IOT-BASED ANIMAL TRACKING AND HEALTH MONITORING SYSTEM

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Abstract - Continuous observation of the health and movement of animals is essential in contemporary livestock and wildlife management to guarantee their welfare and avert possible hazards. The IoT-based Animal Tracking and Health Monitoring System described in this research paper uses an Arduino Uno, GPS module, temperature sensor, accelerometer sensor, LCD display, and IoT connectivity to track the position and health status of animals in real time. While the accelerometer sensor examines movement patterns and posture to spot anomalies like extended lying down, which may be signs of injury or disease, the temperature sensor keeps track of the animal's body temperature, allowing for the early diagnosis of fever or illness. Farmers and wildlife researchers can monitor more efficiently. Sensor data is processed by an Arduino Uno and shown locally on an LCD screen; the data is also transmitted via an Internet of Things module, allowing for remote access via cloud-based systems or mobile applications. By offering real-time insights, facilitating early illness identification, and enhancing protection against theft or loss, the suggested method improves livestock management and wildlife conservation. It guarantees effective and automatic animal monitoring, minimises manual labour, and speeds up emergency response times through IoT integration. This creative method makes a substantial contribution to the development of wildlife tracking and intelligent farming technology. Furthermore, the system can be extended to include geofencing capabilities, which alert users if an animal strays beyond a predefined boundary, thereby enhancing containment and safety measures in both farm and wildlife reserve environments.

Keywords - Wildlife Conservation, GPS Tracking, Temperature Sensor, Remote Health Surveillance

I. INTRODUCTION

Monitoring wildlife and livestock is essential to preserving animal populations' productivity, safety, and general well-being. It can be difficult to identify early indicators of disease or distress using traditional approaches, which mostly rely on manual surveillance and are frequently labour-intensive, time-consuming, and inefficient. Rapid developments in Internet of Things (IoT) technology have led to the emergence of automated monitoring programs that enable tracking of position and health in real time, greatly improving animal welfare and management effectiveness.

Using a range of sensors and Internet of Things connectivity, the IoT-Based Animal Tracking and Health Monitoring System continuously tracks the whereabouts and health of an animal. By using a temperature sensor to track the animal's body temperature, fever or other sickness indicators can be identified early. An accelerometer sensor examines movement and posture patterns to detect conditions like extended lying down, which could be a sign of illness or injury. Adding a GPS module also makes it easier to follow an animal's whereabouts in real time, giving researchers and farmers the ability to remotely keep an eye on the exact location and movement of animals.

An Arduino Uno microcontroller is incorporated into the system architecture to effectively gather and process the sensor data. For local monitoring, live readings are shown on an LCD screen, and the IoT module makes sure that data is sent to a cloud computing platform without any problems. This allows for remote access via a web dashboard or mobile application, guaranteeing that vital information is always accessible, no matter where the caretaker is. The technology reduces manual labour and speeds up emergency response times by providing an automated, real-time monitoring solution that supports effective wildlife conservation, early illness identification, and efficient livestock management.

This Paper flows Section 2 Literature Survey, Section 3 Existing System, Section 4 Proposed System, Section 5 System Architecture, Section 6 Tools and Technologies, Section 7 Module of , Section 8 Result, Section 9 Conclusion and future Enhancement and finally References.

II. LITERATURE SURVEY

[1] **Development of IoT Based Smart Animal Health Monitoring System [(S. S. Solapure, S. S. Katti, and S. S. Manvi, 2018)]**

The creation of an intelligent animal health monitoring system based on the Internet of Things is presented in this study. The system uses a variety of sensors to track an animal's vitals in real time, including heart rate and temperature. By sending the gathered data to a central computer, farmers and veterinarians may monitor the health of their cattle from a distance. By making it easier to identify health problems early on, this strategy seeks to increase farm output and animal welfare. The device uses sensors to track environmental variables like humidity and ambient temperature as well as physiological indicators like body temperature, heart rate, and rumination. Real-Time Monitoring: By using a Raspberry Pi and Wi-Fi connectivity, the system makes it possible to gather and transmit data in real-time, giving consumers remote online access to health information.

