lizes various sensors and modules to obtain and display data in real-time has been. The safety system stands out on integrating collision avoidance and real time tracking into one system that can be implemented in underground mines to improve on safety in the workplace. By embedding the safety system on an LHD the risks associated with underground mining can be improved and productivity can be increased.

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EARLY CATTLE DISEASE AND OESTRUS CYCLE DETECTION USING IOT

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Abstract. This project addresses significant economic losses in dairy farming due to late disease diagnosis and poor oestrus cycle detection, issues particularly challenging for resource-limited farmers. The developed system leverages IoT technology, sensors (including temperature, heart rate, and movement), and a connected camera to monitor dairy cow health and behavioural parameters in real-time. This approach enables proactive disease detection and accurate oestrus cycle identification, facilitating prompt intervention and optimizing breeding management. Studies indicate the system achieves a 98 % decrease in disease detection time and a 95 % increase in oestrus detection accuracy compared to traditional methods. This promises enhanced agricultural productivity.

Keywords: IoT, cattle monitoring, disease detection, oestrus cycle, sensors.

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Introduction. The integration of sensing technologies and wireless networking protocols within the framework of the Internet of Things (IoT) is fundamentally transforming Precision Livestock Farming (PLF). This shift addresses the critical challenge of late disease detection and missed breeding opportunities, which often result in substantial economic losses in dairy farming. Traditional methods relying on visual inspection and conventional laboratory tests are often limited by staff availability and can lead to delayed treatment and increased disease spread.

The automated IoT-based monitoring system showcased aims to provide robust, real-time supervision of dairy cow health and the oestrus cycle. Studies supporting this approach indicate that utilizing IoT technology has resulted in a 98 % decrease in the time required for disease detection compared to traditional methods, facilitating early intervention. Additionally, the system has demonstrated a 95 % increase in the accuracy of oestrus detection, leading to improved breeding efficiency and higher milk production rates. This technology allows farmers to continuously monitor physiological parameters and behavioral patterns to identify abnormal trends or deviations before diseases progress [1].

IoT Architectures and Data Acquisition in PLF. The foundation of the system relies on carefully selected components designed for compatibility, efficiency, and size. The main controller is the ESP32-WROOM-32 microcontroller, chosen for its versatility, integrated Wi-Fi and Bluetooth Low Energy (BLE), and capacity to manage inputs from various sensors. The module features a scalable dual-core processor.

The system integrates several sensors to gather comprehensive data as shown in Figure 1:

GPS Module (NEO 6M): Tracks the cattle's geolocation. Comparisons of GPS receivers indicate that signal propagation critically influences precision.

Temperature Sensor (DHT11): Measures body temperature, noted for high precision and interference resistance.

Heart Rate Sensor (MAX30100): Monitors pulse oximetry and heart rate.

Vibration Sensor (SW 18010P): Detects changes in animal activity levels, which signal potential disease or welfare concerns.

Connected Camera (ESP32-CAM): Provides visual data capture capabilities These components form wearable devices, such as collars, that continuously collect data on vital signs and movement patterns. Real-time data collected by the sensors is analyzed for anomalies and transmitted to a cloud storage system (Firebase).

The system uses the GSM module (SIM800L) to send timely SMS alerts and notifications to the farmer via a dedicated mobile application. The microcontroller utilizes the GSM network and the mobile application to inform the farmer instantly of any abnormalities. Furthermore, LED indicators and a piezo buzzer are included to provide instant local alerts to on-site farm employees, ensuring intervention even if the farmer's phone is off.

Oestrus and Disease Detection Mechanisms. The system's primary objective is the accurate and early identification of impending health crises and reproductive readiness

Early Disease Detection: Early detection is essential for maintaining herd health, reducing [2] economic losses, and minimizing the spread of contagious diseases, especially major threats in Zimbabwe like Lumpy Skin Disease (LSD), Foot and Mouth Disease (FMD), anthrax, and tick-borne diseases [2]. The system monitors continuous data points like body temperature, heart rate, and activity levels to identify deviations from the norm, allowing prompt intervention before diseases advance. For example, a temperature detected above the normal cattle body temperature triggers an alert. Detecting health issues early minimizes treatment costs [3].

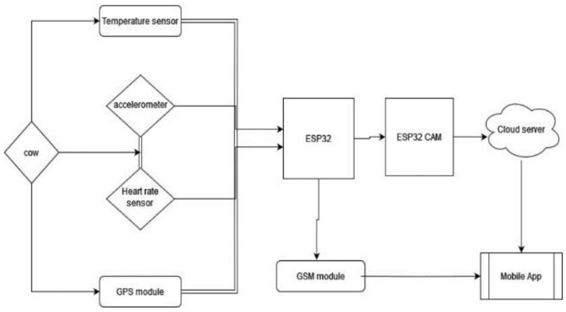

Figure 1 – System design flow chart

Oestrus Cycle Detection: Efficient reproductive management hinges on accurately detecting the oestrus cycle. This is crucial because the optimal window for successful breeding or artificial insemination lasts only 12 to 18 hours every 21 days. The system monitors changes in behavior, activity levels, and other physiological indicators to accurately predict oestrus. The system specifically aims to detect levels of excitement and movement consistent with oestrus. Using IoT-based systems for accurate detection helps to reduce costs associated with reproductive hormones and unnecessary inseminations. The system utilizes data analysis to match collected data with already-known symptoms of certain diseases or indications of oestrus cycles.

Implementation Challenges and Future Directions. The practical implementation of IoT-based monitoring systems faces notable challenges. These limitations include budget constraints and reliance on stable internet connectivity and infrastructure, particularly in remote or rural areas. Obtaining cooperation from dairy farms to provide information and statistics due to security and privacy policies can also be a limitation.

A key technical challenge encountered during prototype testing was the presence of system noise, resulting in sensor value fluctuations. This noise stemmed from integrating components manufactured by different vendors, potentially utilizing different signal processing values.

To mitigate noise and ensure accurate functioning, future development should focus on standardizing the signal processing values used by all integrated components. Architecturally, future research recommends investigating the integration of Edge-Fog-Cloud computing for precise and quick outcomes in disease prediction and reproductive cycle tracking, based on promising models in smart healthcare. Additionally, leveraging advanced data analysis techniques, specifically Machine Learning (ML), is advised for early disease identification and risk prediction in dairy herds.

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A REVIEW OF MODERN INTELLIGENT AND ENERGY-EFFICIENT TOBACCO CURING SYSTEM

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Abstract. The article reviews the core technological components that enable intelligent and energy-efficient control of modern tobacco curing systems. Traditional flue-curing is a highly energy-intensive process relying heavily on subjective manual control, leading to high fuel consumption and variable leaf quality. This review focuses on the integration of Machine Vision (MV), specifically Convolution Neural Networks (CNN), automated leaf recognition and Fuzzy Logic Control for precise barn parameters, that is temperature and humidity. The Specific Energy Consumption (SEC) is analysed. The paper concludes that intelligent systems offer a significant pathway to minimize operational cost ensuring uniform, high-quality cured tobacco.

Keywords: machine vision, tobacco curing, deep learning, fuzzy control, energy efficient.