White Paper

Snack Food Bag Robotic Case Loader Concept

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Executive Summary

This document discusses a novel robotic packaging machine that takes a stream of snack food bags directly from the jaws of the filling tube, forms a row, and places them into a case or tray while maintaining control of each bag. It has been designed for snack food bags ranging from 1 ounce to 10 ounces. Dual commercial robots move the rows into the case. The system has an optional built in bag leak detector and will handle 160+ bags per minute. Changeover for different bag size is minimal.

1.0 Bag Loading into Cases and Trays

This machine has been designed to both fill cases of bags (Figure 1) and the reusable plastic trays found in Central and South America (Figure 2). The cases can be either reusable or standard corrugated construction. The design in this document will focus on case loading but the robotic grippers can be modified for tray loading alternately.

Figure 1 1.0 Ounce 1.5 Ounce 3.75 Ounce

Figure 2 Central and South American Trays

2.0 Traditional Bag Loader Machines

Traditional bag loader machines start with a curved infeed to an inclined conveyor under the forming jaws (Figure 3). This initial operation creates the normal randomness found in other machines. Thus, when a leak detector is placed on the inclined conveyor, its sensor area needs to be large to accommodate random bag positioning.

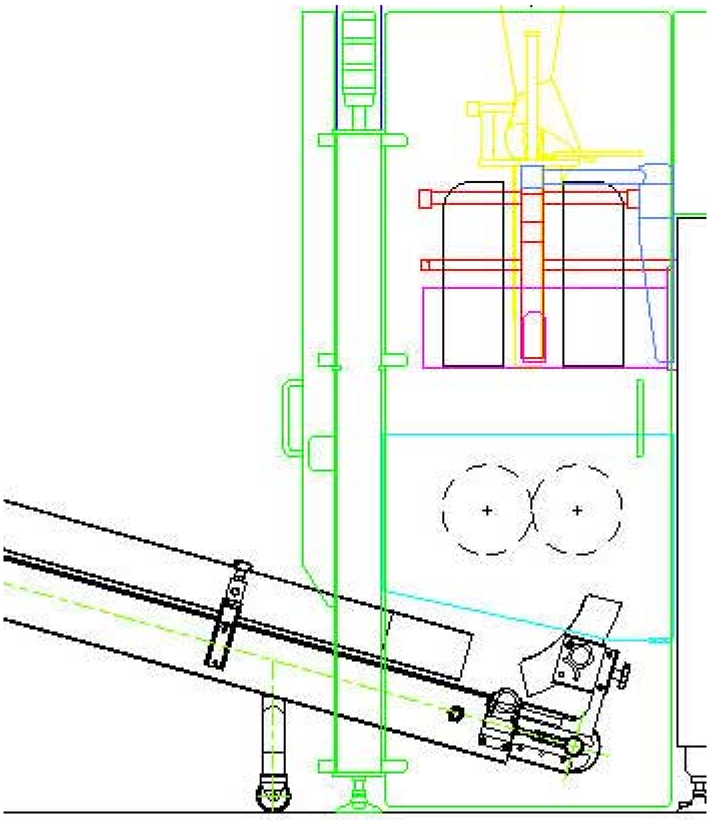

Figure 3 Bag Forming Tube with Jaws (shown as 2 circles), Curved Infeed and Inclined Conveyor

All of the commercially available and patented designs assume that the bags are delivered to the remaining automation from this inclined conveyor. The specific strengths and weaknesses beyond this point are moot since the location of the bags cannot be guaranteed. So a new approach is needed.

3.0 Novel Robotic Bag Loader Concept

The novel bag loader concept starts by removing the curved infeed to the inclined conveyor and works with the axiom that an automation should never loose position and orientation of an object throughout its operational steps. But contrary to the methods used by everyone else to date, the bags are NOT cut at the forming jaws. The bags remain in a stream and are cut just as the bag is formed into rows before insertion into the case.

Figure 4 shows the overall concept, where the stream of bags is loaded over the 2 humps on the path to being cut and formed into rows. The robotic end effector grabs a row of bags to be case packed. The vision system (shown as a red beam) finds the sealing seam between consecutive bags for correct bag cutting. The stream of bags can be short (Figure 5) or when the system timing requires a buffer, can droop between the 2 humps (Figure 6).

