

Real-Time Cattle Monitoring Using Low-Cost IoT Smart Collars with Lora Communication in Sri Lanka's Dry Zones

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Abstract

Effective free-range cattle management remains a critical challenge for smallholder farmers in the rural and dry zones of Sri Lanka due to crop damage, theft, and accidents caused by uncontrolled livestock roaming. This paper presents the design and development of a low-cost, robust smart collar leveraging Internet of Things (IoT) technology with LoRa wireless communication for the real-time monitoring of cattle location and environmental parameters. The collar integrates GPS and multiple environmental sensors, including body temperature, motion detection, battery voltage, received signal strength indicator (RSSI), air quality index, and humidity within a weather-resistant enclosure to ensure durability and extended operational life. Data packets are periodically transmitted to a centralized gateway and visualized through an intuitive mobile application, enabling farmers to track their livestock and receive immediate alerts. Field experiments demonstrated an effective communication range of up to 3.2 km (approximately 3,217 hectares coverage at 30–40 m gateway height) in typical Sri Lankan dry zone terrain. The current design yields an average battery life of 2.5 days at a 5-minute transmission interval. The observed packet loss correlates with distance and obstruction; however, Sri Lanka's flat topography minimizes signal degradation. Incorporating industrial-grade LoRa modules in future iterations could potentially extend the range beyond 10 km and enhance the reliability. These findings verify the viability of the system as an affordable and scalable livestock-tracking solution aimed at improving safety and productivity in rural Sri Lankan cattle farming. Ongoing work focuses on battery optimization, extended field validation, and communication robustness.

Keywords: IoT, smart collar, LoRa, livestock tracking, Sri Lanka, ESP32 GPS