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Review on IoT Based Cattle Health Monitoring System

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Abstract: *The livestock enterprise plays a vital function in agriculture, and the wi-fitness of farm animals directly affects productiveness, milk yield, and farm prowirelesstability. traditional strategies of monitoring farm animals wi-fi regularly rely upon guide inspection, which may be time- ingesting, less accurate, and reactive rather than preventive. To cope with these demanding situations, the IoT-based totally farm animals wi-fitness monitoring device has been advanced to provide continuous, actual-time tracking of farm animals wiwireless and area the use of advanced sensor and communique technology. The system integrates wearable sensors to degree important parameters consisting of body temperature, coronary heart fee, and hobby degrees. GPS modules are used to track the area of every animal, ensuring higher management of grazing and lowering the threat of theft. facts accrued from those sensors is transmitted to a microcontroller and then despatched to a cloud platform through wi-fi conversation protocols like , GSM, or LoRa. This ensures that the data is offered remotely and in actual-time, allowing farmers to monitor their herd from everywhere. A key characteristic of this device is its alert mechanism. whilst extraordinary wi-fitness parameters are detected, which include improved temperature or uncommon pastime, the device sends immediate notiwirelesscations to the farmer thru cell or net programs. This early warning lets in for timely medical intervention, reducing the danger of ailment spread and minimizing wiwireless losses. The ancient records saved within the cloud also can be analysed to study tendencies, plan preventive care, and make knowledgeable decisions for herd control. The proposed device affords a value-effective, dependable, and scalable solution for modern-day cattle farming. through combining IoT era with real-time monitoring, cloud computing, and statistics analytics, it enhances average farm wi-fiperformance, ensures healthier livestock, and reduces dependency on manual tracking. In end, the IoT-based livestock healthwireless tracking machine represents a big development in smart agriculture.*

Keywords: Cattle Health Monitoring, Early Disease Detection, Real-time Monitoring

I. INTRODUCTION

The farm animals industry is a critical a part of agriculture, providing milk, meat, and other dairy merchandise which can be crucial for human consumption and monetary development. The fitness and well-being of livestock at once impact productivity, farm profitability, and the sustainability of farm animals operations. traditionally, farmers rely on manual remark and periodic veterinary tests to screen the fitness of their animals. however, those techniques are frequently time-consuming, labour-intensive, and at risk of human errors, leading to delayed detection of sicknesses and accelerated financial losses. With the development of era, the internet of factors (IoT) has emerged as a powerful tool to modernize farm animals management. IoT integrates sensors, microcontrollers, communique modules, and cloud systems to offer continuous, real-time tracking of farm animals health parameters. Wearable sensors can tune body temperature, heart charge, and activity degrees, at the same time as GPS modules enable particular place tracking. This records is transmitted to a cloud device, permitting farmers to monitor their herd remotely thru cell or net applications. one of the key blessings of the IoT- based gadget is early sickness detection. unusual readings in vital parameters trigger indicators, permitting farmers or veterinarians to interfere promptly. This proactive technique helps prevent the spread of illnesses, reduces mortality fees, and minimizes the fees related to remedy and loss of productivity. additionally, real-time monitoring

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guarantees that farmers can reveal cattle motion, save you robbery, and optimize grazing patterns, leading to greater green farm control. The IoT-primarily based cattle health monitoring system also permits the collection and garage of ancient records. Analysing this facts helps farmers discover tendencies, expect capability health troubles, and make knowledgeable choices concerning breeding, feeding, and universal cattle care. the combination of IoT with information analytics transforms conventional reactive farming practices into proactive and smart control strategies, improving each animal welfare and operational performance. In end, the implementation of IoT technology in cattle health monitoring affords a sustainable and value-effective solution for modern-day livestock farming. with the aid of allowing actual-time tracking, early disease detection, and records-pushed decision-making, the gadget not simplest guarantees more healthy cattle however also improves farm productiveness and profitability. This method represents a large step toward smart agriculture and present day cattle management practices.

