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Sheep Tracker via Radio Frequency Identification (RFID) System

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Abstract— **The Fourth Industrial Revolution (IR 4.0) has significantly impacted various industries in Malaysia through the digitalization and optimization of daily operational processes, leading to heightened efficiency. It's not just the manufacturing sector that has directly experienced the transformative impact of this revolution; even the livestock industry has been touched by its influence. Within the realm of livestock management, a primary challenge arises in the form of effectively monitoring and tracking animals, specifically sheep, while they graze in the fields. Consequently, this research aims to invent a sheep tracker by implementing Radio Frequency Identification (RFID) system to oversee the movements of each sheep in the pasture. This system involves attaching unique identification tags to every sheep, allowing for precise tracking when the sheep are in proximity to the RFID scanner. On top of that, the comparative study of the existing and proposed tracking systems used on the particular farm are presented. As a result, this innovation indirectly reduces the reliance on human labor for sheep monitoring and mitigates the risk of sheep loss. Furthermore, the implementation of RFID technology on sheep aligns with Sustainable Development Goal 9, focusing on the enhancement of industry, innovation, and infrastructure.**

Keywords— sheep tracker, Radio Frequency Identification (RFID) system, livestock industry

I. Introduction

Accurate animal recognition is an indispensable aspect of contemporary farming and efficient farm management. It plays a pivotal role in ensuring the implementation of policies related to animal safety, food quality, and production standards. Over time, a multitude of techniques and methods for animal identification have emerged, tracing their origins back to ancient practices where animal owners devised unique identification methods. Some ancient tribes, for instance, relied on distinguishing animals by their skin color and distinctive patterns.

Conventional methods of animal identification exhibit significant limitations that affect their overall effectiveness. As gleaned from the literature, marks can easily succumb to damage or prove challenging to decipher. For instance, tagging cows' ears requires minimal force and restraint and, when executed correctly, causes minimal to no discomfort. However, this method carries the risk of infection. On the flip side, ear notching stands out as a widely embraced identification technique in the livestock industry due to its efficiency, yet it does come at the cost of inflicting considerable pain [1].

As time has progressed, new technologies have ushered in a transformation in the field of animal identification. A significant majority of cattle farmers now deploy biometric identification methods, with RFID technology emerging as a powerful tool for tracking animals on a global scale [2]. Radio frequency identification (RFID), represents a remarkable form of communication technology designed for non-contact automatic identification. Basic RFID system consists of three components: Tags, readers, and an application system (see Fig. 1). This system excels in recognizing multiple high-speed moving objects, a feat that can be accomplished even in resource-challenged environments without the need for human intervention. Furthermore, RFID has the ability to effortlessly tag, store, and oversee information using radio-frequency signals [3]. When pitted against traditional bar codes, RFID tag technology boasts significant advantages, including unmatched convenience, reduced environmental impact, vast information storage capacity, and the added bonus of being recyclable.

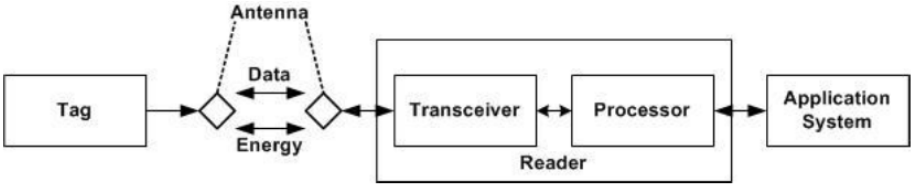

Fig. 1. An Illustrative Block Diagram of an RFID System [4]

In RFID technology, the most common frequencies used for this type of system are Low Frequency (LF) operates at either 125 kHz or 134.2 kHz, High Frequency (HF) works at 13.56 MHz, and Ultra High Frequency (UHF) covers a range from 865 to 868 MHz or 902 to 928 MHz, as explained in Brown-Brandl's 2019 study. The selection of frequency determines how far away the RFID scanner can detect the RFID tag and how many tags it can identify in a second. So, when deciding on the right frequency, it is important to consider the specific area to locate the system. Factors like how close the scanning device is to the RFID tags and how many tags that need to be scanned at the same time all come into play when making this decision. Since this project aims to scan a few sheep at the same time, which also indicates that multiple tags need to be read simultaneously, UHF was chosen for this project.

II. MATERIALS

The implementation of RFID in tracking the sheep's location requires both hardware and software components. The main materials for hardware components include the RFID USB tag reader, reader, RSS232, tagging and projector ceiling bracket, as shown in Fig. 2, Fig. 3, Fig. 4, Fig. 5, and Fig. 6, respectively.

Fig. 2. RFID USB tag reader

Fig. 3. Reader

Fig. 4. RSS232

Fig. 5. Tagging

Fig. 6. Projector ceiling bracket

III. METHODS

An RFID system comprises three essential elements: an antenna or coil, a transceiver with a decoder, and a transponder (RF tag) preloaded with distinctive data. An RFID reader serves as the device responsible for querying an RFID tag. Equipped with an antenna emitting radio waves, the reader prompts the tag to respond by transmitting its stored information. An RFID tag, a compact package housing a microchip and an antenna, is designed for attachment to items earmarked for tracking.