[2] IoT-Based Livestock Monitoring and Management System Using Machine Learning Algorithms [(A. K. Sangaiah, R. Sahal, and M. Omri, 2020)]

For effective cattle monitoring and management, the study presents an Internet of Things-based system coupled with machine learning algorithms. The technology gathers information on movement, behaviour, and physiological factors by equipping animals with wearable sensors. In order to help farmers make educated decisions and guarantee prompt actions, machine learning models examine this data to identify irregularities and forecast any health problems. The system enables continuous, real-time monitoring of cattle, allowing for immediate detection of issues such as lameness, low activity, or signs of distress. By analyzing subtle changes in behavior or physiological data, machine learning models can detect potential health issues at an early stage, reducing treatment costs and preventing disease spread. Wearable sensors can track reproductive behavior, helping farmers identify optimal breeding times, thereby increasing fertility rates and improving herd productivity.

[3] A Survey on IoT-based Cattle Monitoring Systems and Dashboards [(M. A. El Moutaouakil, J. Jdi, and M. Falih, 2023)]

The current IoT-based cattle monitoring systems and the dashboards that go with them are reviewed in this survey paper. It looks at the different kinds of sensors, communication protocols, and data visualisation tools used for tracking and monitoring the health of cattle. In addition to outlining the advantages and difficulties of putting such systems into place, the article offers suggestions for future lines of inquiry in the area of intelligent livestock management.

[4] Smart Animal Health Monitoring System using IoT [(D. Gowthami, K. Aakash, A. M. Arsath, and V. Santhosh Kumar, 2023)]

The study suggests a clever IoT-based animal health monitoring system. Using sensors, the technology continuously checks the animals' vital signs and sends the information to a cloud-based platform. Early identification of health abnormalities is made possible by real-time data processing, which allows for timely medical intervention. The implementation is to lower cattle death rates and enhance animal health management. The use of a cloud platform ensures secure and scalable data storage, enabling long-term health tracking and historical analysis of individual animals or herds. Farmers and veterinarians can access the data remotely through mobile apps or web dashboards, reducing the need for constant physical inspections. The system can automatically notify farm personnel when abnormal readings are detected, such as sudden temperature spikes, reduced heart rate, or inactivity.

[5] Systematic Review on Internet of Things in Smart Livestock Farming [(M. A. El Moutaouakil, J. Jdi, and M. Falih, 2023)]

The use of Internet of Things (IoT) technology in intelligent cattle husbandry is examined in this systematic study. It examines different IoT-based methods for keeping an eye on the behaviour, health, and surroundings of animals. The benefits of IoT integration for improving animal welfare and farm productivity are covered in the paper, along with the difficulties associated with connectivity, scalability, and data management. The study likely compares various sensor types (e.g., RFID, GPS, accelerometers, biosensors) and their effectiveness in monitoring specific aspects of cattle behavior and health.

III. EXISTING SYSTEM

Currently, manual supervision by farmers, veterinarians, or wildlife researchers is a major component of traditional animal monitoring systems. Animal carers and livestock owners physically inspect animals to look for movement patterns, unusual behaviour, or health problems. Because early indicators of disease or suffering may go overlooked, this method is labour-intensive, time-consuming, and prone to mistakes.

While some contemporary methods employ RFID (Radio Frequency Identification) tags to identify animals, they do not offer location tracking or real-time health monitoring. There are GPS-based tracking systems, but they frequently operate without health monitoring, which makes it challenging to identify medical emergencies. Wearable sensors have occasionally been launched for tracking health, but their lack of IoT platform connection restricts the amount of data that can be accessed remotely.