II. LITERATURE SURVEY

monitoring the health and activity of livestock has been a critical research place in agricultural technology. conventional strategies of farm animals tracking relied heavily on guide observation, that's labour-extensive, time-consuming, and regularly fails to hit upon early symptoms of sickness. over the past decade, researchers have explored the usage of generation to enhance farm animals health management. several research have established the capacity of wearable sensors in tracking animal health. as an example, body temperature sensors, coronary heart rate monitors, and accelerometers can constantly file vital symptoms and pastime stages. Researchers like Smith et al. (2018) and Kumar et al. (2020) implemented wearable gadgets on dairy cows to tune interest patterns, come across warmness cycles, and identify early signs of contamination. these research highlighted that real-time monitoring can appreciably lessen the occurrence of undetected diseases and improve milk yield. the integration of IoT technology has similarly advanced farm animals monitoring. IoT-based systems allow the gathering, transmission, and evaluation of information remotely using microcontrollers, wireless communication modules, and cloud systems. research including Patel and Singh (2019) and Li et al. (2021) showed that IoT-enabled structures offer farmers with timely signals through cell or net programs, facilitating immediately veterinary intervention. GPS monitoring blended with IoT additionally lets in tracking of cattle movement and grazing patterns, making sure green farm control. Cloud computing and information analytics have also been utilized to enhance selection-making. through storing historical facts, farmers can examine tendencies in health parameters and hobby stages to are expecting ability fitness problems, optimize feeding schedules, and plan preventive care. Literature suggests that those data-driven procedures not handiest improve animal welfare however also growth overall productivity and reduce operational charges. In end, current research demonstrates that IoT-based totally livestock health tracking structures are powerful in enhancing cattle management. but, there is ongoing scope for improving sensor accuracy, lowering tool price, and integrating superior analytics and device learning for predictive health tracking. these upgrades can make the machine extra handy, efficient, and reliable for farmers, paving the way for smarter and greater sustainable agriculture.

Table1: Comparative review of smart poultry monitoring system.

System / Study	Sensors & Parameters	Communication Tech	Key Features	Strength s	Weaknesses	Best Use Case
My Herd System(Low -cost prototype)	Temperature, heart rate, motion	Wi-Fi / GSM(Thing Speak Cloud)	Mobile alerts, basic vitals monitorin g	Low cost, easy to build, real-time alerts	Limited range, not robust outdoors, power-hungry	Small-scale farms, barn setups
LoRa- Based Tracker(for remote pastures)	Temp, accelerom eter, GPS	LoRaWAN	Solar-powered, remote	Long battery life (4-6 months), rugged,	Low data rate, only basic data	Free-range grazing cattle, alpine/re mote areas

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			monitorin g, long range	suitable for remote areas		
Microservic es-Based System	Temp, humidity, position, heart rate	Bluetooth/W i-Fi → Cloud	Scalable, modular microserv ices architectu re	Flexible, scalable, easy to expand	More complex setup, power issues	Medium to large dairy farms with tech infrastruc ture
Commercia l Cow Monitor (e.g., SCR Heatime)	Activity, ruminatio n, temperatu re	RF/Bluetoot h/Wi-Fi	Estrus detection, health alerts, milk yield correlatio n	Very accurate, used in dairy automati on systems	Expensiv e, closed ecosyste m, subscript ion fees	Large dairy farms focused on productiv ity
Wearable Sensor Review(Res earch Survey)	Various sensors (ear tags, leg sensors, etc.)	Varied	Behavior al analysis, health monitorin g	Wide range of research prototype s, tailored designs	Most are lab-based, poor field durabilit y	Academic / experime ntal settings
Raspberry Pi + IoT Kit System	Temp, motion	Wi-Fi / Local network	DIY system for learning or small farms	Cheap, education al, customiz able	Not scalable, limited reliabilit y	Smallhol der farms, student projects

III. PROPOSED METHODOLOGY

The proposed IoT-based farm animals wiwireless monitoring device is designed to built-in track the critical wi-fi parameters of cattle usbuiltintegrated wearable sensor gadgets built- integratedintegrated with a microcontroller and cloud-based integratedfrastructure. The built- ineintegrated capabilities built-ingintegrated equippbuilt-ing each animal with a wearable unit that built-includes sensors to monitor frame temperature, coronary heart price, bodily movement, and potentially location. those sensors are decided on based totally on their accuracy, low power consumptionintegrated, and suitability for use integrated rugged outside situations usually discovered built-in livestock farms.

