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Tracking and Monitoring Cattle's Health using Wireless Sensor Networks

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Abstract— In modern agriculture, with the rapid demand for increased milk productivity, farm automation has become an important priority. Incorporating technology is essential to meet the demand for increased agricultural productivity while simultaneously reducing costs and labor. As part of this effort, monitoring animal health is important. The purpose of this study is to prioritize the continuous health monitoring of dairy cows using different sensor technologies to monitor various health parameters of dairy cows. The proposed monitoring system includes hardware components such as temperature sensors, heart rate sensors and Arduino UNO, as well as software and representative physiological measures. The main objective of this project is to track the location of goods and provide information to their owners using GPS. We can continuously assess the health of individual animals by collecting monitoring data and reporting results to owners and local healthcare providers.

Keywords: Dairy cattle health monitoring, Farm automation, Sensor technologies, Arduino UNO, GPS tracking;

I. INTRODUCTION

Cattle farming is an important industry, but managing the health of a large herd can be challenging. The system uses wireless sensor points attached to individual items to collect information about their vital signs and behavior. The data is sent to a central server, where machine learning algorithms analyze it to detect health problems. Real-time monitoring of animals allows farmers and veterinarians to detect health problems in time and take practical measures. The systemalso helps to achieve better efficiency and reduce manual control.

Overall, the system aims to improve animal health and welfare, optimize farming practices and ensure the safety and quality of dairy products. Purpose:

- Monitor animals in real-time for early detection of potential health problems.
- Reduce labor-intensive manual control and increase efficiency in large farms.
- Ensure the safety and quality of meat and dairy products by monitoring animal health
- and reducing the risk of disease transmission.

II. LITERATURE SURVEY

Developing a wireless sensor network dedicated to monitoring the health of animals in a feedlot [1]. This paper introduces an innovative and viable livestock health monitoring system that incorporates directional antennas and wireless sensor network technology. The system requires attaching IEEE 802.15.4-based ear tags to the animals, recording feeding behavior, and uploading the data to the aquarium router. Simulationsshow that the minimum wake-up time is 2500 ms for a tag interpretation success rate greater than 90%. Furthermore, the system includes a routing strategy that takes into consideration the trade-off between network lifetime and energy consumption. Future research should explore the trade-off between router numbers, drone assistance, LPWA technology, solar energy, and wake-up radio rather than exploring routing based on duty cycle. A Taxonomy of Intelligent Wearable Devices and Biosensors for Cattle Health Monitoring [2] Smart farm technology is rapidly gaining popularity for livestock health monitoring, and smart wearables and biosensors are becoming the future of livestock management. These compact and minimally invasive devices provide real- time monitoring and rapid response. However, there is currently no classification or classification scheme for these technologies. The aim of this paper is to create taxonomy of the most advanced smart wearables and biosensors used to monitor livestock health. This classification includes sensor type, energy source, health parameter measured and connection area on the body. Implementing wireless sensor networks for remote biometric data collection in cattle farming [3] a wireless health monitoring system was designed specifically for the cattle industry to oversee vital biological parameters, including temperature, pH value, and indications of injuries. The system uses wireless sensors attached to the cattle's body, coordinated by a microcontroller. The ARM7 microcontroller senses and transmits these parametersto a system that monitor the health of the cattle. The system helps prevent liver damage and detects wounds by identifying changes in color and temperature. Implementing a multidimensional association rule- based data mining technique for the purpose of monitoring cattle health via a Wireless Sensor Network [4] Wireless sensor networks (WSNs) produce extensive volumes of data, frequently in unfamiliar and unwieldy formats. Data Storage along with

mining techniques is essential to this domain. In this paper, we suggest a multidimensional association rule-based data mining approach for a livestock health monitoring system based on Wireless Sensor Networks (WSNs).The paper provides an outline of data mining concepts and preferred technique used for WSN data. It discusses various diseases with their symptom within cattle and proposes a rule-based mining method for symptom-based disease identification. Accomplishment of this method will help users to get appropriate measures to identify cattle diseases. The objective of this research is to motivate researchers to develop more robust and

effective data mining methods for identifying diseases in cattle health data acquired through WSNs. Evaluating a monitoring tool based on Wireless Sensor Networks for zero-effort technologies: A case study in monitoring cattle health and movement [5] Wireless sensor networks (WSNs) and the most recent developments in computing are addressing societal challenges, especially in marginalized rural areas. (MRA). Assistive technologies such as Zero Effort Technologies (ZET) are arising from the provision of novel ICT solutions for solving MRA challenges, such as long-term monitoring of animal health. This research proposes a WSN which can connect accountable agencies such as Agricultural Extension workers, into their cattle drove near improve animal tracking and ensure the correct animal breeding.

