International Journal of Creative and Open Research in Engineering and Management
ISSN: **3108-1754 (Online)**
Volume 02 Issue 06 June-2026 | Impact Factor: 3.5

IoT-Based Health Care Monitoring System Using Arduino Uno for Real-Time Patient Monitoring and Emergency Alerting

***Dheeraj*[1]**
dheeraj.sheelvanth123@gmail.com
Department Of Electronics And Communication Engineering
Sharanbasva University

***Pawan*[2]**
pawanhabalkar@gmail.com
Department Of Electronics And Communication Engineering
Sharanbasva University

***Abhishek*[3]**
madiwalabhishek606@gmail.com
Department Of Electronics And Communication Engineering
Sharanbasva University

Sharan Kumar
shanusm6366@gmail.com
Department Of Electronics And Communication Engineering
Sharanbasva University

Sunil.J
gj.sunil@gmail.com
Professor Department Of Electronics And Communication Engineering
Sharanbasva University

How to Cite this Article:
Dheeraj, , Pawan, , Abhishek, & Kumar, S. (2026). IoT-Based Health Care Monitoring System Using Arduino Uno for Real-Time Patient Monitoring and Emergency Alerting. International Journal of Creative and Open Research in Engineering and Management, <i>02</i>(6).
https://doi.org/10.55041/ijcope.v2i6.189

https://doi.org/ 10.55041/ijcope.v2i6.189

Abstract—The rapid proliferation of the Internet of Things (IoT) has created transformative opportunities in healthcare, particularly for continuous and remote patient monitoring. This paper presents the design, development, and experimental validation of an IoT-based healthcare monitoring system built on an Arduino Uno microcontroller. The system integrates four physiological sensors: an ECG module (AD8232) for cardiac signal acquisition, a MAX30100 SpO_2 sensor for blood oxygen saturation, an LM35 precision temperature sensor for body temperature, and an ADXL335 triaxial accelerometer for physical activity and fall detection. Three selector switches allow the user to choose which parameter is displayed on an I^2C LCD in real time. A GSM900A module dispatches automated SMS alerts to registered caregivers whenever any parameter crosses predefined clinical thresholds, and a GPS module appends the patient's geographic coordinates to each alert for emergency localisation. A NodeMCU ESP8266 Wi-Fi module bridges the Arduino Uno to the Adafruit IO cloud platform, enabling real-time dashboard visualisation, threshold-based notifications, and remote data access from any internet-connected device. Experimental results demonstrate multi-parameter monitoring accuracy with an ECG heart-rate MAE of 1.8 bpm, SpO_2 correlation $r = 0.97$, temperature MAE of 0.3°C, fall-detection sensitivity 94.2 %, end-to-end cloud latency 2.4 s, and SMS delivery within 8.7 s. The proposed system is cost-effective (below USD 40), low-power (≥7.5 h battery life), modular, and scalable for home healthcare, elderly monitoring, and rural telemedicine deployments.

Keywords—IoT; Arduino Uno; Health Monitoring; ECG Sensor; SpO_2 Sensor; GPS Tracking; GSM Alerts; NodeMCU; Adafruit IO; Remote Healthcare; LM35; ADXL335.

I. INTRODUCTION

The modern healthcare landscape faces mounting pressure from rising chronic disease prevalence, ageing demographics, and a shortage of clinical personnel — particularly in rural and remote regions. Periodic hospital-based check-ups are inadequate for patients requiring continuous monitoring of cardiovascular parameters, respiratory function, or physical mobility. The Internet of Things (IoT) addresses this challenge by embedding networked sensor nodes into the patient's environment, enabling uninterrupted acquisition of vital-sign data and real-time transmission to cloud platforms accessible by physicians irrespective of geographic separation [1].

IoT-based health monitoring systems leverage low-cost microcontrollers, compact sensor modules, and widely available wireless infrastructure to deliver professional-grade monitoring at a fraction of clinical-grade equipment cost. Arduino Uno, based on the ATmega328P 8-bit AVR microcontroller, is widely adopted for rapid prototyping owing to its open-source ecosystem, extensive library support, and broad sensor and communication peripheral compatibility [2].

The proposed system monitors four vital signs — heart rate/ECG, SpO_2, body temperature, and physical activity/fall detection — using a dual-alert architecture that combines Adafruit IO cloud dashboards with GPS-enriched GSM SMS messages, ensuring caregiver notification even when broadband connectivity is intermittent. This paper presents the complete hardware design, firmware methodology, cloud integration, and experimental results.

II. LITERATURE REVIEW

Krishnan et al. [1] demonstrated wireless vital-sign transmission to a remote server with real-time alert generation but did not integrate multi-modal sensors on a single embedded platform. Valsalan et al. [2] developed an IoT health monitoring system with pulse oximetry and temperature sensing; it relied on a single communication path and lacked fall detection or GPS localisation.

