Design of an oval bottle filling line

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1 Introduction

Konings is an international beverage production company. One of their production sites is situated in Zonhoven, Belgium. Here, they **bottle** a variety of products, spanning from juices to alcoholic beverages. Among these products is **Fireball whisky**, notable for its distinctive shape. This is illustrated in Figure 1.

Due to the **oval shape** of the bottle, they can easily **interlock** with each other. This presents a challenge when removing the bottles from the pallet, as the square layer of 207 bottles must discretise into a single row. An occurrence of this situation is depicted in Figure 2.

Figure 1: Fireball bottle [1]

Figure 2: Bottles stuck in production line

2 Requirements

To ensure that all requirements are met, a **package of requirements** is set up. All requirements regarding the project are incorporated in this package. This package can then later be used to **validate** if the solution is appropriate. Requirements are categorized into different types. **Functional** requirements, which are measurable or quantifiable, must be fulfilled. Additionally, **variable** requirements allow for varying degrees of compliance. Finally, **desires** are also considered, which are not essential. Table 1 outlines these key requirements.

Table 1: Requirements

Functional	Variable	Desires	
x			Able to discretise Fireball bottles, without human interaction
x			Solution packaged in **space of 5x2x3 m**
x			Connectable to current production line
	x		Filling capacity of **10500** ± 500 **bottles/hour**
	x		Cost of €50-60k incl. installation
x			6000 hours untill maintenance
		x	Compatibale with other bottles
x			Adherance to **food regulations**
		x	Usage of SEW or Euronorm for propulsion

3 Methodology

The **Van Kroonenberg method** was employed to attain a viable solution. In this approach, the problem is split up into **functions**, each defining the operations of individual components. These functions can be linked together using a function block diagram. Through this approach, the problem can be seen as a **black-box**. Thus, a function defined with in- & output characterises. Figure 3 illustrates this approach applied at the highest level of the problem faced at Konings. One of the key advantages of this method is its promotion of an open-mindset, facilitating finding the most suitable solution. Lastly, these functions are organized in a **morphological chart**, enabling the comparison of different concepts. This results in a well-chosen concept for each function, ensuring coherence across the entire system.

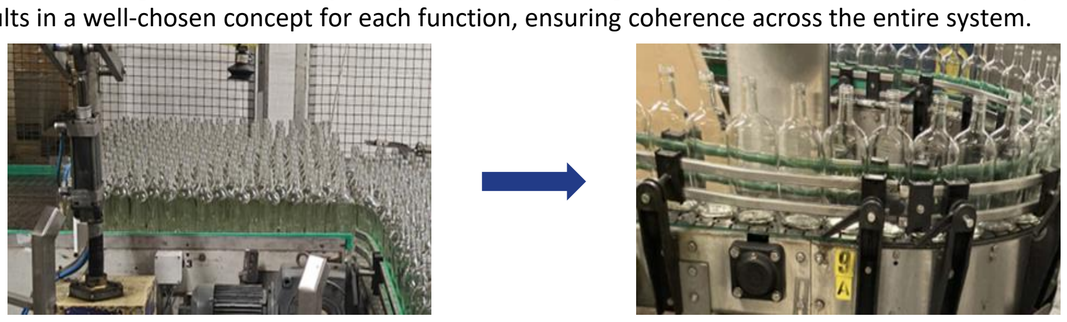

Figure 3: Black-box approach

4 Concept

The methodical design process led to the development of a concept, as depicted in Figure 4.

The automated process is achieved by placing **two conveyor belts in different directions**. Excess bottles are extracted towards the rear of the conveyer belt, where they will regroup with other new bottles. Additionally, an additional **floating motor** is incorporated to disengage interlocked bottles, allowing one of them to be redirected back into the conveyer belt.