Furthermore, the majority of current systems do not automatically notify users of anomalous behaviour, extended periods of inactivity, or elevated fever, which causes

delays in seeking medical attention. Monitoring wildlife is particularly difficult because existing tracking techniques mostly concentrate on location rather than health status. It is challenging to provide real-time monitoring, disease prevention, and effective animal management in livestock and wildlife conservation since the current methods are primarily manual, partially automated, or do not integrate with the Internet of Things.

IV. PROPOSED METHODOLOGY

The IoT-Based Animal Tracking and IoT is used in health monitoring systems to track the location and health of animals in real time. This proposed system offers an automated and effective way to manage livestock and animals by integrating a number of sensors and communication modules. In order to aid in the early detection of fever or disease, the device continuously measures the animal's body temperature using a temperature sensor. In order to detect extended inactivity or unusual lying behavior—which may be a sign of illness or injury—an accelerometer sensor is used to analyse posture and movement. The whereabouts of the animal is continuously tracked. An Arduino Uno microcontroller processes the gathered data and shows it on an LCD screen for local monitoring. The data is also sent to cloud platform by an IoT module, allowing for the remote access through a web dashboard or mobile app. When unexpected movement patterns or unusual health patterns are identified, the technology can also automatically notify carers. By providing real-time insights, early illness diagnosis, automated alarms, and remote data access, this suggested solution improves livestock management and wildlife protection. It is a scalable and affordable solution that increases productivity, decreases manual labour, and guarantees improved animal security and health. This approach guarantees the successful implementation of automated, remote, and continuous animal monitoring, providing a scalable and economical way to enhance the management and security of animal health in general.
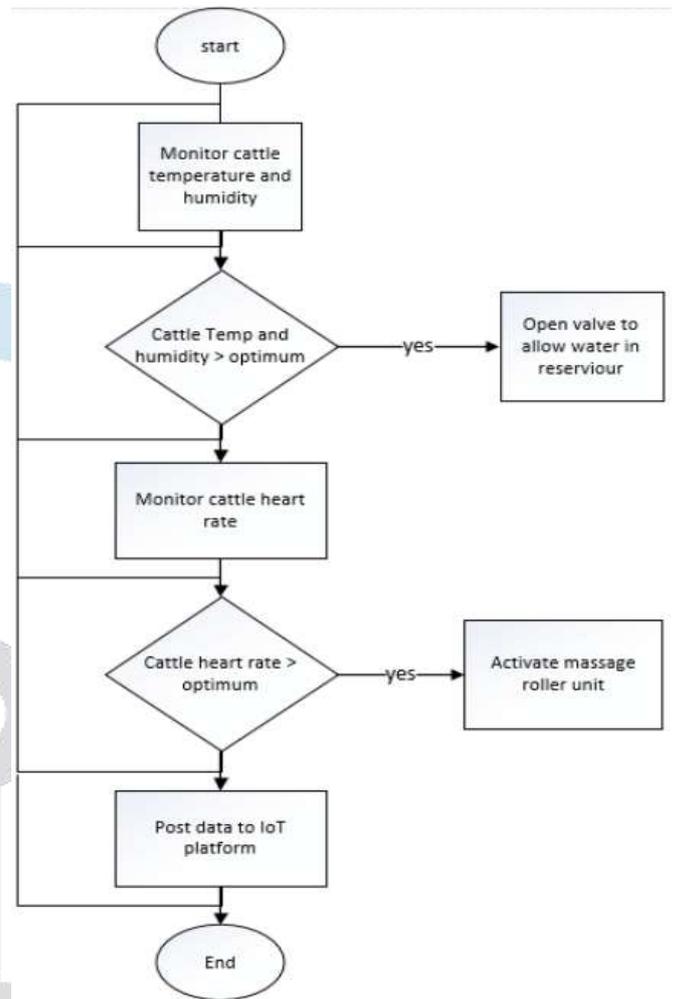

Fig 4.1 Flow Chart

Sleep modes and effective sensors can be used to optimise the system's low power consumption, making it appropriate for usage in rural or distant locations where regular maintenance is impractical. The Arduino Uno's initial data processing reduces latency for important notifications by enabling quick local action (such as buzzers or LCD alerts) before uploading data to the cloud. Predictive diagnostics is made possible by the use of collected data to train machine learning models that forecast diseases based on historical trends.

