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Detection of Milk Products Adulteration using ML and IoT Sensors

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Abstract: *Milk adulteration has become one of the most pressing issues in the food and dairy industry, posing serious health hazards and economic losses to consumers. Traditional testing methods are often manual, time-consuming, and laboratory-dependent, making them unsuitable for quick, on-site analysis. To overcome these limitations, this project "Detection of Milk and Milk Product Adulteration using Machine Learning and IoT Sensors" introduces a smart, automated, and real-time detection system using integrated sensor technology and artificial intelligence. The proposed system utilizes an ESP32 microcontroller integrated with a pH sensor, colour sensor (TCS34725), gas sensor (MQ series), temperature sensor (LM35), load cell with HX711 amplifier, and moisture sensor to capture multiple physical and chemical properties of milk. These readings are transmitted through Wi-Fi to Firebase Real-time Database, where they are analysed by a Machine Learning model (Decision Tree or Random Forest) trained to detect adulteration patterns. An Android application, developed using Java/XML, displays live readings and the final classification result — Pure, Diluted, or Adulterated. The OLED display and buzzer on the device provide instant on-site alerts. This combination of IoT, AI, and cloud technologies ensures reliable, fast, and cost-effective milk quality assessment suitable for dairy farms, collection centres, and household testing.*

Keywords: IoT, Machine Learning, ESP32, Firebase Realtime Database, pH Sensor, Milk Purity Detection, Colour Sensor, Gas Sensor, Temperature Sensor, Adulteration Detection, Android Application.

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