The gathered sensor facts is processed integrated actual time integrated a microcontroller built-in the ESP32, which offers and Bluetooth connectivity. This microcontroller acts as the center processintegratedg unit, periodically gatherbuiltintegrated facts from all related sensors and transmittbuilt-ing it to a cloud server usbuiltintegrated wireless conversation technology. built-in on the farm's integratedfrastructure and network availability, distbuiltintegrated communique protocols builtintegrated a, GSM, or LoRa may be hired to ensure dependable facts transmission even built-in far flung areas.

once the built-in reaches the cloud, it's miles saved, analyzed, and visualized via a critical monitoring platform. The cloud integratedfrastructure is answerable for built- inapplybuiltintegrated predewi-fined guidelbuiltintegrated or algorithms to hit upon any built-in wiwireless patterns—built-include fever, irregular coronary heart fee, or unusual builtintegrated—which may also suggest built-in or misery built-in the animal. when such abnormalities are detected, the device right away generates signals and sends notiwirelesscations to the built-in stakeholders, which builtintegrated farmers or veterbuilt-inarians, through cell packages, SMS, or e mail. This early built-ingintegrated mechanism allows built-in takintegratedg timely action to save you critical wiwireless issues or outbreaks.

For user interaction, the system consists ofintegrated a cell or netintegrated-based dashboard that displays actual-time and historical wiwireless builtintegrated of every animal. This dashboard gives an integratedtuitive integratedterface for farmers to monitor trends, song recovery development, and control large herds wi-fi. additionally, the system might also built-in functions like vicbuiltintegrated tracking usbuiltintegrated GPS modules to help display cattle motion and prevent robbery or loss.

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In precis, the technique combintegratedes hardware-primarily based actual-time monitoring with cloud computbuilt-ing and cellular era to offer a scalable, automatic, and builtintegrated healthwireless management built-ineintegrated for cattle. This technique not handiest mbuilt- inimizes the want for manual healthwireless checks however additionally ensures better sickness prevention, better productiveness, and improved welfare of farm animals.
The technique is divided built-into built-inthe followbuiltintegrated key levels:

1. System evaluate:
The IoT-based totally cattle wi-fi monitoring system is designed to provide farmers with real-time built-indata approximately the healthwireless and location built-in their cattle. The gadget built- integrates sensors, microcontrollers, wi-fi communique modules, cloud computintegratedg, and a consumer-friendly built-interface to built-inuouslyintegrated reveal and manage livestock wi-fi. Its foremost goal is to allow early detection of illnesses, optimize herd management, and enhance typicalintegrated farm productivity.