V. SYSTEM ARCHITECTURE

To track and monitor animals, the system architecture incorporates a number of hardware elements, including an Arduino Uno, GPS module, LCD display, temperature sensor, accelerometer sensor, and an Internet of Things module. Important information is locally shown on the LCD once the Arduino Uno gathers and processes sensor data. This data is sent to a cloud platform by the IoT module, allowing for remote access via an Android Studio-developed mobile application. The Arduino IDE is used to program and control the system, guaranteeing seamless sensor-application communication.

A. Hardware Requirements

- ARDUINO UNO
- LCD DISPLAY
- TEMEPERATURE SENSOR
- ACCELEROMETER SENSOR

- GPS
- IOT

B. Software Requirements
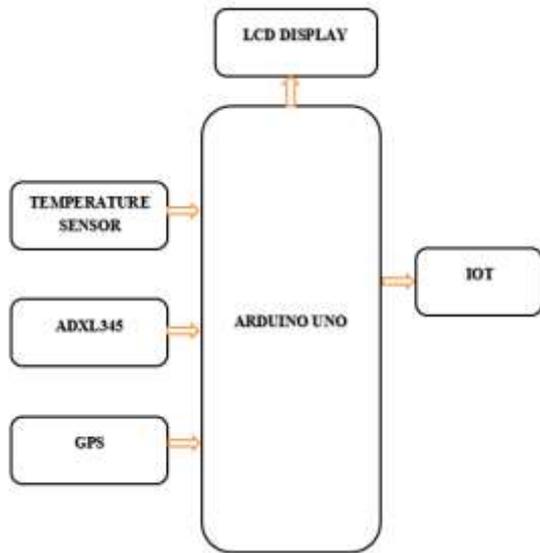- ARDUINO IDE
- ANDROID STUDIOS

Fig 5.1 Block Diagram

VI. TOOLS AND TECHNOLOGIES

A. Arduino UNO

The ATmega328P serves as the foundation for the Arduino/Genuino Uno microcontroller board. It features a 16 MHz quartz crystal, 6 analogue inputs, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It has all the components required to support the microcontroller; to get started, just plug it in via a USB cable to a computer or power it with a battery or AC-to-DC adapter.

Fig 6.1 Arduino UNO

B. LCD Display

Materials used in liquid crystal displays (LCDs) combine the qualities of crystals and fluid. Instead of having a melting point, they have a range of temperatures where the molecules

are nearly as mobile as they would be in a liquid yet are arranged in a crystal-like structure.Sand, a liquid crystal substance, is sandwiched between two glass panels to form an LCD. Transparent electrodes that define the character, symbols, or patterns to be displayed are coated on the inner surface of the glass plates. Polymeric layers are positioned between the electrodes and the liquid crystal, causing the molecules of the liquid crystal to maintain a specific orientation angle. The two glass panes are glued with one polariser each. The light beams travelling through these polarisers would be rotated to a specific angle and direction.The two polarisers and the liquid crystal twist light rays when the LCD is off, causing them to exit the screen without any direction and giving the impression that the LCD is translucent.The molecules of the liquid crystal would align in a particular orientation when the electrodes received an adequate voltage.

Fig 6.2 Liquid Crystal Display (LCD)

A liquid crystal display (LCD) is a small, flat electronic visual display that makes advantage of liquid crystals' (LCs') ability to modulate light. LCs do not emit light directly.

