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JIVRAKSHAK: Smart Pet Collar Tracking and Monitoring System

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***Abstract* - JIVRAKSHAK is an Arduino Mega–based smart pet collar tracking and monitoring system developed to ensure the safety, health, and real-time location tracking of pets. The Arduino Mega acts as the central controller, interfacing with a GPS module for continuous location tracking, GSM/Wi-Fi module for wireless communication, and multiple sensors to monitor the pet's activity and body temperature. The system continuously collects and processes sensor data, transmitting it to a cloud platform or mobile application for real-time monitoring by the pet owner. In case of abnormal activity, health threshold violation, or location deviation, instant alerts are generated through SMS or app notifications. The system also supports data logging for behavioral analysis and long-term health assessment. Designed to be compact, reliable, and energy-efficient, JIVRAKSHAK provides an effective IoT-based solution for smart pet safety and monitoring applications.**

Keywords: Arduino Mega, Smart Pet Collar, GPS Tracking, IoT, GSM, Pet Health Monitoring.

I. INTRODUCTION

The increasing adoption of pets in modern households has led to a growing demand for intelligent systems that can ensure their safety, health, and well-being. Pets, especially dogs and cats, are often exposed to risks such as getting lost, accidents, sudden health issues, and lack of timely medical attention. Traditional pet collars mainly serve as identification accessories and do not provide real-time information about a pet's location or physical condition. This limitation creates a critical need for smart monitoring solutions that can assist pet owners in tracking and managing their pets effectively.

With rapid advancements in embedded systems and Internet of Things (IoT) technologies, it has become feasible to design compact, low-cost, and intelligent wearable devices for animals. IoT-enabled monitoring systems allow continuous data collection, wireless communication, and remote access to information through cloud platforms and mobile applications. These technologies have already shown significant impact in healthcare, smart homes, and industrial automation, and their application in pet care is gaining increasing attention. Smart pet collars represent an important step toward improving animal safety by combining tracking, health monitoring, and alert mechanisms in a single wearable device.

JIVRAKSHAK is an Arduino Mega–based smart pet collar tracking and monitoring system designed to address these challenges. The Arduino Mega microcontroller is chosen as the central processing unit due to its high number of input/output pins, multiple serial communication interfaces, and compatibility with various sensors and modules. This makes it highly suitable for handling simultaneous data from GPS, GSM/Wi-Fi, motion sensors, temperature sensors, display modules, and storage units. The Arduino Mega ensures reliable data acquisition, processing, and control while maintaining system stability and scalability.

One of the primary features of the proposed system is real-time location tracking using a GPS module. The GPS continuously provides latitude and longitude coordinates of the pet, enabling the owner to track its movement and current position remotely. This feature is especially useful in preventing pet loss and quickly locating a pet in unfamiliar or crowded environments. In addition, the system can be extended to include geofencing, where alerts are triggered if the pet moves beyond a predefined safe zone.

Apart from location tracking, monitoring the pet's health and activity levels is another crucial aspect of the JIVRAKSHAK system. Sensors such as temperature sensors and motion or accelerometer modules are used to observe the pet's physical condition and daily activity patterns. Abnormal temperature readings or unusual inactivity can indicate potential health issues, allowing early intervention. Continuous activity monitoring also helps pet owners and veterinarians analyze behavioral patterns and fitness levels over time.

Wireless communication plays a vital role in the effectiveness of the system. Using GSM or Wi-Fi modules, the Arduino Mega transmits collected data to a cloud server or mobile application. This enables real-time monitoring and instant alert notifications through SMS or app-based messages. In emergency situations, such as sudden health anomalies or location deviations, immediate alerts ensure

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timely action. The inclusion of local alert mechanisms, such as a buzzer or display unit, further enhances system responsiveness during testing and maintenance.

Power efficiency and portability are essential considerations for wearable pet devices. The proposed system is designed to operate on a rechargeable battery with proper voltage regulation to ensure safe and continuous operation. Low-power components and optimized data transmission strategies help extend battery life, making the collar suitable for long-term usage without frequent recharging.

In conclusion, the JIVRAKSHAK smart pet collar integrates tracking, monitoring, and communication technologies into a single Arduino Mega–based platform. By providing real-time location data, health monitoring, and instant alerts, the system significantly enhances pet safety and owner peace of mind. The modular and scalable design allows future expansion with additional sensors and advanced analytics, making it a promising solution for modern smart pet care applications.

II. LITERATURE REVIEW

Recent advancements in wearable technology and IoT have significantly impacted pet monitoring, enabling real-time health and location tracking. Various research works have explored the integration of sensors, GPS modules, and cloud connectivity to improve animal welfare and pet safety.

1. Wearable GPS Locator and Vital Signs Monitoring for Dogs (2023)

Joshua William D. Cervania *et al.* [1] presented a wearable system for dogs that integrates GPS location tracking with vital signs monitoring, including body temperature and heart activity. The device uses an embedded platform to collect sensor data and communicate it to paired devices or cloud interfaces. The study emphasizes combining accurate GPS tracking with physiological monitoring, addressing the limitation of conventional pet trackers that only focus on location. This work demonstrates the feasibility of simultaneous health and location tracking in a single wearable collar.