The cattle industry plays a vital role in the global economy, and continuous monitoring of animal health is pivotal for ensuring high-quality beef production. Monitoring essential data, including core body temperature, is fundamental for health assessment. This paper provides an overview of a Wireless Sensor Network (WSN)-based cattle monitoring tool that can serve as a Zero Effort Technology (ZET) for monitoring both cattle health and their movement.

There are no existing cattle tracking systems on South African ranches body temperature, rectal temperature or location. Digital thermometers and manual controls are used to monitor body temperature but remote temperature monitoring is possible to offer an additional precise measurement. Therefore, a WSN-based system for body temperature along with position monitoring is suggested.

The system is effortless to set up and enables continuous consistent monitoring of cattle health would greatly recover cattle health and production. The subsequent advantages, such as early disease detection and the prevention of livestock deaths, can be realized through the application of this technology.

III. METHODOLOGY

We first conducted a literature review and theoretical research within the Animal Control and Health Monitoring System project. We then analyze the challenges and develop effective approaches to implement such control systems. Then we connect components like Arduino and some sensors. We developed this model to identify constraints and conditions for animal health analysis.

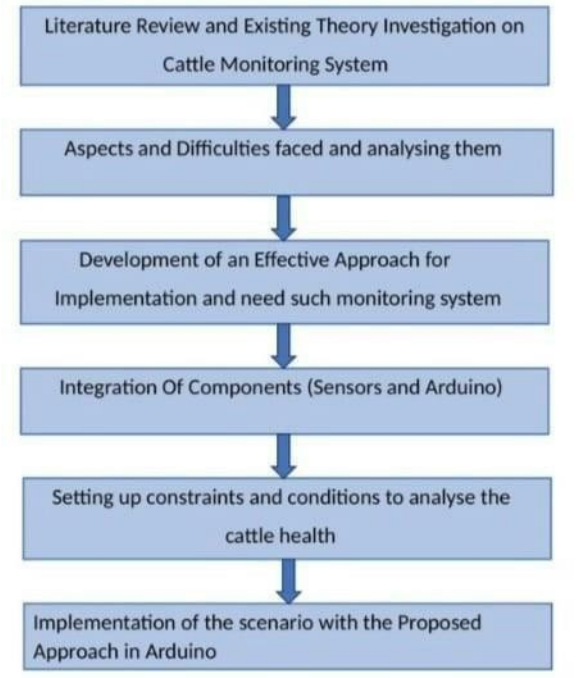

Fig. 1. The methodology utilized in an existing model.

A livestock health monitoring prototype is a working model or early version of a system developed to monitor and manage the health and safety of livestock. The prototype includes various sensors to collect data such as livestock, health parameters such as heart rate, body temperature, and even location tracking. These sensors are attached to the animal, often with a collar or ear tag. The GPS module tracks the real location and movement of individual items. The prototype is accessed and controlled by a mobile application. This interface allows users (farmers, veterinarians, etc.) to monitor livestock health, track

movements, issue alerts, and configure system settings. The livestock health monitoring prototype is a functional model that integrates hardware, communication, data processing and user interface to demonstrate the concept of livestock health and behavior monitoring.

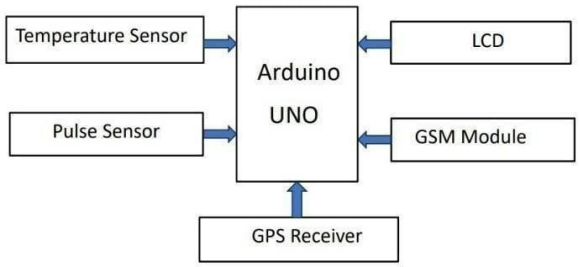

Fig. 2. The schematic representation of the proposed system in a block diagram

A. Arduino UNO

The 8-bit AVR® microcontroller features an advanced RISC architecture and 131 powerful instructions. Equipped with 32 x 8 general purpose work registers, it operates in full static mode and achieves a throughput of up to 20 MIPS. This microcontroller has an on-chip 2-loop multiplier and a non-volatile memory segment. It also offers in-system programming capabilities and program locking functions to improve software security. It also provides various peripheral functions, including two 8-bit timer / counter, one 16-bit timer / counter, real-time counter, six PWM channels, temperature measurement capabilities, USART programmable serial interface, master / slave SPI serial. interface, a byte-oriented 2-wire serial interface, programmable timer, an on-chip analog comparator, interrupt support, and the ability to wake up on pin changes. It also includes custom microcontroller functions and provides 23 programmable I/O lines. The operating voltage range is from 1.8V to 5.5V and can operate from -40°C to 85°C. Even at 1MHz and 1.8V, it consumes less power at 25 °C.