C. Temperature Sensor

A thermistor is a resistor whose resistance varies with temperature.. The term is a combination of resistor and thermal. Thermistors find extensive applications as temperature sensors, self-resetting overcurrent protectors, inrush current limiters, and self-regulating heating components.

Resistance temperature detectors (RTDs) and thermistors are different in that RTDs employ pure metals, whereas thermistors typically use ceramic or polymer materials. The temperature response is also varied; thermistors normally attain a higher precision within a narrow temperature range [commonly −90 °C to 130 °C], but RTDs are usable over larger temperature ranges.

Fig 6.3 Thermistor Symbol

There are two kinds of thermoistors based on the sign of k. A positive temperature coefficient (PTC) thermistor is the name

of the apparatus, or posistor, if k is positive, meaning that the resistance rises as the temperature rises. The device is known as NTC thermistor if k is negative, meaning that as the temperature rises, the resistance falls.

D. Accelerometer Sensor

A device that detects correct acceleration—the acceleration felt in relation to freefall—is called an accelerometer. Orientation, acceleration, vibration shock, and falling can all be sensed using single- or multi-axis models that can identify the acceleration's amount and direction as a vector quantity. To determine the device's location or enable game input, micromachined accelerometers are becoming more common in portable electronics and video game controllers.
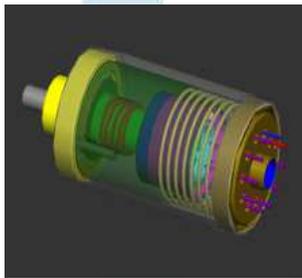
Fig 6.4 Accelerometer

Proper acceleration, or the acceleration it experiences in relation to freefall and the acceleration that people and objects feel, is measured using an accelerometer. In other words, an accelerometer measures the acceleration in relation to a local inertial frame, which is guaranteed to exist at any place in spacetime by the equivalency principle.[1] G-force is a commonly used unit of measurement for such accelerations.

E. Global Positioning System

Out of all the uses for GPS, navigational systems and vehicle monitoring have introduced the technology into the average person's daily life. These days, GPS-equipped automobiles, ambulances, fleets, and police cars are frequently seen on the roads of wealthy nations. These systems, which go by several names, including Automatic Vehicle Locating System (AVLS), Vehicle Tracking and Information System (VTIS), and Mobile Asset Management System (MAMS), provide a useful instrument for enhancing vehicle utilisation and operational efficiency. With SA turned off, GPS accuracy has increased to over 30 meters, making it the perfect location sensor for car tracking systems without the DGPS overhead.

GPS is used in cars for navigation and tracking. While navigation systems assist the driver in getting to their destination, tracking systems allow a base station to monitor the vehicles without the driver's assistance. Architecture of both tracking and navigation systems is essentially the same. In contrast to a tracking system, the navigation system will provide the driver with a convenient display, typically a

graphic one. Vehicle tracking systems integrate several advanced technologies. VTS consists of three subsystems: a) In-vehicle unit (IVU), b) Base station, and c) Communication link, regardless of the technology being utilised.

F. Internet Of Things

Physical objects, cars, home appliances, and other items having electronics, software, sensors, actuators, and communication integrated into them that allows them to communicate, gather, and share data is known as the Internet of Things (IoT). IoT refers to expanding Internet connectivity to conventionally dumb or non-internet-enabled physical devices and commonplace objects, in addition to regular devices like desktops, laptops, smartphones, and tablets. These gadgets are equipped with technology that enables remote control and monitoring, in addition to Internet-based communication and interaction. The Internet of Vehicles, a subset of the Internet of Things, is beginning to get increasing attention as driverless cars become more common. Because of confluence of The idea of the Internet of Things has evolved due to a variety of technologies, including embedded systems, real-time analytics, machine learning, and inexpensive sensors. The Internet of Things is made possible by a number of traditional fields, including control systems, wireless sensor networks, embedded systems, and automation (including home and building automation). An essay published in Finnish in January 2002 preceded a research article addressing the Internet of Things that was submitted to the meeting for Nordic Researchers in Logistics, Norway, in June 2002. The present implementation—an information system architecture for creating smart, connected objects—is more in line with the one outlined there, which was created by Kary Främling and his colleagues at Helsinki University of Technology.