The production of bags at the filler tube is normally very highly timed, running like clockwork. The bag loading by the system is not as regular. There are slight pauses while the case moves from one case to the next or when a bag is rejected. Even though the cases are on a conveyor belt of their own (not shown) there are irregularities to the bag flow. By using the stream of bags as its own buffer (and not having expensive hardware, sensors, and control) a very inexpensive solution is produced.

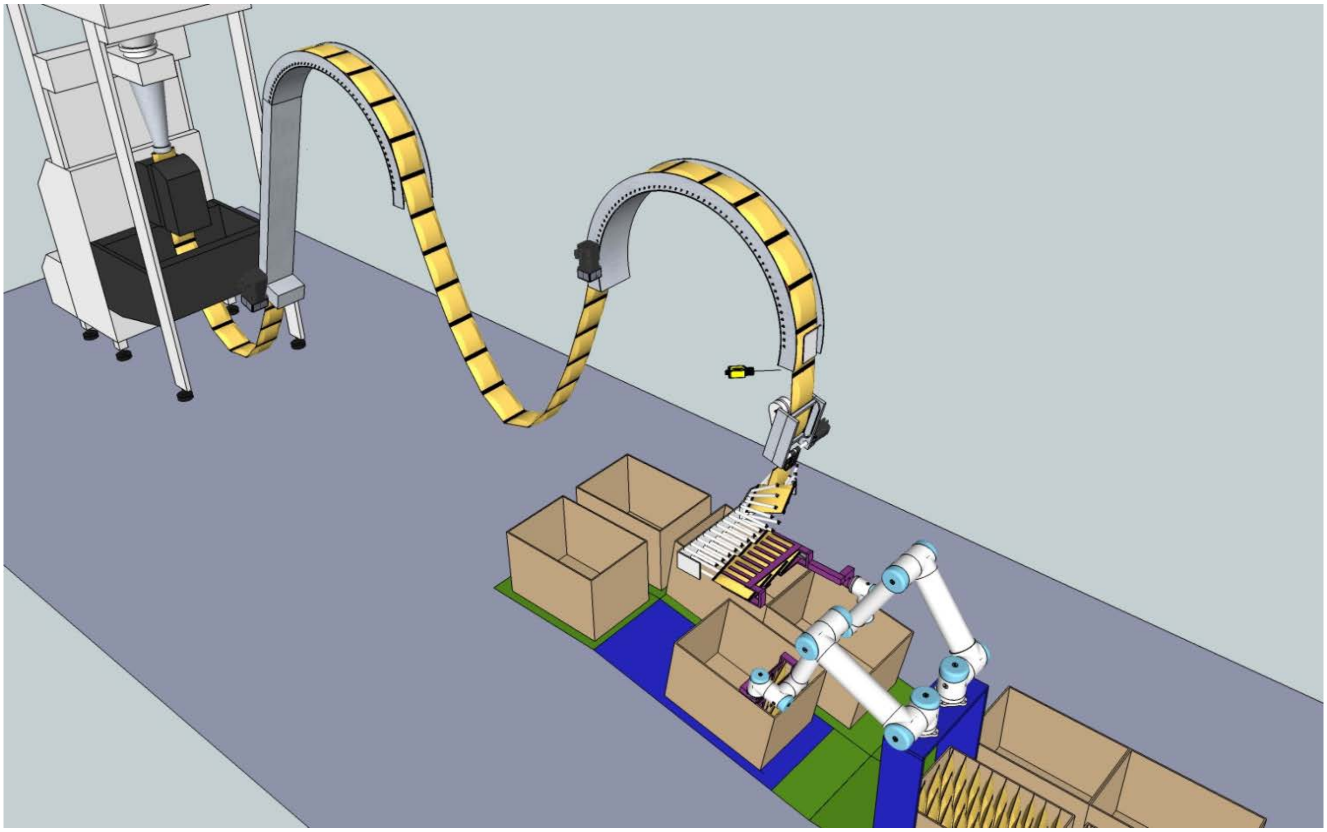

