

Animal friendly and durable attachment for the future

A product development project to improve the design of smart animal tags

Smart ear tags help dairy farmers detect diseases, improve fertility, and optimize milk production. But when tags fall off, cows can get injured, data is lost, and electronic waste ends up in fields. This thesis identifies some of the key design factors that improve durability and animal safety.

Modern dairy farming is increasingly dependent on smart technology to maximize production while minimizing cost and environmental impact. One of these technologies are smart ear tags that monitor cows' activity, fertility cycles, and health indicators such as eating and rumination in real time. This data enables farmers to improve both productivity and animal welfare by optimizing reproduction and detecting diseases earlier, in turn reducing the need for and use of antibiotics. However, the physical design of smart ear tags presents a significant challenge. Compared to traditional identification tags, smart tags are larger, containing both batteries and electronics. They are also attached to an ear that is almost in constant motion in a tough environment filled with manure, water, metal pipes, feed fences, and other animals. If a tag gets stuck, the typical reaction of a cow is to pull away with force to free itself. This often leads to torn ears, lost tags, disrupted data collection and replacement costs. Many lost tags are never recovered and may end up in manure systems where they eventually end up in agricultural fields as part of the fertilizer. The purpose of this thesis was to improve the physical design of smart ear tags to reduce the risk of them tearing off and causing damage, while considering durability and long-term sustainability.

Through interviews with farmers in Sweden and Italy, survey data, and on-site observations, high-risk situations and obstacles were identified, particularly around feeding areas. Based on these insights, several design concepts were developed. To evaluate them, an obstacle course was developed to simulate the conditions on a farm in a repeatable way. The prototypes were subjected to controlled mechanical loads that mimicked the situations that occur when a cow gets stuck and struggles to free itself. Also, a factorial experiment was conducted to systematically analyze how different design parameters such as flexibility, thickness and shape affect performance. The results show that the flexibility and structural thickness of the material play a more important role in reducing the risk of entanglement than simply minimizing size or weight. Increased flexibility allows the tag to deform under load, reducing stress and lowering the likelihood of it falling off and causing damage to the ears.

The proposed final concept demonstrates how informed design decisions can simultaneously improve animal welfare, reduce electronic waste, and lower replacement costs. In addition, the developed test method provides a structured way to evaluate future tag designs under realistic conditions. As dairy farming moves forward toward a more sustainable and data-driven future, this project highlights an important insight, that even small mechanical design decisions can have significant consequences for animals, farmers, and the environment.

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