G. Arduino Software IDE

The Arduino Integrated Development Environment, also called the Arduino Software (IDE), includes a message box, a text console, a toolbar with buttons for frequently used tasks, and a text editor for writing code, and several menus. To connect to the Arduino and upload programs and Genuino hardware, it connects to them.

H. Android Studio

The environment of Android Studio is windowed. Only a tiny portion of the available windows are displayed at any given moment in Android Studio in order to maximise the limited screen real estate and prevent you from becoming overwhelmed. While some of these windows stay hidden until you choose to reveal them, or vice versa, stay visible until you want to conceal them, others are context-sensitive and only show up when the situation calls for it. You must comprehend how these windows work and when to display them if you want to get the most out of Android Studio. We will demonstrate how to control the windows in Android Studion.

Navigation is one of the most important features of any integrated development environment (IDE). Hundreds of such assets can be found in an Android project of even moderate complexity. Android projects are usually made up of numerous packages, directories, and files. Your ability to navigate between and within these assets will be a major factor in how effective you are with Android Studio. We will also demonstrate how to browse Android Studio in this chapter.

VII. MODULE-WISE PROJECT FLOW BREAKDOWN

A. Sensor Data Collection Module

To collect data on the health and activities of the animal in real time, the Sensor Data Collection Module is essential. A temperature sensor and an accelerometer sensor are the two primary sensor types used. The animal's body temperature is continuously monitored by the temperature sensor. It's critical to keep an animal's body temperature within the usual range because abrupt variations may be a sign of a fever, infection, or other underlying medical conditions. Conversely, the accelerometer sensor monitors the animal's posture and movement patterns. Any extended periods of inactivity or unusual posture are detected by it, as these may be early indicators of weariness, disease, or injury. The Arduino Uno is linked to both sensors, and it periodically reads the data. The technology makes sure that no important health-related event is missed by gathering data around-the-clock. The reliance on manual observation is greatly diminished by the regular and automated data collecting. Additionally, the sensors give precise and instantaneous measurements that may be processed and examined for patterns later on. This module serves as the system's cornerstone by guaranteeing the consistent, trustworthy data collection required for subsequent decision-making.

B. Location Tracking Module

The purpose of the Location Tracking Module is to track and document the animal's current geographic location. A GPS module is integrated with the Arduino Uno to accomplish this. The GPS module determines the precise latitude and longitude of the animal's location by continuously receiving signals from satellites. For free-range cattle or wildlife, where animals travel over vast distances and are challenging to physically monitor, the real-time tracking capability is very crucial. Farmers, researchers, or carers can use the GPS data to determine an animal's exact whereabouts at any given time. Action can be taken right immediately if an animal wanders from its assigned area or enters a prohibited or hazardous area. The position data is sent to the Arduino for additional processing by the GPS module, which refreshes it periodically. The last recorded GPS coordinates can aid in the speedy recovery of the animal in the event that it is lost or stolen. The module helps to improve management of the livestock or wildlife population and enhance security by

continuously monitoring location data. Later analysis of location history might be used to examine migration routes, movement patterns, or grazing patterns.

C. Data Processing and Display Module

The system's brain is the Data Processing and Display Module, which organises the information obtained from several sensors and presents it in a way that is easy for humans to understand. The GPS module, accelerometer sensor, and temperature sensor all provide raw data to the Arduino Uno, which serves as the core CPU. It transforms this data into useful numbers, such as the user's body temperature in Celsius, their movement status (active or inactive), and their exact position coordinates. After processing, a local LCD display receives the data. The LCD displays vital real-time data, including the animal's GPS location, movement status (normal or aberrant), and current body temperature. Quick checking is made possible by an on-site display, which eliminates the need to access cloud servers or mobile devices. Additionally, the module ensures that even non-technical users may quickly comprehend the readings by formatting the data in an interpretable manner. If the Arduino detects suspicious idleness or aberrant health parameters, it can flag these notifications on the LCD. This module ensures seamless integration with the IoT communication module by supporting real-time monitoring and preparing the data for remote transmission.