B. Heartbeat Sensor

A heart rate sensor or pulse sensor measures the animal's heart rate, which is related to stress, pain and disease. Heart rate variability is used as an indicator of stress and well-being. Large cows have a heart rate of 48-84 beats per minute, which can be estimated using a heart rate monitor or pulse monitor. Advanced systems have alarm and warning mechanisms that alert farmers or veterinarians if significant deviations from normal heart rates occur, allowing for timely intervention and treatment.

C. Temperature Sensor

Body temperature is an important parameter used to assess the body's condition and can be an early warning sign for illness and disease. However, obtaining data on pastures is very demanding in terms of time and effort, which addresses the measurement requirements to ensure systematic and programmatic safety of these parameters. Various methods have been used to measure the body temperature of bulls, including anatomical areas such as anus, ear (tympanic), forehead, and hand (groin). Romani's experiment measured the normal core temperature of resting dairy cows, which is usually reported as 101.5 degrees Fahrenheit (38.6 degrees Celsius). Animals must be kept indoors to maintain body temperature and physiological processes; . According to some scientists, the range is 100 to 104 °F [37.8 °C to 40.0 °C]. The body temperature of dairy cows rises during the middle of the day, unlike animals that spend their time in the heat. The lowest body temperature usually occurs at a young age and then rises steadily throughout the day.

D. Liquid-crystal display(LCD)

The 16x2 LCD provides real-time animal health updates with a real-time display of body temperature and heart rate. Each of the two lines can represent an alphabet displayed in a grid of 5x7 pixels. This LCD consists of two registers: a command register that holds instructions to control the LCD's functions such as initialization, clearing the screen, cursor position, and display control; and Data register, which stores data to be displayed in the form of ASCII code that represents characters on the LCD. Two systems listed together form a complete operation displayed on a 16x2 LCD screen.

*E. **Global Positioning System(GPS)***

GPS (Global Positioning System) devices are widely used to provide real-time location information in livestock tracking and health monitoring systems, monitor livestock movements, and improve herd management. In such a system, GPS technology is used as follows: It allows for accurate and continuous tracking of the location of individual animals in the herd. Each animal is equipped with a GPS-enabled collar or tag that transmits precise geographic coordinates to a central monitoring system. This helps farmers to track where their livestock is and locate them quickly if needed.

E. Global System for Mobile communication(GSM)

GSM (Global System for Mobile Communications) technology can be seamlessly integrated into asset tracking systems and health monitoring systems, providing real-time communication, data transfer and remote management functions. GSM enables real-time transmission of data from GPS trackers, sensors and other monitoring devices attached to goods. This data may include location data, health metrics (heart rate, body temperature, and activity level) and other relevant data points.

IV. COMPARATIVE ANALYSIS

Table 1: Comparing the existing model with the proposed model.

Parameters	Existed Model	Proposed Model
Functionality	Loc-Tracking	Loc-tracking ,health monitoring
Accuracy	Less Accurate Data	More Accurate Data
Cost	High Cost	Cost Efficient
Hardware Requirements	Temp-pulse Sensor	Temp-pulse Sensor ,PS

V. SOFTWARE

The Arduino IDE (Integrated Development Environment) serves as a software platform dedicated to programming and application development for Arduino microcontrollers and compatible boards. It offers a user-friendly interface for crafting, compiling, and uploading code to manage diverse electronic projects. Arduino IDE simplifies code programming and debugging, making it a valuable tool for both writing and uploading code to Arduino boards, such as the Arduino UNO, via a PC or laptop connection using a data cable.

VI. RESULTS

A. Working model of cattle ,health monitoring andtracking system

A livestock health monitoring prototype is a working model or early version of a system designed to monitor and manage the health and welfare of livestock. The prototype includes several sensors to collect data such as animal health parameters, heart rate, body temperature and location tracking. These sensors are attached to the animal, often with a collar or ear tag. The GPS module tracks the real location and movement of individual items. The prototype is accessed and controlled by a mobile application. This interface allows users (farmers, veterans, etc.) to monitor farm health, track movement, configure alerts, and configure system settings. The livestock health monitoring prototype is a functional model that integrates hardware, communication, data processing and user interface to demonstrate the concept of livestock health and behavior monitoring.

