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Invention of a Mechanism for Automatic Sealing of Polythene Bags

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Abstract

Technology's benefits have skyrocketed in recent years, and everything seen around us is a result of its contributions. As a result, staying current with technology is a requirement of modern science. The more automated the procedures, the more current the technology. This article describes the design and construction of a low-cost, flexible, and secure polythene bag sealer based on automation. This article will look at the automation function, sealing mechanism, and system integration of an automated filler, robotic hand, and conveyor. This system's aim is to provide polythene bags via vacuum grippers and mechanically seal these bags, therefore the name "automated sealer." The parts utilized in this system are functioning well, and the strength of the sealing has been verified by hanging a dead weight with the polythene bag. If enough resources and investment are put behind this procedure, it will be feasible to build the necessary equipment and make it suitable for usage in the industry.

***Keywords:** Sealing, Automation Low cost, flexible and secure operation*

INTRODUCTION

Automation in the modern era, where most things are done automatically rather than manually on a regular basis, ranging from the common practice of switching lights on and off to controlling the entire work cycle, it is past time for people all over the world to grasp the concept of automation and run with the rapidly changing modern civilization. Before it's too late, before others take control of you, before you fall completely behind the contemporary world, now is the moment to start learning how to use automation to manage all you see around you. Though automation does not completely eliminate human involvement in a task, it does decrease human judgment to the bare minimum. As a result, the accuracy of the output follows the rising trend. The sectors in which automation has bestowed its gifts are virtually unlimited. There are few industries that have not followed in the footsteps of automation. From industry to facility operation, military to utilities, transportation is available everywhere.

Automation applications Food, chemical, pharmaceutical, and petroleum manufacturing, as well as paper and pulp manufacturing, are all examples of manufacturing. Automotive, rail, and aircraft are all forms of transportation. Wastewater and water, gas and oil, telecommunications, and electric energy are all examples of utilities. There are several more fields, such as environmental control, safety, energy management, security, and other building operations.

Heat sealing is the process of sealing one thermoplastic with another of the same type of thermoplastic using heat and pressure. The direct contact heat sealing process employs either a sealing bar or a continually heated die to deliver heat over a defined route or contact area in order to weld or seal the thermoplastics together. Thermally activated adhesives, heat seal connections, plastic ports, film media, and foil sealing are all examples of heat sealing applications.

The automated polythene bag sealer, on the other hand, is designed in such a manner that the sealing process is automated, and the rendering of polythene bags is carried out by a vacuum gripper, followed by a robotic hand, allowing for the pouring of things into the polythene bags. The filling is also automated, and a conveyor belt transports the polythene bag to the sealing machine. All of these techniques are thoroughly examined in the study. With such a low cost and a rise in sealing rate, this sealer machine is highly coveted. The materials needed to build this machine are all widely available in our surroundings, resulting in a minimal cost. This machine has a high potential for future use, making it appealing to industries.

Bhairavi N. Savant addressed a procedure that can automatically handle and transport several sorts of polythene bags and papers. The procedure may control the speed of automation and monitor the output. Instead of PLCs and servo motors, he utilized a microcontroller and a DC motor to automate the procedure. In his article, R.A.R.C Gopura explored the constraints of polythene bag production, including the bag sealing methodology. He concentrated on the precision of the sealing system before moving on to other operations such as printing, cutting, packaging, and quality checking. R. Callies published a report in which they enlarged the limit of vacuum grippers to manage an object such as polythene bags or plastic. He achieved his goal by lowering the contact surface between the weight and the gripper.

Tsujii Tetsuya created a procedure in his article in which the temperature of impulse heat sealing was compared to that of manual heat sealing and how it minimized power loss[5]. In their study, A. K. Jaiswal and B. Kumar discussed the vacuum gripper, which can grab and load a variety of objects ranging from pallets, bags, and sacks to any type of material. They stressed the wide range of materials that vacuum grippers can lift [6]. Their major focus was enhancing the quality of end effectors, which can undoubtedly improve lifting and grasping quality. L. Brainbridge explored the issues surrounding automation and how to cope with them. Its difficulties include the incapacity of the automated process to make rapid decisions and the inability to manage aberrant conditions. Raja Parasuman investigated how humans misuse or overuse automated technologies, generating a variety of issues in decision making and monitoring. He also talked about the underutilization or neglect of automation in places where it could have been deployed. In his book, T.B Sheridan emphasizes the importance of automation and robotics in the coming era. It explains everything about automation and how it relates to robotics. Karen Slinkard compared manual and automated methods of determining total phenols in wine and other plant extracts. He collected 40 samples per hour using the singleton-rosy approach. Using replicate analysis, he calculated the coefficient of variation in manual, semi-automated, and automated systems.