When the reader's radio waves engage with a passive RFID tag, a coiled antenna within the tag generates a magnetic field. This magnetic field acts as a power source, activating the tag's circuits. These activated circuits then facilitate the transmission of the encoded information stored in the tag's memory.

The sheep and tag must be registered in the system manually. Based on the associated tag number, all pertinent data for each sheep must be precisely recorded. When the sheep passes by a spot with a scanner, the scanner will scan the tag it is wearing, enabling the system to identify the animal's presence in that particular location. The system's floor plan is portrayed in Figure 2.

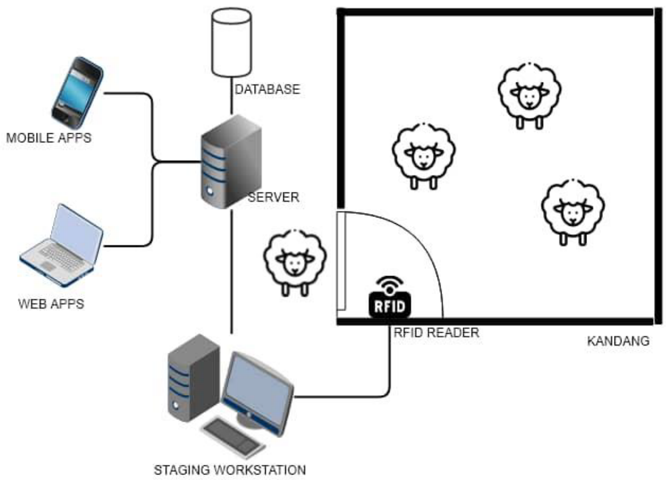

Fig. 7. The system's floor plan

In this proposed method (refer to Fig. 7), when the sheep pass through the RFID reader, the reader will send the information to the staging workstation, which is then uploaded to the server and saved in the database. In line with that, the process of monitoring each sheep can be done through web and mobile applications, which offer an effective approach to monitoring.

IV. RESULTS AND FINDINGS

Table 1 presents the comparative study of the existing and proposed tracking systems used on the particular farm.

Table 1. Comparative study of existing and proposed tracking system

No.	Existing System	Proposed System
1.	The information about the sheep was kept in the excel file.	The information about the sheep was kept on the website, which made it more accessible for the staff and the owner.
2.	Any update regarding the sheep must be made manually in Excel.	Any update can be made easily via the website.
3.	The sheep's tags were made manually on a piece of paper.	The tags are updated during the registration of the sheep.

4.	The sheep need to be monitored regularly on site while they graze in the field.	Minimal monitoring is required since the sheep can be tracked when they pass through the nearby RFID scanner.
5.	It is time-consuming to recheck the sheep manually.	The system will provide information about the location of sheep by only entering their tag number.

Previously, the process of registering the sheep on a particular farm was done manually through an Excel file, keeping the information as well as making the tags for each sheep manually. In fact, when the sheep were released to the field to do their activity, the staff needed to be aware of the total number of sheep released and the whereabouts of the sheep when they needed to enter their pens. Besides, it is time-consuming for the staff to check the number of sheep manually every day. Thus, in order to solve all these limitations, the proposed system can be executed. The information about the sheep can be registered through the website, which makes it more accessible for the staff as well as the owner of the sheep. Any update regarding the sheep, for example, their age, owner, health issues, and many more, can be done through the web application, which also links to other related associations such as the staff, owner, and veterinarian. In addition, minimal monitoring is required since the sheep can be tracked when they pass through the nearby RFID scanner. Thus, the location of the scanner at the door or gate is important. Significantly, the system allows the staff to know the exact location of the sheep with just one click, which is by entering the sheep's tag number only. Consequently, the system proposed will provide a huge benefit in terms of managing the sheep efficiently. The system provides non-invasive approach to tagging or identifying livestock that ensures their well-being, increase the efficiency of completing daily tasks, reduces the reliance on human labor for sheep monitoring and mitigates the risk of sheep loss.

V. CONCLUSIONS

The livestock industry has been significantly transformed by technological progress, tackling issues like disease transmission and monitoring complexities head-on. Among these innovations, Radio Frequency Identification (RFID) systems have risen as potent tools for tagging and overseeing livestock, resulting in a noteworthy reduction in infections and losses. By embracing these systems, it enables a holistic approach to livestock monitoring, effectively diminishing the need for human labor in sheep supervision and minimizing the likelihood of sheep losses. Furthermore, this adoption of technology closely aligns with Sustainable Development Goals, particularly in SDG 9, industry innovation and infrastructure. Collectively, these advancements fortify the livestock sector's resilience and make substantial contributions to sustainable development.

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