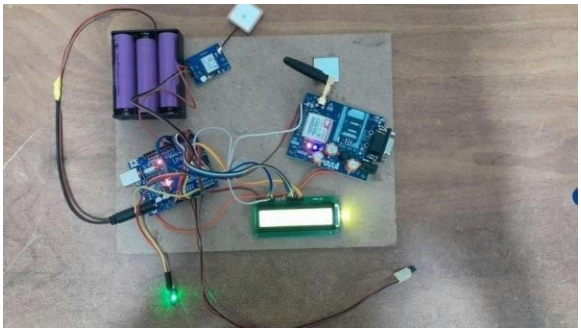

Fig. 3. Working Model

B. Outputs

LCDs are used in livestock health monitoring systems to provide real-time visual feedback and display information for owners. LCD cow health monitoring system is used to display cow temperature and heart rate detected by temperature sensor and heart rate sensor.

Fig. 4. Temperature and heart rate of the cattle displayed in LCD

C. Simulation Results

Livestock tracking and health system results show the location of livestock tracked using GPS.

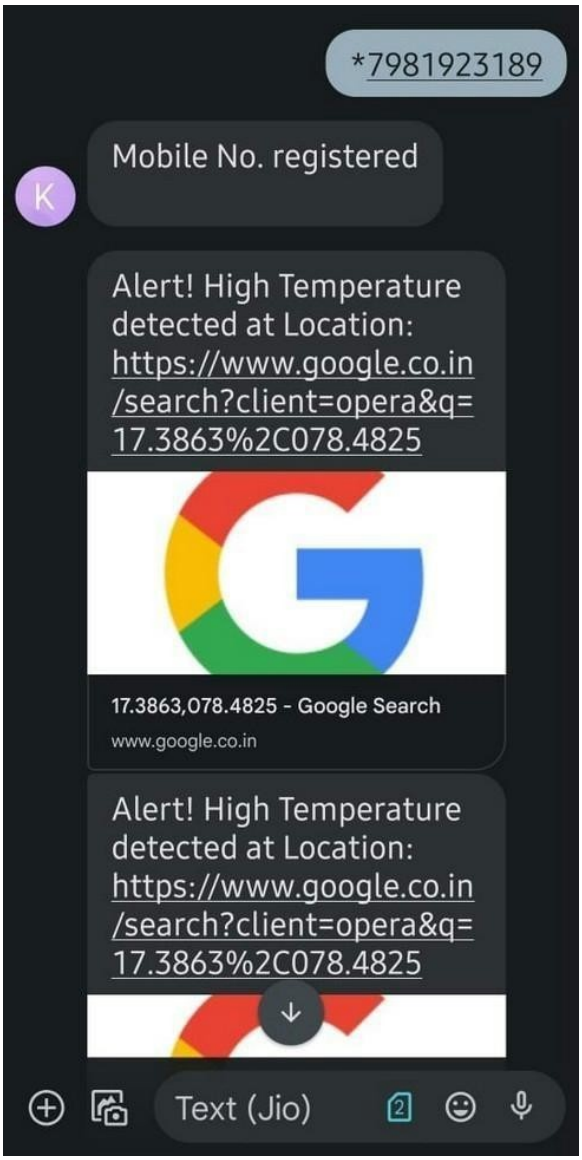

Fig. 5. Result of Cattle tracking and health monitoring

VII. CONCLUSIONS AND FUTURE SCOPE

A. Conclusion

In summary, the project effectively demonstrated the introduction of a livestock health monitoring system using a wireless sensor network. By combining temperature and heart rate sensors, real-time data is collected and transmitted, enabling early detection of animal health problems. The project also notifies farmers or veterinarians in real time when abnormal health conditions are detected. This technology has significant potential to improve animal husbandry practices, improve animal welfare, and improve agricultural practices. As the project continues to develop, further improvements and advances in sensor accuracy, data analysis and system scalability can add even greater benefits to agriculture. We have introduced a livestock health monitoring system that uses a network of wireless sensors to collect vital information about each animal. This data includes heart rate measurements taken using a pulse sensor and temperature readings collected using a temperature sensor. The goal is to use these wireless network-based sensors to help in the early detection and prediction of livestock diseases.

B. Future scope

Livestock tracking and health monitoring systems using wireless sensor networks are promising in precision agriculture and livestock management. Future areas include data analytics and predictive models, disease detection and prevention, behavioral analytics, environmental monitoring, energy efficiency, integration with IoT platforms, remote monitoring and control, long-term health trends, collaboration with veterinarians, sustainability and ethics.network expansion. Successful implementation requires a multidisciplinary approach involving agriculture, veterinary education, information science and technology development. Featuring advanced analytics, disease detection algorithms, behavioral analytics, environmental monitoring, energy efficiency, IoT platforms, remote management, long-term health trends, collaboration with veterinarians, and sustainability and ethical considerations, this system provides livestock management expertise and improve animal health control.

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