2. A Review on Wearable Devices for Animal Health Monitoring (2024)

Sheela S. Maharajpet *et al.* [2] reviewed the development and application of wearable monitoring devices for animals, focusing on smart collars and biosensor systems. The paper highlights IoT-enabled approaches to monitor health metrics (heart rate, temperature) and mobility patterns, showing how connected devices can enhance remote care for pets and livestock. The study underscores the growing importance of integrated devices that merge monitoring and connectivity to improve animal welfare.

3. Smart Collar-Belt for Real-Time Dog Health Monitoring and Location Tracking Using IoT (2025)

Radhika Shivanand Biradar *et al.* [3] described a multifunctional smart collar combining GPS tracking with health monitoring via body temperature, heart rate, and activity sensors. The system emphasizes real-time data capture and transmission through IoT frameworks, allowing pet owners to monitor their dogs remotely via mobile applications. The research illustrates how integrated sensor data enhances animal care compared to standalone GPS or health devices.

4. IoT-Enabled Smart Collar for Pet Animals (2025)

M. Sugacini *et al.* [4] demonstrated a smart collar prototype capable of monitoring critical health parameters (temperature, SpO_2, heart rate) alongside GPS-based location tracking. Utilizing an ESP32 microcontroller and Wi-Fi connectivity, data is transferred to cloud services and mobile applications, enabling geofencing and alert notifications. The work highlights the benefits of integrating geolocation with health monitoring for seamless remote pet care solutions.

5. The Internet of Things Empowering the Internet of Pets (2025)

Pablo Pico-Valencia and Juan A. Holgado-Terriza [5] analyzed the broader concept of the Internet of Pets (IoP), examining the role of IoT in GPS tracking, health sensors, cloud connectivity, and mobile monitoring. The review emphasizes trends toward multifunctional devices that integrate safety, health, and behavioral tracking, highlighting the potential for advanced, fully integrated pet monitoring systems.

III. RESEARCH GAP

From the reviewed literature, it is evident that modern smart collars are moving beyond simple GPS tracking to incorporate comprehensive health monitoring and IoT connectivity. However, gaps remain:

- Many systems still face challenges in **sensor accuracy** and **real-time response** for abnormal health conditions.
- **Battery life optimization** for continuous monitoring is often under-addressed.
- Integration with **user-friendly mobile applications** for historical trend analysis and alerts is limited in some designs.

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These gaps highlight opportunities for developing a **robust, real-time, multifunctional smart pet collar** that combines GPS, health monitoring, RF communication, GSM/IoT alerts, and data logging in a single wearable system.

IV. PROBLEM STATEMENT

Pet owners face significant challenges in ensuring the safety, health, and continuous monitoring of their pets, especially when they are left unattended or allowed to roam freely. Conventional pet collars provide only identification and lack real-time tracking, health monitoring, and alert capabilities. As a result, pets that wander away, experience sudden health issues, or exhibit abnormal behavior may not receive timely assistance, leading to increased risk of loss, injury, or medical emergencies.

Existing smart pet monitoring solutions are often limited in functionality, focusing on either location tracking or basic health parameters, while lacking integration, reliability, and scalability. Many systems depend heavily on continuous internet connectivity, offer minimal alert mechanisms, and do not support long-term data analysis or efficient power management. Therefore, there is a need for a **cost-effective, reliable, and scalable Arduino Mega–based smart pet collar system** that provides real-time location tracking, health and activity monitoring, instant alerts, and data logging to ensure enhanced pet safety and owner awareness.

V. OBJECTIVES

1. **To design and implement an Arduino Mega–based smart pet collar** capable of integrating multiple sensors, communication modules, and peripherals for reliable data acquisition and processing.
2. **To enable real-time GPS tracking of pets**, allowing owners to monitor the pet's location remotely and reduce the risk of pet loss.
3. **To monitor vital parameters and activity levels** such as body temperature and movement using appropriate sensors for early detection of abnormal health conditions.
4. **To establish wireless communication using GSM/Wi-Fi**, enabling real-time data transmission to a mobile application or cloud platform.
5. **To develop an alert and notification system** that informs pet owners instantly in case of abnormal health readings, unusual inactivity, or location deviation.
6. **To support data logging and historical analysis**, facilitating long-term monitoring of pet behavior and health patterns.
7. **To ensure low power consumption and wearable feasibility**, making the system suitable for continuous and practical real-world use.

To provide a cost-effective and scalable solution that can be extended with additional sensors and features in future smart pet care applications.