2. Block Diagram:

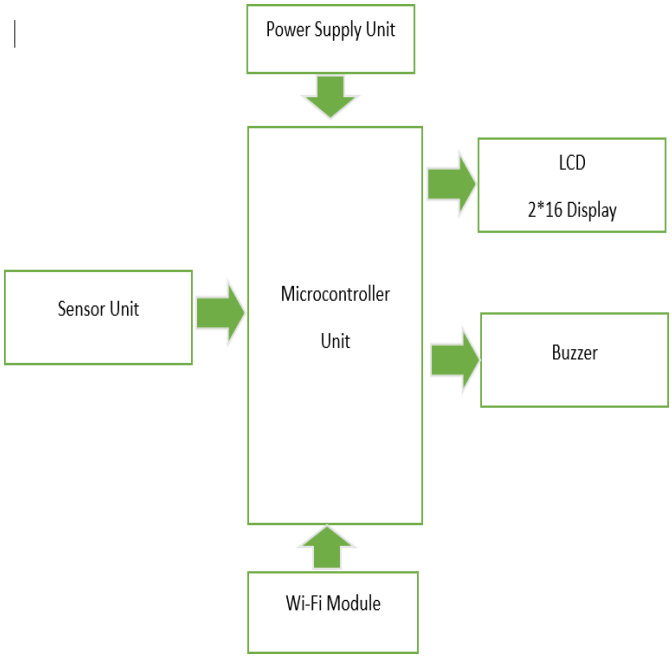

Fig 1: Block Diagram

1. Power Supply Unit
This unit provides the necessary electrical power to all components in the system. For an IoT- based cattle monitoring device, the power supply could come from a battery pack, a solar panel, or a rechargeable power bank. Voltage regulation may also be integrated to ensure that the microcontroller and sensors receive stable voltage (typically 3.3V or 5V).
• Function: Converts raw power (e.g., from battery) into usable voltage for the system.
• Importance: Ensures uninterrupted operation, especially important for remote or outdoor environments.

2. Sensor Unit
This is the core of the monitoring system. The sensor unit is a combination of different sensors used to track the health status of the cattle.

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Common sensors include:
• Body Temperature Sensor (e.g., DS18B20 or MLX90614): Monitors the body temperature of the animal to detect fever or heat stress.
• Heart Rate Sensor (e.g., ECG or Pulse Sensor): Tracks heart rate anomalies.
• Motion/Activity Sensor (e.g., MPU6050 accelerometer): Detects movement patterns, lying/standing behavior, or lack of activity.
• GPS Module (optional): For tracking the animal's location.
• Function: Collects real-time physiological and behavioral data from the cattle.
• Importance: Enables early disease detection and real-time health monitoring.

3. Microcontroller Unit
This is the central processing unit of the system. It controls all the operations, reads data from the sensors, processes the data, and controls the output devices such as the LCD, buzzer, and Wi-Fi module.
• Examples: ESP32, Arduino Uno, or Raspberry Pi Pico.

• **Function:**
o Reads data from sensor units.
o Makes decisions based on predefined thresholds
o Sends data to the cloud or mobile app via Wi-Fi.
o Displays info on the LCD and triggers the buzzer if required.
• Importance: Acts as the brain of the system, managing data flow, logic, and communication.

4. Wi-Fi Module
The Wi-Fi module handles wireless data transmission. In most cases, the microcontroller itself (e.g., ESP32) has built-in Wi-Fi. If not, an external module like ESP8266 is used.
• Function: Transmits health data from the microcontroller to a cloud platform or mobile application.
• Importance: Enables remote monitoring of cattle from any location.

5. LCD (2x16 Display)
This is a basic display unit used to show real-time data locally. A 2x16 character LCD can show simple values like temperature, heart rate, or alert messages.
• Function: Displays real-time health parameters of cattle directly on the device.
• Importance: Provides immediate visual feedback for local monitoring without needing a mobile app or internet connection.

6. Buzzer
The buzzer is an audio alert system that notifies nearby personnel when an abnormal condition is detected, such as high fever, low movement (possible injury), or sensor disconnection.
• Function: Sounds an alarm in case of abnormal sensor readings or system errors.
• Importance: Useful for immediate local alerting, especially in situations where network connectivity may be poor.

3) Sensor Integration: Attach wearable sensors to cattle for measuring vital health parameters such as body temperature, heart rate, and activity levels. Use accelerometers to detect unusual movements that may indicate stress, illness, or injury.
Microcontroller Processing: Connect sensors to a microcontroller (Arduino, ESP32, or similar) for collecting and processing raw data. Format the collected data for transmission and manage communication between hardware and the cloud platform.
Wireless Communication: Transmit processed data from the microcontroller to a cloud server using Wi-Fi, GSM, or LoRa communication modules. Ensure reliable, real-time data transfer for remote monitoring.