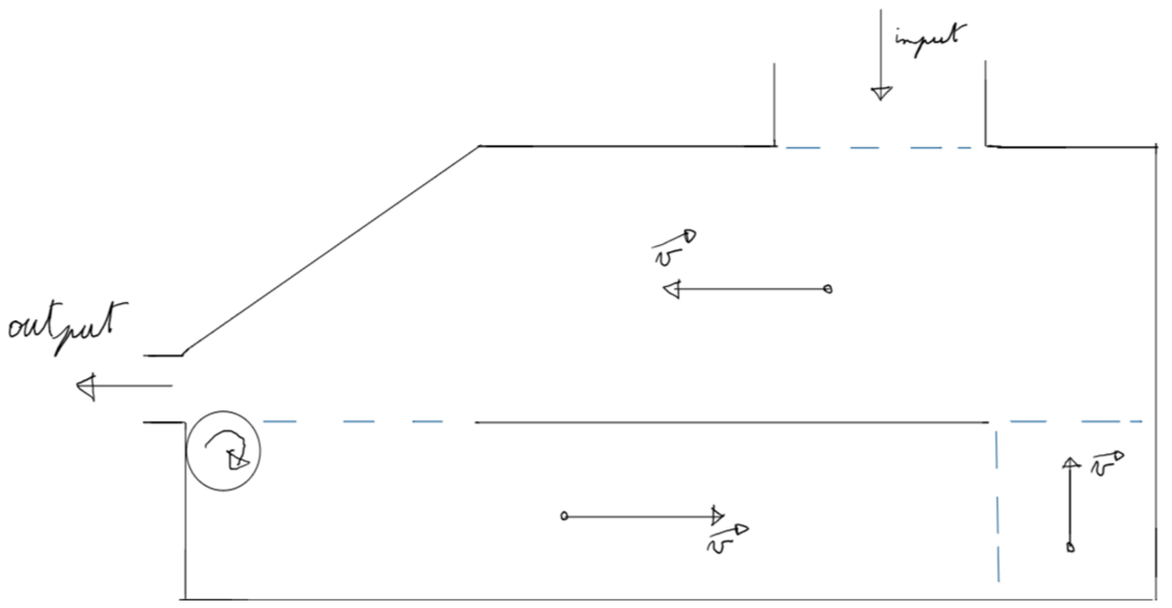

Figure 4: Concept discretisation of bottles

5 Result

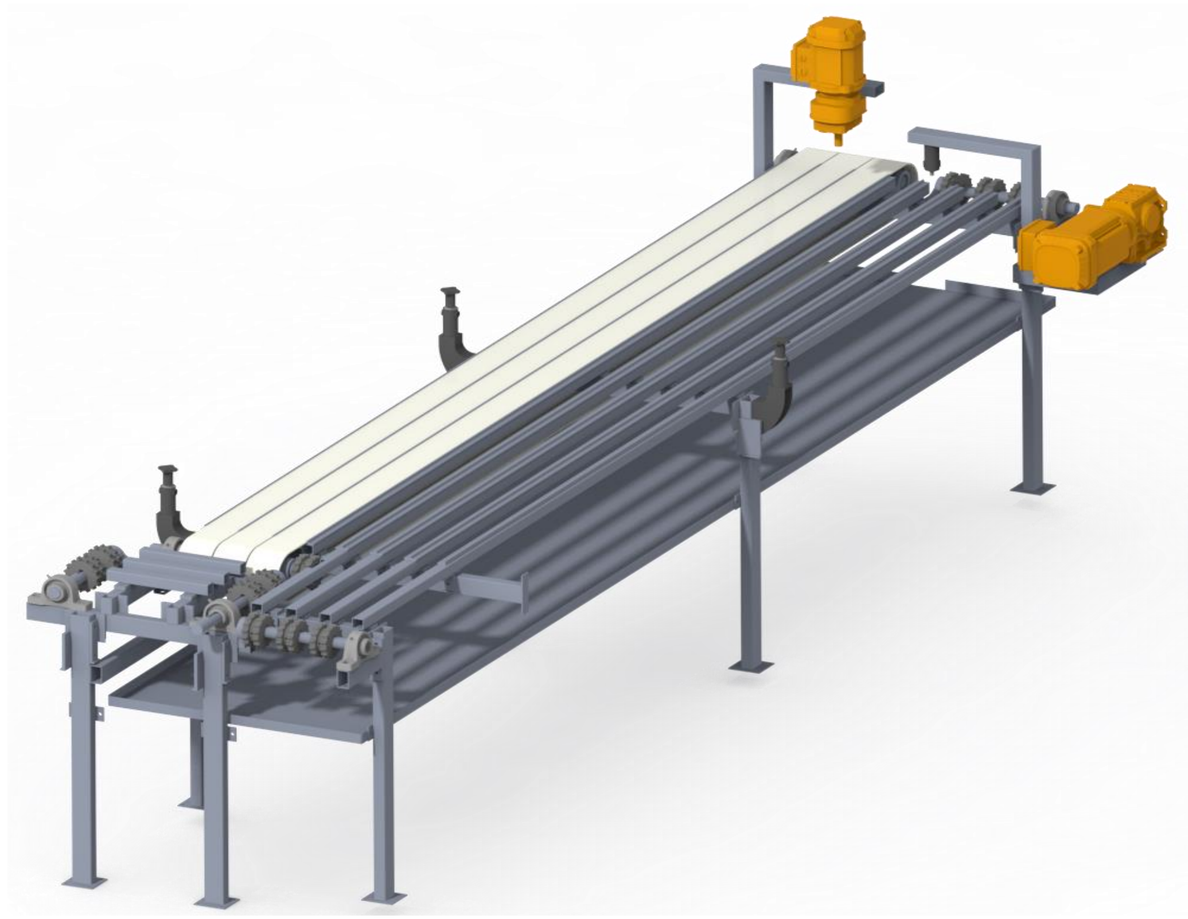

Figure 5: 3D-representation of assembly

References

[1] "Fireball Whisky," www.fireballwhisky.com (accessed Oct. 20, 2023).

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