In the field of system design and analysis, T.B Sheridan recognized the link between humans and automation. He even created the main concepts of human-machine interaction. [11] Prime Minister Taylor emphasized the importance of managing limp material (cotton, leather) in the business and how it is less prone to mistakes than manual handling. F. Erzincanli discussed the use of appropriate end effectors for handling non-rigid materials. Because there are few convenient end effectors for moving and grasping non-rigid materials, it is critical to creating such an end effector, which he achieved.

Erzincanli created a technique for packaging food goods and a categorization system for robotic handling, which is addressed in the context of an automated packaging cell. [14] R. Kolluru outlined in his study an analytical model of a flat-surfaced robotic gripper meant to automate a reliable, distortion-free, and quick limp material handling system. An industrial robot manipulator is included in the gripper prototype. N.B Sarter illustrated the level of uncertainty and surprise placed on human workers by automation. Because of its unexpected nature, automation has a tendency to surprise human workers.

Work breakdown or machine breakdown
According to the preceding literature analysis, automation is an absolute requirement in our everyday lives. As a result, an automated polythene bag sealer is devised and constructed in this work. The automation process is carried out using vacuum grippers, robotic hands, automated fillers, and conveyor belts with timing and pressure controls. It also intends to assess the system's performance.

Materials and Methods Working Principle

Each section of the work follows a certain mechanism. The vacuum gripper lifts the polythene bag, followed by the second gripper attached to the other side of the polythene bag, which sucks the surface air of the polythene bag and opens the bag to be filled by the automated filler. The robotic hand is holding the bag beneath the filling. Following the command of a servo motor, the robotic hand moves after a set amount of time.

The gear mechanism would power it in industrial applications. The hand lifts the bag off the conveyor and transports it to the sealing machine, where it is sealed. After a certain amount of time, the hand releases the thing on the conveyor, where the Pulley loops over the material in an infinite procession of rubber belts. During sealing, the conveyor remains motionless because the Conveyor protection switch controls the movement of the conveyor, and then it moves again. Figure 1 depicts the whole operation of the sealing mechanism.

