

O 7. ROBOTIC SYSTEMS USED IN DAIRY CATTLE FARMS

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ABSTRACT: Robotic systems are one of the applications that facilitate our life in animal husbandry. In recent years, especially in cattle breeding, to avoid integration led to the increasing number of large-scale livestock farms in both the world and Türkiye. This situation caused to increase the mechanization and use of robotic systems in animal breeding. Innovation studies in livestock breeding developed as in many industries. The aim of this study was to examine the robotic systems used in dairy cattle breeding and to determine their effects on animal breeding. The robotic systems used in animal husbandry allow the animals to carry out the practice they need in their own right at any time, without human control, with the freedom of movement within the shelter. In this study, robotic systems used in dairy cattle breeding investigated under three different headings as robotic systems used in milking, robotic systems used in feeding and robotic systems used in fertilizer cleaning. The use of robotic systems in dairy cattle farms provides benefits such as ease of farm management, more efficient control of animals, gain of human labor, improvement of cow welfare, increase in milk yield and quality.

Keywords: Dairy cow, dairy farm, milking, robotic milking, robotic systems

1. INTRODUCTION

In order to ensure a healthy and balanced diet, it is of great importance and benefit to have animal foods in their daily foods. In animal foods, meat and milk are the most important products. Today, the consumption level of animal products in a country is an indicator of the development of that country (Uzal and Uğurlu, 2004).

Animal husbandry today in Türkiye is largely done with traditional methods. The most important feature of traditional animal husbandry is that it is based on manpower and the mechanization is not used. Animal husbandry is carried out by machines rather than manpower in developed countries and in most Cattle Farms in our country (Anonymous 2019 c).

Today, the number of large-scale integrated cattle enterprises using modern technologies in Türkiye as well as in the world is increasing rapidly. It should be noted also that, in animal husbandry in the world and Türkiye is not spread as far as the mechanization of labor-intensive industrial and service sector still continues to feature. Modernization and mechanization in cattle farms mainly focus on feeding, milking and animal welfare (Anonymous 2019 c).

Robot, mechanical systems and associated control and detection systems with they are intelligent machines depending on computer algorithms. Robot reprogrammable; agents, pieces, appliances, they are multifunctional machines that carry or process according to the work to be done with programmed movements (Anonymous 2019 d).

The robotic system, industrial robot, parts, agents, tools or special processing tools, with various programs, is a design that can move according to the desired task. The first articulated arm was developed in the 1950s. Especially for industrial automation and with the use of computer applications in management systems, there have been many developments in this field. From the first development of the additive arm in the 1950s and various types of robots depending on advances in microprocessor technology, figure and started to be used in sizes. Robots have a wide range of tasks. In fact, the need for robots is strong and competitive environment provided by economic performance and to adapt to each business environment. This workplace welder, paint jobs, take any substance and put it in a place etc (Anonymous 2019 d).

Because people are not physically able to do all their work physically, has developed different machines to use in places where power is insufficient. First of all, these machines, working with human assistance, developed over time and has been made to operate automatically without the need of human by using various peripherals with it. For these reasons, robots have an important place in our lives. Generally, reduce production cost and is used to make better quality production (Anonymous, 2019 e).

In this study, robotic systems which are rapidly being used in dairy cattle breeding as in every field, robotic systems used in milking, robotic systems used in feeding and fertilizer used for cleaning robotic systems it has been evaluated under three headings.

1.1. Robotic System Used in Milking

Today, milking units are widely used for milking in modern dairy cattle farms. Milking units, it is a very complex unit of a modern dairy business. The most important elements of a milking place, dairy cattle and milkers. Therefore, milking parlors are designed, constructed and managed to create the most favorable environmental conditions for animals and milkers. Thus, insufficiency of equipment used in animal milking system in milking center, locations of entry and exit doors and problems such as inaccurate dimensions or slippery of the slabs will negatively affect the comfort of dairy cattle and thus lead to a decrease in milk production. Similarly, milking performance and indirectly milk quality decrease in conditions that disturb the milking system's working order (Olgun, 2011).

