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Robotics in Dairy and Food Processing Sector: A Review

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SUMMARY

As mentioned before, robotics technology is undeniably the forthcoming of the Indian agrarian community. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design machines that can help and assist humans. Robots are primarily application of dairy and food industries are packaging and palletization, but applications range now widen. The future of robotics in dairy and food industry is both exciting and attention-grabbing. It will be remarkable to see if the food production will employ the same number of robots in the future as does the automotive industry at current. Hence there is enormous potential of research in robotics for those particular in automation, while educational organizations have a similarly important role in imparting the innovative knowledge to retain the food industry at par with other more advanced sectors.

INTRODUCTION

One of the most important reasons for increased interest in automating the food industry is its need and cost construction. Automating repetitive tasks will improve quality control and productivity and reduce the high level of accidents. One of the important hurdles in the automation of food manufacturing is the biological variation in shape, size, and equality of the raw materials. Some materials (e.g., dairy) offer themselves readily to automatic processing because the raw material (milk) can be handled in majority. The dairy industry is among the most automated. But materials such as vegetables, fruits, meat, etc., need to be handled on a more single unit basis. Thus, dairy and food industry automation requires a level of elasticity uncommon to other mature industries. Dairy & food processing industries is highly labor-intensive, with sometimes labor costs at anything up to 50% of the product cost. Much of the manual work in dairy and food industry requires rapid, repetitive, and monotonous movement and, consequently, low levels of motivation among workers. Improving efficiency and reducing labor costs will therefore have a major impact on cost-effectiveness. This leads to poor quality control and a high incidence of industrial accidents. Dairy and food industry aimed the use of robots for various applications to improve the proficiency and reduced work space (Zongwei, 2015) and to reduce the cost (Rene et al., 2010). The applications of robotics and automation have been successfully achieved in a wide range of artificial industries dealing with well-defined methods and products (Hurd *et al*., 2005). Robotic applications include butchery, and fruit and vegetable sorting. Secondary processing - ingredients are combined to form new food products by cooking, baking, chilling etc. Robotic applications include product sorting, defect removal, and mixing.

Robotics application in food processing

What is robotics?

The International Organization for Standardization (ISO) defines a robot as, “An automatically controlled, re-programmable, multi-purpose, manipulative machine with several degrees of freedom, which

may be either fixed in place or mobile for use in industrial automation applications." A robot can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. More generally, it is a machine that functions in place of a living agent. Robotics is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. Characteristics of robotics are easy to clean robot, minimum retention areas; connection protection; increased efficiency; less room required, simpler mechanical solution; good hygiene; marketing innovative products and packaging; product picked and precise in process, in any position (Anon., 1996)

Types of Robots

1) Pre-Programmed Robots

An example of a pre-programmed robot would be a mechanical arm on an automotive assembly line. Pre-programmed robots operate in a controlled environment where they do simple, monotonous tasks. The arm serves one function - to weld a door on, to insert a certain part into the engine, etc. and its job is to perform that task longer, faster and more efficiently than a human.

2) Humanoid Robots

Humanoid robots are robots that look like and/or mimic human behavior. These robots usually perform human-like activities (like running, jumping and carrying objects), and are sometimes designed to look like us, even having human faces and expressions.

3) Autonomous Robots

These robots are usually designed to carry out tasks in open environments that do not require human supervision. Autonomous robots operate independently of human operators. They are quite unique because they use sensors to perceive the world around them, and then employ decision-making structures (usually a computer).

4) Teleoperated Robots

Teleoperated robots are semi-autonomous bots that use a wireless network to enable human control from a safe distance. These robots usually work in extreme geographical conditions, weather, circumstances, etc.

5) Augmenting Robots

Augmenting robots either enhance current human capabilities or replace the capabilities a human may have lost. The field of robotics for human augmentation is a field where science fiction could become reality very soon, with bots that have the ability to redefine the definition of humanity by making humans faster and stronger.

Types of robot used in dairy and food industries

SCARA robots are one of the types of stationary robots also known as horizontal articulated arm robots, with motions same as human arm. The recent developments in the food industry, different types of robots were put into operation for several purposes. The old model SCARA (selective compliance assembly robot arm) robots for pick and place, spider robots for high speed picking and placing of light weight objects are the recent examples of robots used in the industry. Its reliability for fast and repeatable movements make it fit for packaging palletizing, loading and unloading purposes (Brumson, 2011). Delta robotsis also known as Parallel Link Robots are the category of modern day robotics. Delta robots are designed for high-speed handling of lightweight products and offer lower maintenance due to the elimination of cable harnesses and absent of multiple axis. Parallel robots are deployed into many food processing steps. Again they offer high speed transfer food stuffs, primary (unpacked) or secondary (packaged) through manufacturer lines and a multitude of processes.

Application of Robotic in Dairy and Food Processing industries

The food industry is a highly competitive manufacturing area, but with relatively little robotic involvement as compared to the automotive industry.

- Grading of food products
- Pick and Place operations
- Packaging and palletizing
- Meat processing
- Robotics in dairy industry
- Robots in freezers and ovens

Challenges for robotics automation in food processing

Robotics knowledge varies by segment

- Some areas have little or no experience with robotic automation
- Critical for integrator and supplier to educate the market

Harsh working environment

- Refrigerated and freezer warehouses present unique challenges
- "High Care" areas require IP-69K robots with food safe paint and grease

CONCLUSION

The food market is a large and fast growing segment for robotic automation. Food safety and cleanliness requirements must be well understood for each individual application. Some food segments are new to robotics and will have a steeper learning curve than the established robotics user base.

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