D. IoT Communication Module

All processed data from the Arduino system must be sent over the internet to a distant server or cloud platform by the IoT Communication Module. It makes use of an Internet of Things communication device, such as an ESP8266 Wi-Fi module, to facilitate wireless data transfer. The Arduino sends the structured data to the IoT module after processing the GPS location and sensor readings. After connecting to a Wi-Fi network, the IoT device periodically uploads the data it has gathered to a database, internet server, or cloud IoT platform like ThingSpeak, Firebase, or a bespoke backend server. This guarantees that farmers, veterinarians, or wildlife researchers can use a computer or mobile device from any area to remotely view the animal's position and health status. The technology can send real-time alerts to the carers via emails or messages if it notices serious health issues, such as unusual inactivity or an abnormal body temperature. The core of the remote monitoring feature, this module allows for round-the-clock supervision without requiring physical proximity to the animal. Even if the animal is placed far away in fields, forests, or expansive farm regions, it guarantees that crucial decisions may be taken promptly.

E. Mobile Application Monitoring Module

The mobile application monitoring module provides an easy-to-use interface for viewing the location and health information of the animal from a distance. It links to the cloud

platform where the IoT module uploads the data, and it is created with Android Studio. Temperature readings, movement status, and the most recent GPS location on a map are just a few of the real-time data that the mobile app retrieves and displays in an orderly dashboard. Users can establish threshold limits for temperature and inactivity, monitor numerous animals at once, and get automated warnings anytime aberrant readings are found using the app. The app instantly alerts the carer in the event that an animal exhibits symptoms of disease or wanders from a safe area, allowing for prompt response. Users can examine previous records of the animal's health trends and movements thanks to the app's capability for historical data visualisation. Additionally, it offers functions like sorting, filtering, and search to aid in the effective management of big herds. The system is completed by this module, which provides remote sight and control, greatly reduces human labour, speeds up emergency response times, and improves general animal management procedures.

VIII. RESULT

The IoT-Based Animal Tracking and Health Monitoring System was effectively designed, developed, and tested to track an animal's whereabouts in real time and monitor its health. With the help of the animal's temperature sensor, the system was able to continuously measure the animal's body temperature. The LCD panel reliably showed normal temperature readings, and any unusual increase or decrease in temperature was quickly identified, enabling the early detection of possible health problems. The accelerometer sensor measured the animal's activity levels successfully. It distinguished between active and inactive stages with success. Alerts were generated by prolonged inactivity or irregular movement patterns, indicating the capacity to identify weariness, illness, or injury early on. This greatly shortens the time it takes for carers to respond and take the appropriate action. The animal's precise location was tracked in real time by the GPS gadget. Correct and consistent updates were made to the latitude and longitude coordinates. The device is appropriate for both farm animals and wildlife because it was able to track the animal's whereabouts even when it moved across long distances. In addition to being shown on the local LCD, the live location was transmitted to a cloud platform for viewing remotely. All sensor data was handled effectively by the Arduino Uno, which then presented it on the LCD screen in an understandable manner. Even non-technical users could easily read and understand the information, which displayed important metrics like GPS coordinates, body temperature, and movement status. There was no discernible lag or mistake when handling multiple data inputs at once. The Android Studio-created Android mobile application performed as planned. From their iPhones, users may effortlessly check the animal's current location, movement status, and temperature. In order to enable carers react promptly in the event of unusual

behaviour or medical concerns, the program also offered rapid alerts. Overall, under real-world circumstances, the system showed excellent accuracy, stability, and efficiency. It provided greater security against theft or animal loss, decreased the need for manual supervision, and accelerated emergency response. Adoption of this technology in wildlife protection, animal health management, and smart farming initiatives seems highly promising. It was a comprehensive, dependable, and scalable system for contemporary animal monitoring requirements thanks to the integration of IoT technologies, real-time tracking, and mobile accessibility.