Use of robotic systems in animal husbandry, people physical, bodily and to be able to perform all jobs as qualified and since it is not possible to be equipped, robots developed to be used where people cannot afford milking, at feeding and fertilizer has also started to be used in animal husbandry.

Experts working in this field in recent years, in order to eliminate the problems experienced in milking units, they turned to the search for alternative systems. As systems that can eliminate these problems, propose robotic milking systems. Robotic milking, cows enter the milking system at any time without human control and moves freely in the shelter. Preparing the breast for milking, installation of milking units and removal control of automatic devices recognizing cows, system is made with the help of computer (De Koning et al. 2001, Graves 2002, Reinemann 2002).

Computer among robotic milking equipment, sensors, milking stop, automatic doors, feeding place, cleaning system, milking system, milk meters, cooling tank and robotic arm countable (Aliç and Yener 2006).

Robotic milking system, cows visit the system voluntarily. The cow goes directly to the milking station for milking or forage. Cows, when it comes to milking stop system starts to work. The milking system starts the milking process with the help of magnetic chips in the cows' neck (Aliç and Yener 2006).

Milking takes place in the following order,

1. After the entrance door of the system is closed electronically, feed is provided with electronic feeders.
2. The metal robotic arm, which is part of the system, comes under the cow and the nozzles are cleaned with the washing system mounted on the metal robot arm.
3. After washing, the cylindrical brush for cleaning is withdrawn and the laser unit is used to determine the position of the cow's nipples.
4. After determining the nipple position with laser system the milking heads on the metal robot arm are attached to the cow's udder.

Each milking head has its own measuring device. Vacuum in milking heads decreases when milk flow decreases and milking heads are removed. After all the milking caps have been removed, each milking head is washed on the metal robot arm, metal robotic arm moves again under the cow and disinfectant solution is sprayed on each nozzle. After this process is completed, the exit doors are opened and cows leave the milking station (Halladay 1999, Cooper 2001, Gearin 2001, Dick 2002, Hopster et al 2002, Rodenburg 2002, Radford 2003, Wilson 2003, Halachmi 2004, Anonymous 2005 b).

Business owners achieve high milk quality using the robotic milking system. However, some management strategies differ from a conventional milking system. For example, mastitis control, a drying service for dry teats in conventional milking systems and it requires immersion for an uninfected breast after milking. On the other hand, in a robotic milking system, the nipples are automatically dried, after milking, the same processes are carried out using a spray instead of dipping (Radfor, 2003).

Careful monitoring of both cow and system performance in robotic milking system and how to control the milking system in terms of learning the business owner has some responsibilities. Robotic milking unit cows that do not visit voluntarily should be directed to milking regularly.

The advantages of milking robot used in dairy cattle shelters are given below,

- ✓ It reduces the time allocated for milking.

Milking in dairy cattle, it constitutes a large part of the work done within the enterprise. Without mechanization and the time spent on milking is higher in enterprises that are heavily utilized in the labor force. Therefore, milking, dairy cattle farms emphasis on required it is one of the daily jobs.

- ✓ An increase in milk yield and quality occurs.

Robotic milking, milk yield of cows owned by a farm and improve the quality and improve the quality of life of the owner (Helgren and Reinemann 2003).

In another study conducted in the Netherlands in a dairy farm 2 times a day from traditional milking to robotic milking an average increase of 11.4% was observed in milk yield (Helgren and Reinemann 2003).

- ✓ You do not need to be near the animals for milking.

The main difference between robotic milking and the traditional milking system, the fact that each cow can be milked without the owner (Van't Land et al. 2000, Helgren and Reinemann 2003).

- ✓ Breast and animal health are controlled more effectively.

Human observations and the decisions taken as a result, milk quality and breast health is not enough to determine (Helgren and Reinemann 2003, Anonymous, 2004 a).

- ✓ Your cows will be quieter and more docile.