Figure 4 Robotic Bag Loader – Overall View

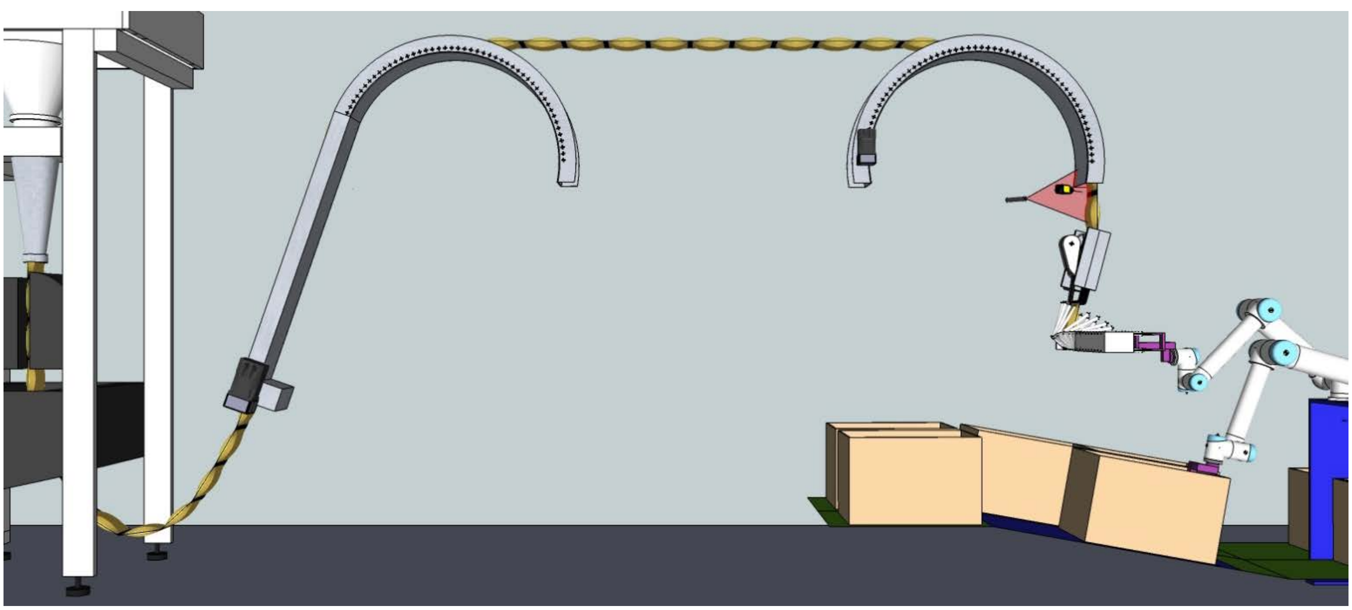

Figure 5 Robotic Bag Loader – Minimal Accumulation between Humps

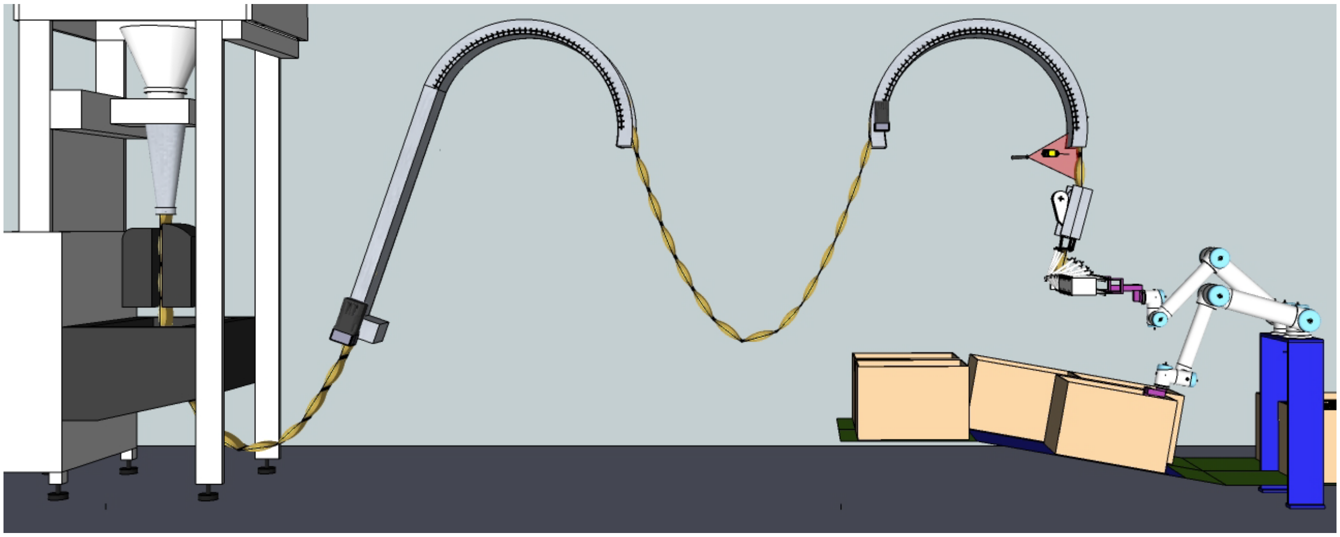

Figure 6   Robotic Bag Loader – Maximum Accumulation between Humps

The vision system uses an angled projected laser line and a traditional camera (modeled in Figure 7). The sample actual picture of this laser line is shown in Figure 8.

A pressure plate sensor (Figure 9) on the hump near the robots can identify bags with leaks.