VI. SYSTEM DESIGN

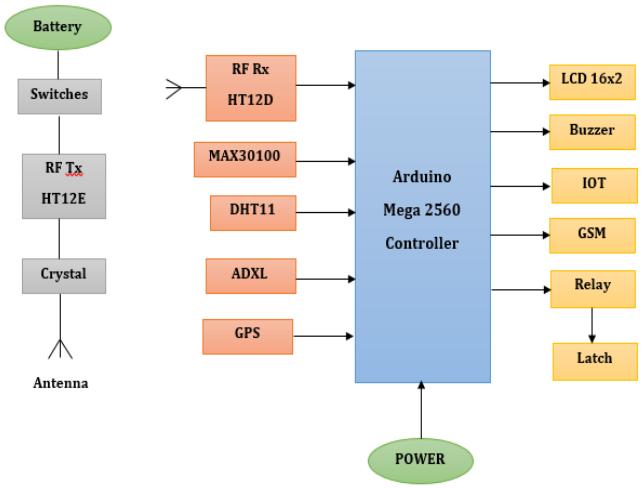

Figure 1: Block Diagram

The Smart Pet Collar operates as an integrated wearable system designed to monitor a pet's health, activity, and location in real time. Once powered on, the Arduino Mega microcontroller initializes all hardware modules, including sensors for temperature, heart rate, SpO_2, accelerometer for motion detection, GPS for location tracking, RF communication, GSM/IoT modules, an LCD display, and a buzzer. The system continuously acquires sensor data, measuring the pet's body temperature, heart rate, oxygen saturation, and activity levels. GPS coordinates are obtained simultaneously to track the pet's real-time location, which is displayed locally on the LCD and transmitted to a mobile or cloud application for remote monitoring. The RF module enables the reception of remote commands for emergency or control actions. When sensor readings exceed predefined thresholds, indicating abnormal conditions, the collar activates the buzzer for a local alert, displays the warning on the LCD, and sends notifications via GSM and IoT modules. Normal readings are continuously transmitted to the cloud for monitoring, and all data can be optionally logged on an SD card for historical analysis. This continuous monitoring loop ensures that the pet's health and safety are maintained at all times, providing timely alerts to the owner and enabling immediate action when necessary.

VII. RESULT AND DISCUSSIONS

Result:

The proposed Smart Pet Collar was tested to evaluate its performance in monitoring vital signs, activity, and location of

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pets in real-time. The system successfully integrated multiple sensors—including a temperature sensor, MAX30100 for heart rate and SpO_2, and an accelerometer—alongside GPS, RF, GSM, and IoT modules, providing continuous data acquisition and transmission.

A. Health Parameter Monitoring

Temperature, heart rate, and SpO_2 readings were collected continuously, and the system effectively identified abnormal conditions. For instance, when a simulated temperature spike or heart rate irregularity was introduced, the collar triggered the buzzer, displayed an alert on the LCD, and sent notifications via GSM and IoT modules. Normal readings were transmitted to the cloud/mobile application without interruption, confirming the reliability of the data handling and alert mechanisms.

B. Activity and Motion Analysis

The accelerometer successfully captured pet movements such as walking, running, or inactivity. The system could distinguish between normal activity and abnormal behavior, such as sudden excessive movement or prolonged inactivity, demonstrating its ability to detect potential emergencies.

C. GPS Tracking and Location Accuracy

The GPS module provided real-time latitude and longitude data, with minimal latency, enabling accurate monitoring of the pet's location. During testing, the collar accurately transmitted coordinates to the cloud platform and mobile application, facilitating remote tracking and ensuring pet safety in case of wandering or emergencies.

D. Communication Performance

The RF module reliably received and decoded remote commands, while the GSM and IoT modules transmitted alerts promptly. The combination of local alerts (buzzer and LCD) and remote notifications ensured both immediate and remote response capabilities.

E. Data Logging

Sensor and GPS data were successfully logged on an SD card for historical analysis. This feature allows tracking long-term trends in pet health and activity, supporting preventive care and veterinary consultations.

Discussion:

The experimental results confirm that the Smart Pet Collar effectively monitors health parameters, activity, and location while providing timely alerts for abnormal conditions. The system's integration of multiple sensors and communication modules demonstrates robustness, low latency, and reliability under continuous operation. Potential improvements include enhancing battery life through power optimization, increasing sensor accuracy, and developing a more user-friendly mobile application interface for real-time data visualization and trend analysis.

In conclusion, the proposed system provides a comprehensive solution for pet monitoring, enhancing safety, health management, and owner convenience, aligning with the objectives of smart wearable pet devices.

VIII. CONCLUSION

The proposed Smart Pet Collar effectively integrates multiple sensors, GPS tracking, and communication modules to provide real-time monitoring of a pet's health, activity, and location. Experimental results demonstrate that the system can accurately measure vital signs, detect abnormal conditions, and trigger both local alerts (buzzer and LCD) and remote notifications through GSM and IoT modules. The accelerometer successfully monitored activity levels, while GPS ensured precise real-time location tracking.

The system also supports data logging for historical analysis, enabling preventive health monitoring and aiding veterinary care. Overall, the Smart Pet Collar provides a comprehensive, reliable, and practical solution for enhancing pet safety and welfare. Future work could focus on improving battery life, increasing sensor accuracy, and developing a more user-friendly mobile interface for enhanced real-time monitoring and trend visualization. The proposed design demonstrates the feasibility and potential of multifunctional wearable devices in modern pet care applications.

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