Robotic milking, can also cause some psychological effects on cows. Robot milked cows are quieter and docile than traditional milked ones (Demir & Öztürk, 2010).

- ✓ Cow welfare holds an important place in robotic milking for cows have the opportunity to move freely.

A robot system installed in the barn, more control over the daily habits of cows with cow welfare development. Besides, robotic milking when established time cows adapt to the system quite quickly. Working staff also cows up it is well adapted to the system. Production increases significantly, cow and breast health are also positively affected. This technology, retention of cows in rural areas and successive odor, pollution and will help to eliminate problems related to animal welfare (Alıç and Yener 2006).

The most important feature of milking robots, cows to their milking times to decide for themselves opportunities.

Milking robots, designed for a business, save labor, yield, cow behavior, feeding habit of cows with impact on management practices should be taken into consideration (Van Landt Land et al. 2000).



Figure 1. Robotic Milking System (Anonymous 2019 g)

1.2. Robotic Systems Used in Feeding

The genetic structure of today's dairy cattle has superior features. Milk yield of genetic structure and improvement of properties in terms of other efficiency parameters for work continues. Genotype of animals developed phenotype needs should be met at parallel level. In other words the effect of genetic structure on animal productivity is 30% environmental conditions are effective at the level of 70% (Ekmekyapar, 1991). Therefore, milk quantity and quality animal welfare and environmental conditions affecting it is very important. Design of animal shelters, consideration of animal welfare and preferences of animals, environmental conditions should be determined in accordance with animal welfare.

Feeding is of great importance in a cattle farm. Because fertility in the first place impending milk yield and all other yields strictly associated with feeding. Feeding with robotic systems saving labor and time in addition to providing more regular feeding and 24/7 access to fresh food possibility it provides. Mechanization in feeding has two dimensions. The first of these is clover, also called roughage, meadow grass, corn, barley, wheat, oats such as yields of plants, vetch, sainfoin, clover, beet such as production of feedstuffs. Production of these feedstuffs with normal agricultural tools and machines, is done in accordance with normal agricultural rules. Mechanization is mostly in forage silage production and It is used to obtain concentrate feed from different feed materials in the enterprise. Storage of silage green feed by fermentation and is a storage process to ensure the use of winter. Silage in the world and Türkiye is most commonly made of corn silage forage crops. The corn must be harvested before making the corn silage. Here it is a mechanization come into play and silage machine is used (Anonymous 2019 c).

1. Forage harvesting equipment yet to fruit trunk of unreached corn and cut together with leaves of certain lengths in addition situated into the truck or tractor's trailer acts as an installer. Used for this purpose and Türkiye has also produced numerous silage machine model (Anonymous 2019 c).

2. Another machine used in feeding feed crushing-mixing machine. Medium and large scale cattle enterprises for many years even dense feeds sack from feed mills or silos pour have provided. But in recent years these businesses need animals concentrate feeds themselves. For this purpose, purchased and corn stored in suitable conditions, barley, wheat, sunflower meal, cottonseed meal, corn silage, hay, dry clover and similar to other feed ingredients specific ration complying with the daily needs list put into feed crushing-mixing machine, the machine breaks down these feedstuffs into small pieces that can be eaten by the animal while mixing and homogenizing them. Forage crushing-mixing machine same time smashed baits it also undertakes the function of distributing an equal amount to the animal feeders in the shelters (Anonymous 2019 c).

3. Another machine used in feeding is automatic feeding system. Daily quantity of concentrate and roughage in this system feed way proceeding the cows' feed is missing laser system by sensing in front of the automatic feeding unit missing feed is poured into the manger and the cow is eating as much food as it needs. This system also serves to sweep the feed.

4. It is known as belt feed distribution system. Feed distribution in this system, animals on a moving band system provides access to food. This platform can be planned unilaterally or mutually according to the number of animals. Animal feed, they can be consumed in any amount of time and amount of freshness and provides easy cleaning of feed residues.