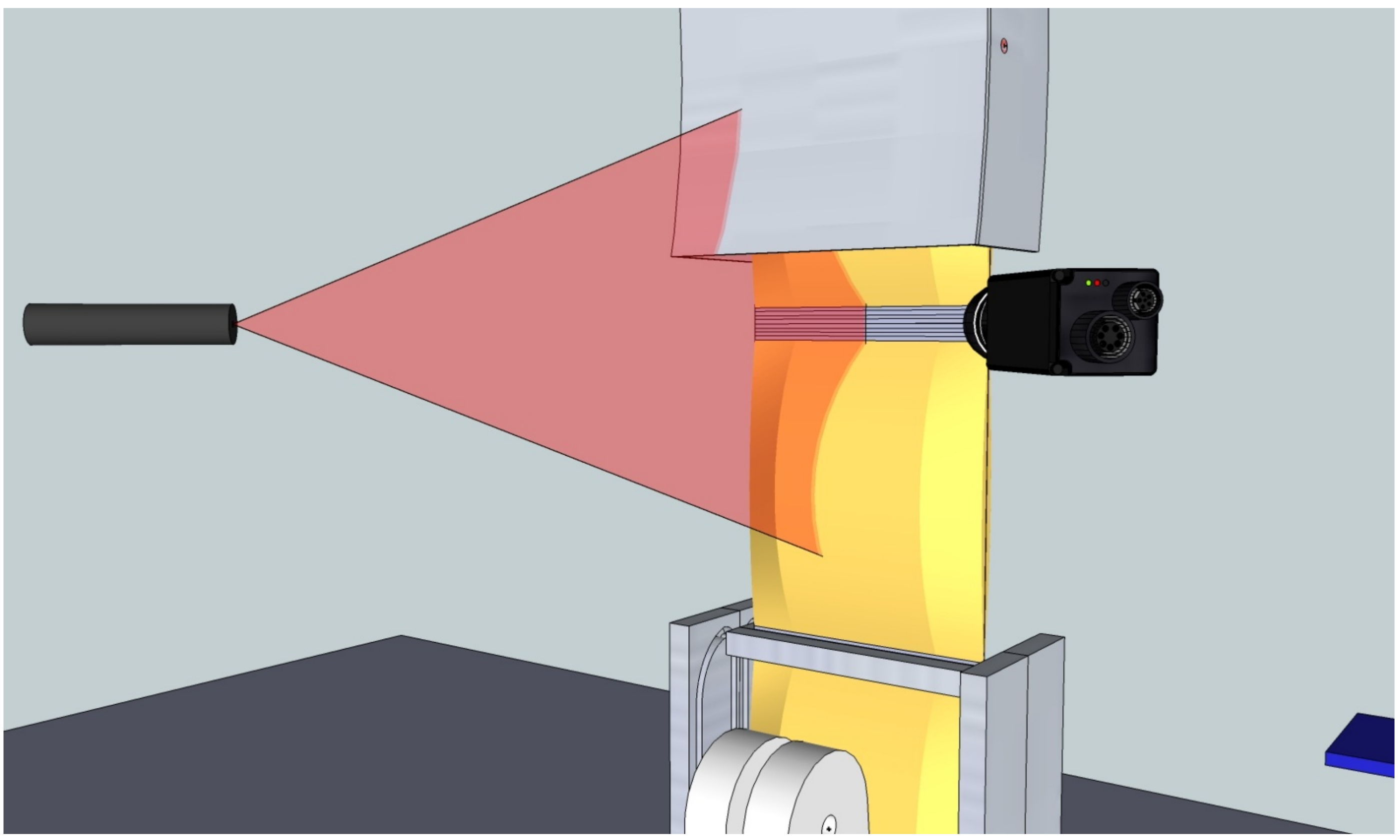

Figure 7   Angled Laser Line and Camera for Bag Seam Detection

Figure 8   Image of Angled Projected Laser Line as Viewed by Camera

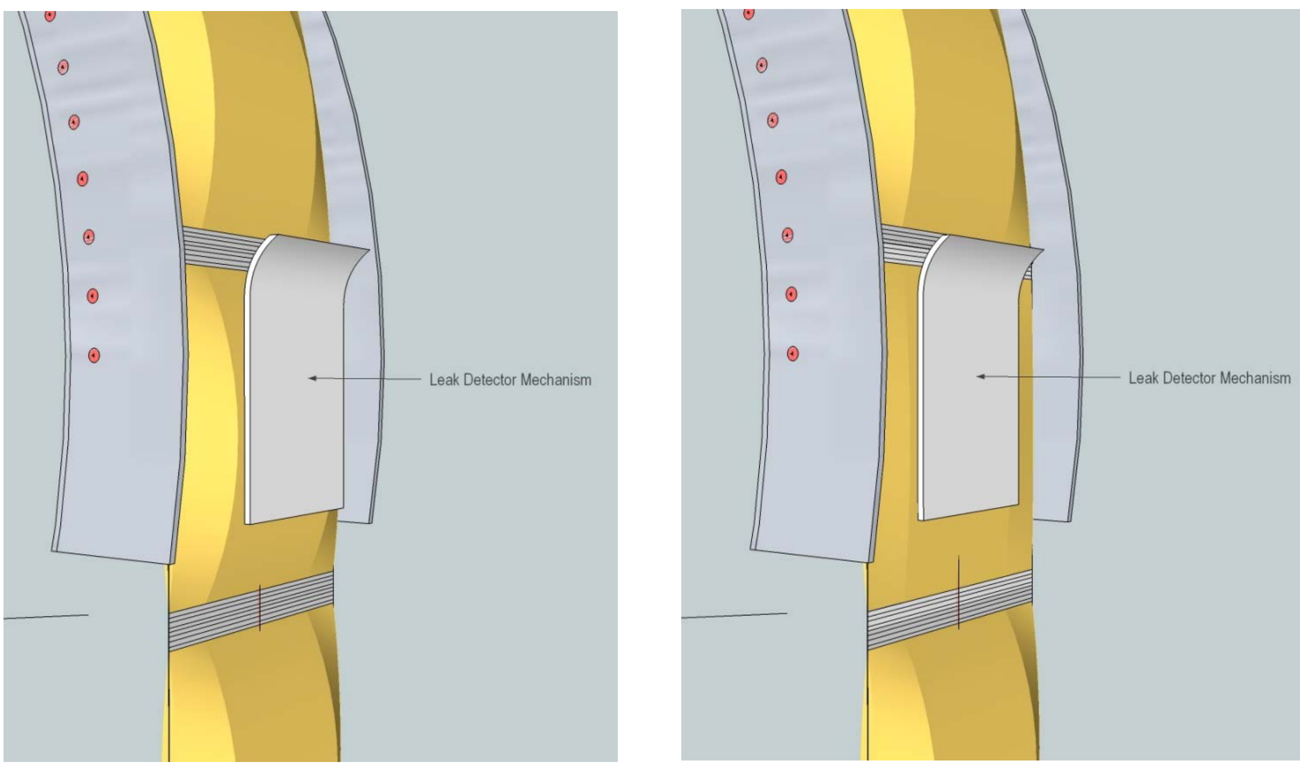

Figure 9   Pressure Plate Sensor Identifies Bags with Leaks – Robot will Reject These Bags

The robots place the row of bags into the case in a “hand over hand” motion (Figure 10) where the inserted rows of bags index into the case with their independent timing.