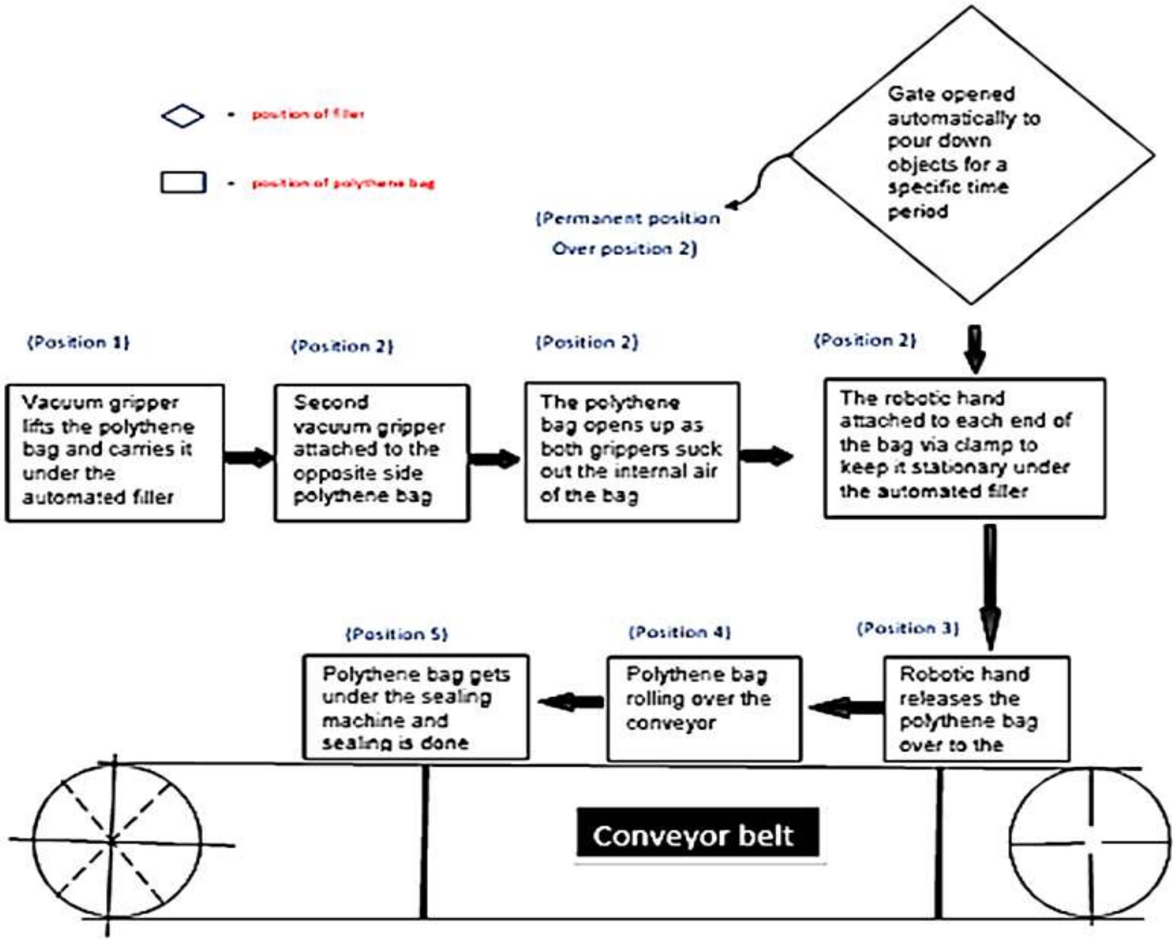

Figure 1: Working principle of the automated sealing process

Components of Sealing System

The different component used in this sealing system is sown in figure 2.

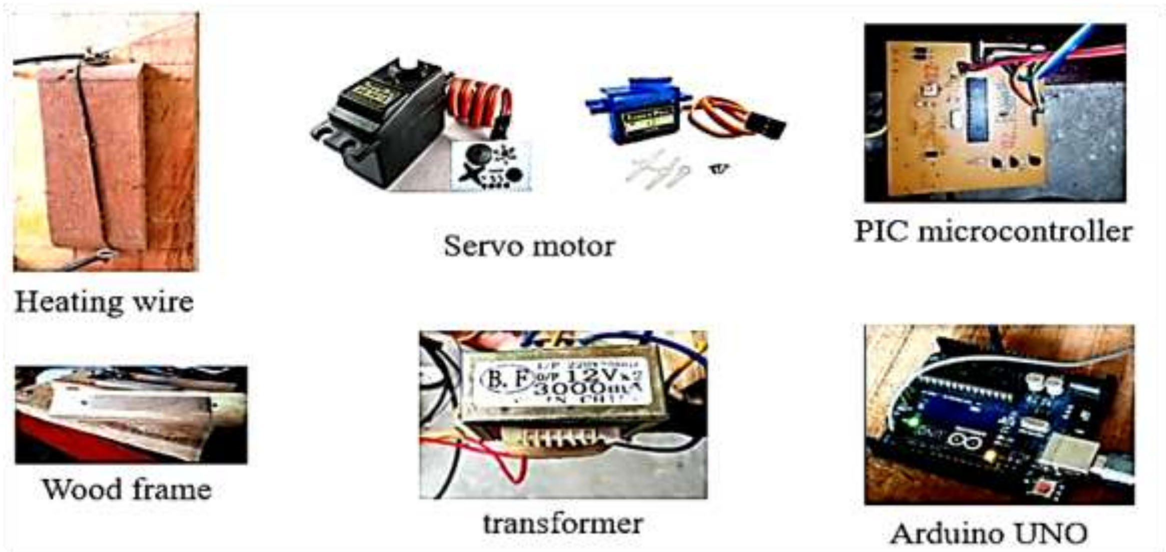

Figure 2: Different components used to construct the sealing system

Vacuum grippers: Vacuum grippers can take up and drop off objects of various shapes and sizes. Typically, vacuum grippers are used to hold and lift bags, plates, boxes, items, stackers, barrels, and reels. The processes for lifting polythene bags using vacuum grippers are detailed in this study. The vacuum gripper is set to move up and down as well as sideways, and the polythene bags may be rotated.