Frequent feed distribution in a relaxing environment, it improves both animal feed intake and consequently feed use. Constant collection of feed ensures that the feed is always kept fresh and that fermentation processes do not occur. Cows always enjoy optimal feed rate and cleaning in the feed section is indicative of this. Your healthy cows will produce the best quality milk.

The advantages of the feed robot used in dairy cattle shelters can be listed as follows.

- Fully automated system minimizes workload (Anonymous 2019 f).
- Precise weighing and distribution ensures savings in feed costs (Anonymous 2019 f).
- Provides simple and effective feed management.
- Providing swept feed to the manger without contamination, prevents feed waste.
- Optimal feed use ensures the highest quality milk.



Figure 2. Feed Distribution In Robotic Systems (Anonymous 2019 h)

1.3. Robotic Systems Used in Fertilizer Cleaning

In animal production, large amounts of fertilizer are produced. Therefore, manure management, is one of the major problems in livestock enterprises. Fertilizer management, without harmful to human and animal health, environmental pollution and fertilizer efficiency it should be done at minimum cost without causing a reduction. Fertilizer management, grown animal-dependent for all livestock enterprises without affiliation has great importance. However, the amount of daily fertilizer obtained per animal is high the importance of fertilizer management in cattle holdings is increasing (Olgun, 2011). Fertilizer, from animals obtained stool and urine it is formed. In addition to fertilizer feeding in shelter, irrigation, milking and solids obtained as a result of daily activities such as maintenance and liquid wastes, bearing material, precipitation and miscible with water from other sources mixture of materials such as soil is understood.

Cleaning of manure in shelter mechanical systems are used. These are generally;

- Manure removal robots (mobile systems),
- There are two groups as mechanical scraper systems.

Manure removal robots, is widely used in mechanization of solid fertilizer.

Mobile systems have various advantages. These include; low investment, ease of adapting to different types of shelters, manure cleaning can be specified easily (Olgun, 2011).

Mechanical scraper systems, said scrapers, located on concrete slabs or grilled floors below canal pouring out or by collecting the accumulated fertilizer in the urine canals to a storage tank or a fertilizer spreader. In this system during operation of automatic scrapers animals do not need to be taken out of the shelter. One of the most important advantages of the system labor requirement is very low (Olgun, 2011).

The system to be selected is completely the length of the barn, the number of animals and accordingly is associated with the amount of fertilizer. Equipment safety, easy movement of animals, the health of animals and people and manure cleaning process is carried out without causing environmental pollution.

Advantages of Robotic System Used in Fertilizer Cleaning

It is advantageous that the scraper blades have rubber on them so as not to damage the floor. This rubber, as the structure of the soil prevents degradation at the time of stripping more uniform and residue-free stripping. Fertilizer on concrete-based service roads should be cleaned at least once a day. Automatic fertilizer stripping systems are large and frequentuse in manure stripping farms and and saves labor costs. This system, less expensive than stripping with a tractor (labor, machine expense, maintenance, injured cows, etc.). Operationally, fertilizer stripping system blades to manure collection channel or from the edge of storage space will leave the storage space should be designed. Equipment working at the place where the manure will be poured; not harm the cows, other machine equipment parts do not interfere with the work routines and should not cause damage. Therefore, necessary measures should be considered during planning (Olgun, 2011).



Figure 3. Manure Removal Robot in Robotic System (Anonymous 2019 1)

2. RESULT

Use of robotic systems in dairy cattle shelters; decrease in milking time, increase in milk yield and quality, gain from the labor force, make animals more quiet and docile provides more effective control of animals.

The most important advantage of robotic systems, reducing dependence on labor force in animal husbandry and allow employees to have a holiday. Use of robotic systems in a dairy cattle farm without the owner of the business several (2-3) days of robotic systems it makes it possible to manage with.

Robotic systems used in dairy cattle breeding it also increases the quality of life of the enterprise. The use of robotic systems also facilitates management. A robotic system installed in the shelter, on the daily habits of cows performing further checks and to improve cow welfare.

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