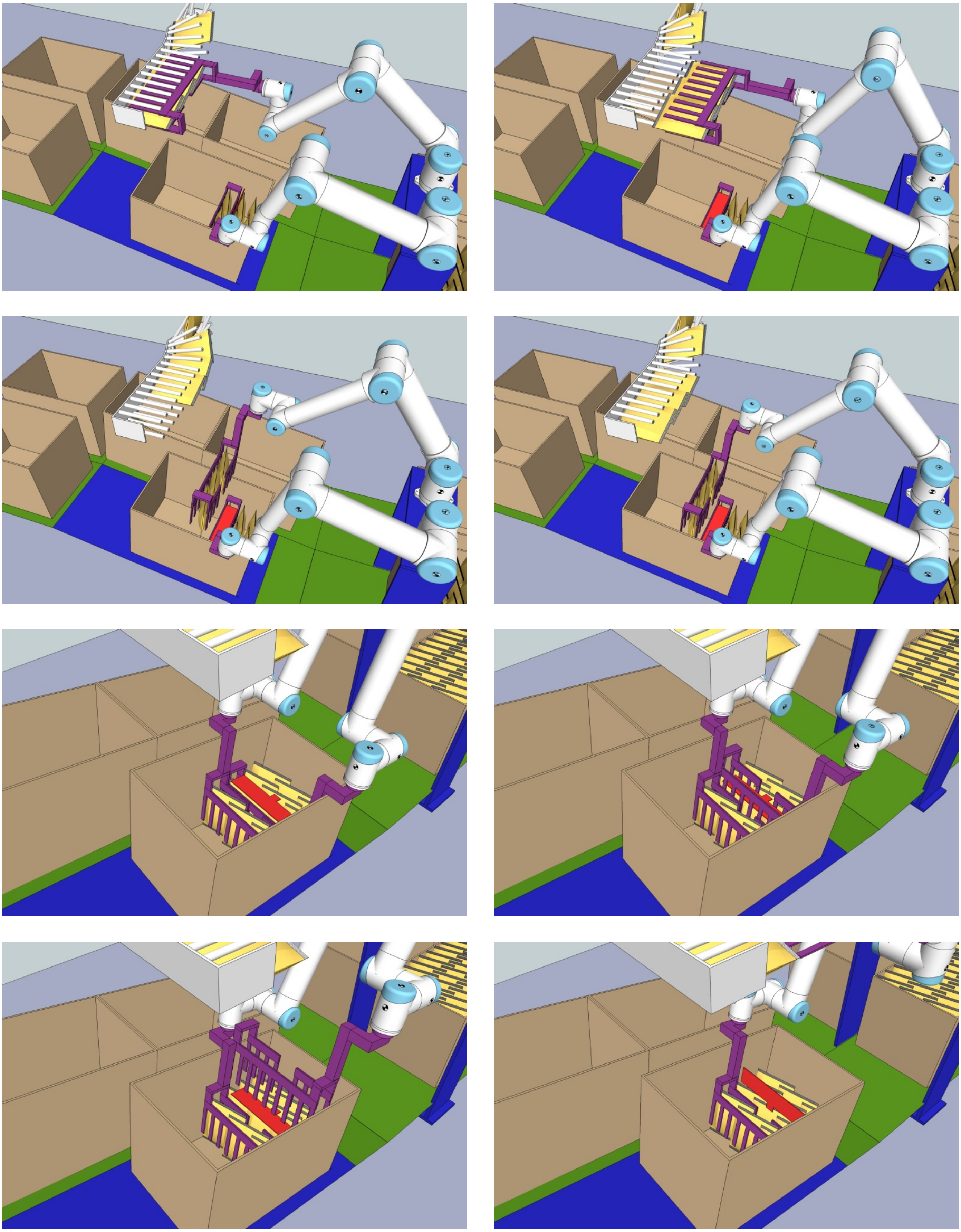

Figure 10 Robot Grabs Row of Bags, Slides Row of Bags Rearward and Indexes Case

4.0 Alpha Robot Test Unit

An Alpha Robot Test Unit was constructed using a Universal Robots UR-5 (Figure 11). This robot has the benefit of being low powered and has torque sensing so it is inherently safe. No guarding is necessary.

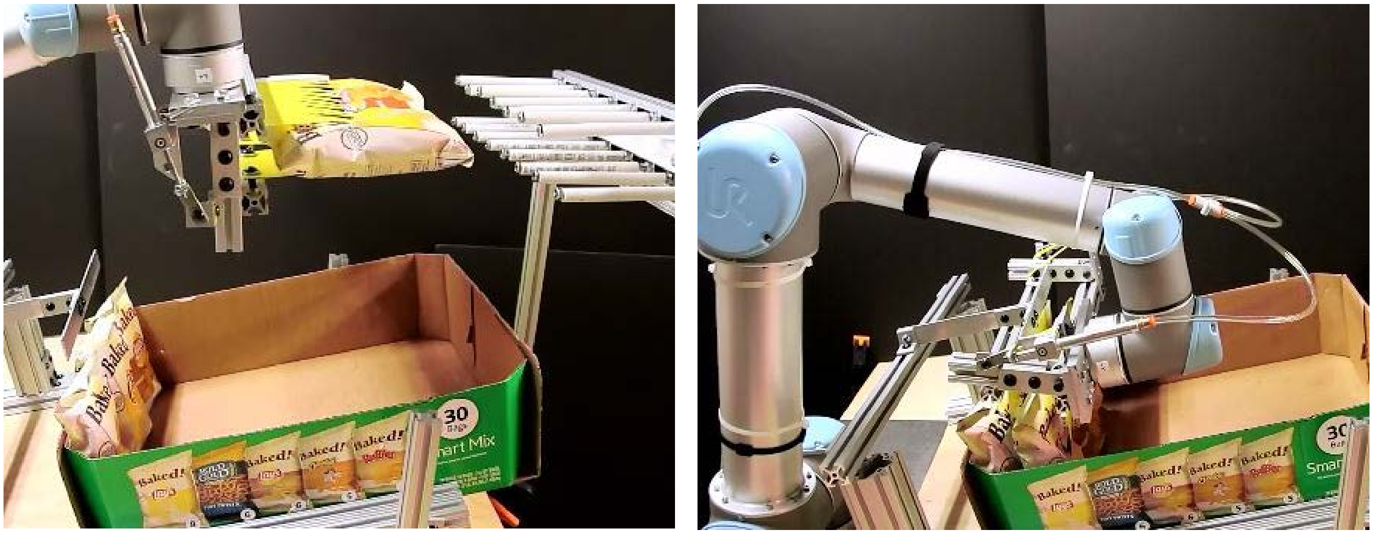

Figure 11   Alpha Robot Test Unit Grabbing Row of Bags and Loading into Case

5.0 Conclusions

A novel bag robotic loader has been designed so that the bags formed at a filling tube are transported as a connected stream until they are each cut, formed into rows and then loaded into a case or tray. Though the design in this document shows cases exclusively, the grippers used can be modified for trays. This process removes a significant number of parts compared to existing machinery. Dual commercial robots produce an operation of 160+ bags per minute while compressing the previously packed rows for easier insertion of the last row. This machine has been sized to fit many existing installations, including where twin tube systems are side by side.