Robotic hand: A servo motor controls the robotic hand. The motor may be controlled at any angle and at any time, and the servo motor's coding is accomplished using an Arduino.

Belt Conveyor: A conveyor is a piece of material handling machinery. It is used in the mechanical industry to move materials from one location to another. A cotton belt is utilized in this project since it is less expensive and more flexible.

Automated filler: An automated filler machine is a method of automating the filling process. In contrast to traditional manual filling methods, an automated filler machine is designed to reduce human usage while increasing productivity.

Wood frame: The sealing procedure was carried out using two distinct wood frames. One of the two wood pieces is firmly fastened with a wood board in the initial wood frame. This wood item has dimensions of 6" × 75" × 1". Another little wood piece is bonded over this one, upon which the product to be sealed is placed. This little wood item has dimensions of 4" ×.25" ×.5". A servo motor controls the second wood frame, which finally performs the sealing action. The engine is attached to one of the two wood components of this wood frame. This wood piece's dimensions are 8" ×.75" ×1". Another little wood piece is glued over this one, and a heating wire is secured with two screws.

Heating wire: As a heating wire, a "Nichrome25" wire was utilized, which was fastened to the wood frame with two screws. This Very wire was chosen because it has a high resistance and can thus be heated without tearing.

Transformer: In this project, a transformer is utilized to deliver electricity to the heated wire, allowing it to seal the desired result. Transformers are commonly employed in electric power applications to either boost or lower alternate voltages.

Microcontroller: To run the servo motor, a complex microprocessor is necessary.

This project's controllers are Arduino and a PIC microcontroller. The Arduino utilized in this project is mounted on the wood board and uses programming to control the movement of the servo motor.

Servo motor: The servo motor is used to automate the sealing operation. It may be controlled at any angle and at any time, and the servo motor's coding is done with an Arduino. The high torque standard servo can spin around 180 degrees (90 in each direction), and they may be controlled with any servo code, hardware, or library.

Sealing Strength Test Procedure

To test the strength of the polythene bag, we suspended a dead weight with a rope under the sealed bag, as shown in Figure 3. Then we gradually raised the weight till the sealed section tore. The experiment demonstrates that the sealing strength is greater than the strength of the polythene itself. As a result, it may be inferred that the sealing is adequate.

RESULTS AND DISCUSSIONS

In this study, the automated filler and sealing parts are built individually. These two sections are joined together with the conveyer belt after successful fabrication. The performance results suggest that all components of this sealing system are functioning properly. It can also seal any form of polythene bag. Figures 4 and 5 depict an automated filler and a sealing component.

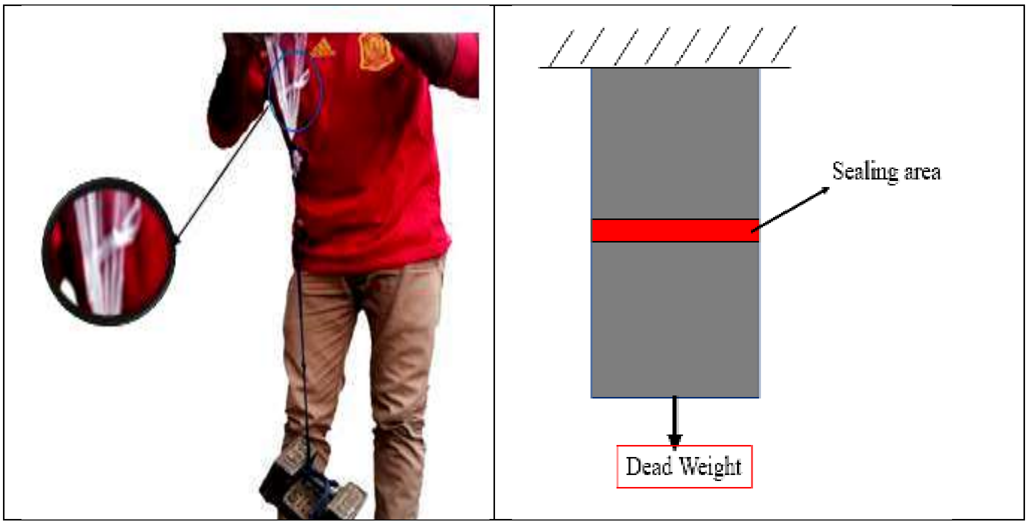

Figure 3: Strength test procedure (a) Original view (b) Schematic view.

