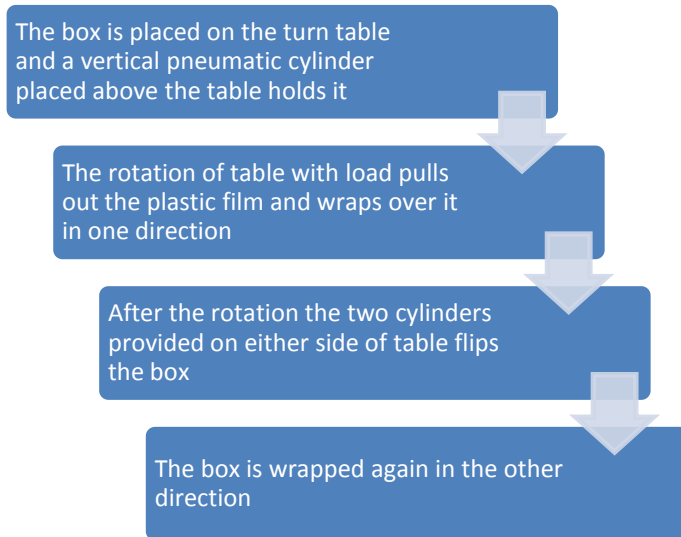


Fig. 4. Process flow

#### D. Process flow

The working nature depends on the motion of wiper motor placed in the base of the table. The product enclosed box is placed on a rotating table. A Pneumatic cylinder is placed upside down and initially actuated by the Arduino to hold the box in a position. Arduino actuates the rotating table for a particular time. After the rotation of the table the pneumatic cylinder retracts. Two pneumatic cylinders are placed on the either sides of the rotating table. The cylinders placed in the sides are actuated sequentially in the order of A+ B+ A- B- with delay in between them.

Thus the box is flipped, after which the upper cylinder is actuated again and the motor starts to rotate. As a result the box is wrapped on all the sides. After which the motor is stopped and the upper cylinder retracts. Now the wrapped box can be obtained. The thickness of wrap around the box depends upon the time of rotation of the turn table. Hence it

can be altered in the program fed into Arduino according to the various boxes placed in the table.

### III. RESULT & DISCUSSION

By modifying the existing methods, a system wrapping the product enclosed box in all the direction without the intervention of the humans can be obtained. More experiments could be done to evaluate the efficiency and can be further improved. The provision of sensors can detect the box in the table and automatically start the process.

Although initially the human have to place the box on to the table and start the process, it doesn't affect the process flow and doesn't consume much time comparing the existing systems. This machine can be placed near a robotic arm which can pick and place the box on the table one after the other and thus completely reducing the human hand in the system.

### IV. CONCLUSION AND FUTURE SCOPE

The proposed wrapping machine wraps the box on one direction and flips it automatically and completely wraps it in all the direction uniformly without human intervention. Thus this system consumes only less time to wrap a box completely comparing the existing system. This system can be further improved by provision of a conveyor which places the boxes on to the machine one after the other and takes it away after wrapping to a storehouse. A sensor mounted to the system detects the presence of the box on the turntable from the conveyor. Also the system's efficiency can be further improved by providing a pneumatic cylinder in the negative Z axis just below the turntable with an offset such that it doesn't disrupt the rotation of turntable and helps in flipping the box from the bottom.

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