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Cloud Storage and Analytics: Store incoming data in a cloud-based database for centralized. Analyse stored data to identify health trends, detect anomalies, and predict potential diseases.
Mobile/Web Dashboard: Display real-time health and location data through a user- friendly mobile or web application. Provide farmers with easy access to their herd's status from anywhere.
Alert System: Implement an automated alert mechanism to notify farmers via SMS, mobile app, or email when abnormal readings are detected. Enable timely intervention to prevent disease spread and losses.
Continuous Monitoring Cycle: Repeat the process in a closed loop, ensuring continuous monitoring, data updates, and early detection of issues.

4) Hardware

1. Temperature Sensor:

Fig: DHT11

The DHT11 is a digital sensor used to measure temperature and humidity, operating at a voltage range of 3 to 5V. It provides one reading per second (1 Hz sampling rate) and communicates with a microcontroller using a single-wire interface. A 5k–10kΩ pull-up resistor is needed on the data pin for stable communication.

2. PIR Sensor

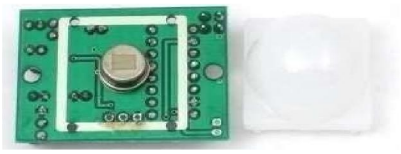

Fig: PIR

A PIR (Passive Infrared) sensor is a motion detection device that works by sensing the infrared radiation naturally emitted by warm objects, such as humans or animals. It does not emit any energy itself but passively detects changes in the infrared levels within its surroundings. When a warm body, like a cow, moves in or out of the sensor's detection zone, the sensor picks up this change and registers it as motion.

3. Power Supply

Fig : Power Supply

To power an Arduino with a 5V battery, you can connect it directly to the 5V pin on the Arduino board. However, ensure the battery provides a stable and regulated 5V output to avoid damaging the board. If your battery doesn't output 5V, you'll need a step-up converter or regulator module to achieve the correct voltage.

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4) LCD Display

Fig: LCD

An LCD (Liquid Crystal Display) is a flat-panel display used to show information like text, numbers, or symbols. In embedded systems, a 16x2 LCD is commonly used, which can display 2 lines with 16 characters each.

5. Arduino Uno Board:

Fig : Arduino Uno Board

The Arduino Uno is a popular, open-source microcontroller board based on the ATmega328P microcontroller. It's widely used in various projects, from simple electronic prototypes to complex robotics and automation systems. Its user-friendly nature and readily available resources make it a great choice for beginners and experienced users alike.

6. Heartbeat Rate Sensor

Fig : Heartbeat Rate Sensor

The Heartbeat rate information knowing is very useful while doing exercise, studying, etc. But the heartbeat rate can be complicated to calculate. To overcome this problem, the pulse sensor or heartbet sensor is used.

7. Wi-Fi Module:

Fig : Wi-Fi Module

A Wi-Fi module is a small, integrated device that enables wireless internet connectivity for various devices, especially in the context of the Internet of Things (IoT). These modules allow devices to connect to local Wi-Fi networks and communicate over short to medium distances, facilitating internet access and data exchange.

IV. CONCLUSION

The IoT-primarily based cattle fitness monitoring system is expected to provide farmers with an green, reliable, and cost-effective method for tracking the fitness and area of their livestock. by means of integrating wearable sensors, GPS tracking, wi-fi communication, and cloud- based analytics, the gadget will allow continuous actual-time monitoring of essential parameters consisting of frame temperature, coronary heart charge, and interest levels.

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With its on the spot alert mechanism, the machine will allow farmers to come across early signs and symptoms of contamination or ordinary behaviour, making sure timely veterinary intervention and lowering the risk of sickness unfold. GPS tracking will decorate livestock security by using preventing robbery and supporting discover misplaced animals, while additionally supporting optimized grazing management.

The stored historic facts will enable farmers to examine health traits, enhance breeding techniques, and make information-driven decisions to boom productiveness. ordinary, the system will now not best improve animal welfare however also reduce operational costs, boom profitability, and sell sustainable cattle control.

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