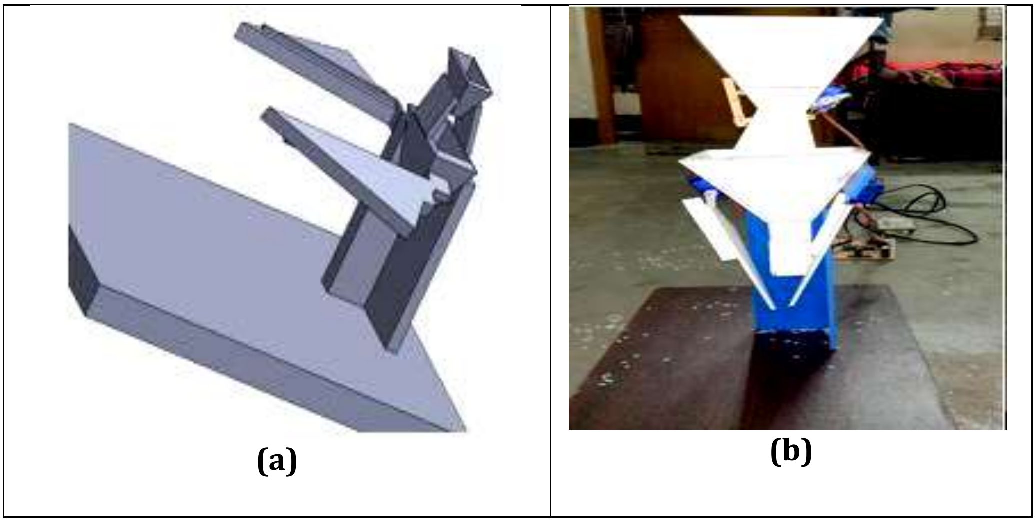

Figure 4: Automated Filler Part of This Sealing System (A) CAD Design (B) Constructed View

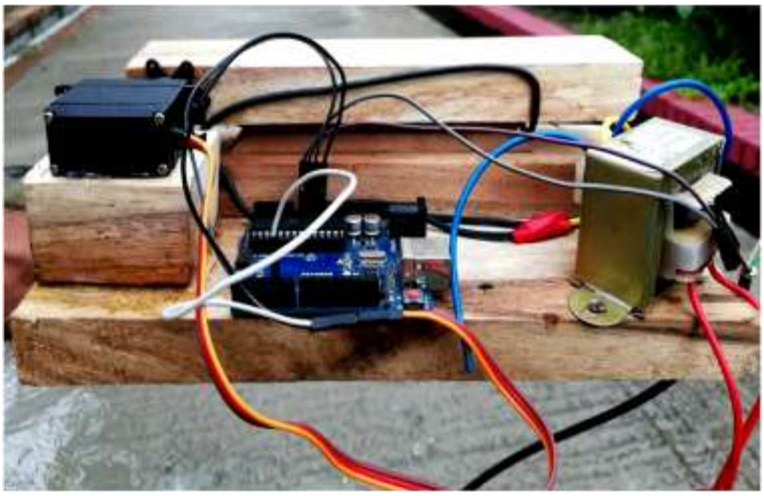

Figure 5: Final construction of the sealing system

Strength of the seal

Table 1: Sealing strength analysis results

Weight	**Condition of sealing area**
1 kg	No significance damage
2 kg	No significance damage
3 kg	No significance damage
4 kg	No significance damage
5 kg	Observed little damage without a tear

Table 1 displays the sealing strength values. This table shows that the sealing can withstand a force of up to 5kg, at which point the polythene bag tears, but the sealing area remains intact. As a result, this technique may be utilized to seal any polythene material for packing. The testing findings clearly demonstrate the vast difference between human and automated processes. The initial cost of an automated system may be higher, but it is more cost-efficient in the long run since it removes labour costs permanently. The payback time is also short, and the startup cost will be quickly repaid.

CONCLUSION

The automated Polythene bag sealer technique, which is suitable for industrial application and has a high sealing rate, has been developed successfully. Though this method works best for tiny bags, bigger bags can also be sealed. With a power usage of 0.038 kW/seal in the industry, there is some space for improvement. The automated polythene bag sealer has a wide range of applications, including the food production business, the limp material industry (cotton), the tiny packaging industry, and many more. Because of its numerous applications, the demand for this product will only rise.

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