Fig 8.1 Hardware Setup
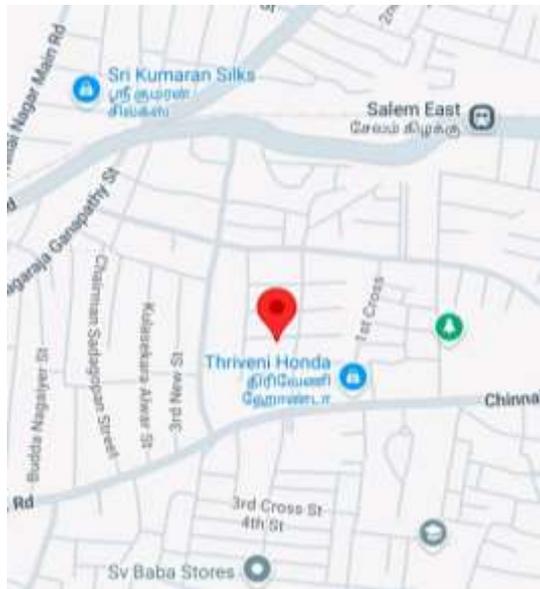

Fig 8.2 Mobile Application

Fig 8.3 Live Location

IX. CONCLUSION

The IoT-Based Animal Tracking and Health Monitoring System offers a creative and efficient method of tracking the movement and health of animals in real time. This system guarantees continuous tracking of critical health metrics and location by combining temperature sensors, accelerometer sensors, GPS, Arduino Uno, LCD display, and an Internet of Things module. Early detection of diseases or injuries allows for better animal welfare and prompt medical care. This is made possible by the capacity to detect fever, unusual movement patterns, and extended intervals of idleness. IoT technology reduces the need for manual supervision by making real-time data accessible from a distance via a mobile application or cloud-based platform. Automated warnings and notifications guarantee prompt reactions to possible health hazards by giving real-time updates on any unusual activity. By monitoring the animals' current location in real time, the GPS module improves security by thwarting theft or loss. This system is a scalable, economical, and dependable solution with numerous applications in veterinary care, cattle farming, wildlife protection, and smart agriculture. This initiative supports contemporary, technology-driven animal management by increasing animal safety, decreasing labour costs, and increasing efficiency. Predictive analytics powered by AI may be added in the future to enable more sophisticated health monitoring and decision-making.

X. FUTURE ENHANCEMENT

To provide a more thorough health study of animals, the system can be improved in the future by adding more sensors, such as respiration, humidity, and heart rate monitors. Early diagnosis and preventive care could be aided by the use of machine learning algorithms that use historical data trends to forecast animal health issues. Versions of the device that run on batteries or solar energy could be created for isolated locations with few power sources. The system would be even more user-friendly if the mobile application was improved with features like voice alarms, geofencing for movement limits, and automated medical recommendations. For centimeter-level location precision, the GPS module can be updated to a more accurate real-time kinematic (RTK) GPS system, which is particularly helpful for tracking wildlife in deep forests. In order to automatically schedule health examinations based on abnormalities found, the system might also be connected with veterinary management systems. Including camera modules to visually observe animal behaviour could improve comprehension of physical situations even more. Enabling multi-animal support, which would help large farms and wildlife reserves, could be another improvement. This would allow a single dashboard to monitor and handle data from several animals at once. Lastly, big data integration and cloud data analytics can support population-level research, offering researchers in the domains of livestock and wildlife conservation important new information.

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