Gómez et al. [3] achieved robust cloud data storage across multiple patients but without automated threshold-based alerting. Digarse and Patil [4] implemented an Arduino Uno + GSM wearable with SMS alerting but limited to two sensor modalities and no cloud visualisation. Pradhan and Vincent [5] added cloud connectivity but lacked GPS localisation. Ramani et al. [6] extended the concept to employee health with dashboards. Taştan [7] demonstrated a wearable IoT health system at higher hardware cost and complexity.

The review reveals that multi-sensor integration, dual-path alerting, GPS localisation, and cloud visualisation have not been combined on a single low-cost Arduino Uno platform. The proposed system bridges this gap.

III. PROPOSED SYSTEM

A. System Architecture

The system has three functional layers. (1) Sensor and Input Layer: ECG module, MAX30100 SpO_2, LM35, ADXL335, and three selector switches interfaced to Arduino Uno. (2) Processing and Local Output Layer: Arduino Uno (ATmega328P) performs data acquisition, threshold evaluation, I^2C LCD management, and UART communication with peripheral modules. (3) Communication and Cloud Layer: NodeMCU ESP8266 for Adafruit IO publishing, GSM900A for SMS alerting, and GPS module for location acquisition.

B. Working Principle

At each 5-second sampling cycle, the Arduino reads all four sensors and updates the I^2C LCD per the active selector switch. The data frame is forwarded to the NodeMCU via UART, which publishes each parameter to its dedicated Adafruit IO feed over HTTPS. On threshold breach, the Arduino commands the GSM900A via AT commands to dispatch an SMS, appending the GPS fix for emergency localisation.

C. Data Flow

Sensors → Arduino Uno (ADC/GPIO) → Processing → I^2C LCD (local). Concurrently: Arduino → UART → NodeMCU → HTTPS → Adafruit IO dashboard. Threshold breach → GSM900A → SMS + GPS coordinates → Caregiver mobile.

D. System Reliability and Alert Management

To ensure reliable patient monitoring, the system continuously validates sensor readings and filters abnormal noise before processing. The Arduino Uno compares each measured parameter against predefined medical threshold values and generates alerts only when abnormal conditions persist, reducing false alarms. The NodeMCU maintains regular communication with the Adafruit IO cloud platform, enabling uninterrupted remote monitoring and historical data storage. In emergency situations such as abnormal heart rate, low SpO_2 level, high body temperature, or fall detection, the GSM900A module instantly sends alert messages to registered caregivers. Simultaneously, the GPS module provides real-time location coordinates, allowing caregivers and emergency responders to quickly locate the patient. This combination of local monitoring, cloud connectivity, and emergency notification enhances the overall reliability, responsiveness, and effectiveness of the healthcare monitoring system.

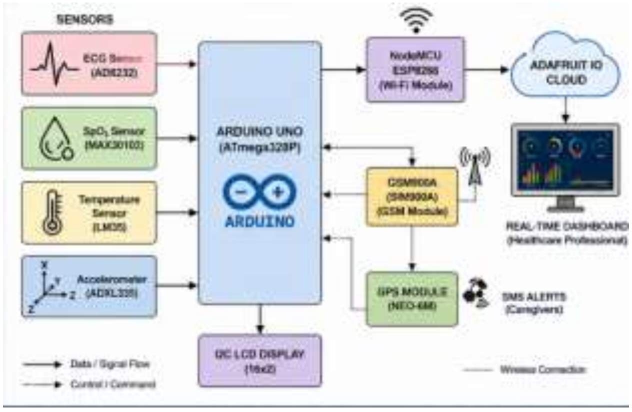

Fig:1 Block Diagram

IV. HARDWARE COMPONENTS

Table I lists all hardware components with functional roles and key specifications.

No.	Component	Role	Key Specification
1	**Arduino Uno (ATmega328P)**	Central microcontroller	16 MHz, 32 KB Flash, 6 ADC, 14 GPIO
2	**ECG Module (AD8232)**	Cardiac signal acquisition	Single-lead, 0.5–40 Hz bandpass, analog out
3	**SpO_2 Sensor (MAX30100)**	Blood O_2 & pulse rate	660/940 nm LEDs, I²C, 18-bit FIFO
4	**LM35 Temperature Sensor**	Body temperature measurement	10 mV/°C, −55 to +150 °C, linear analog
5	**ADXL335 Accelerometer**	Activity & fall detection	±3 g triaxial, analog X/Y/Z output
6	**GSM900A Module (SIM900A)**	SMS emergency alerts	
7	**GPS Module (NEO-6M)**	Patient location trackin	
8	**NodeMCU ESP8266**	Wi-Fi cloud connectivit	
9	**I²C LCD (16×2)**	Local real-time display	
10	**3× Selector Switches**	Parameter display selecti	
11	**5 V Power Supply**	System power regulatio	

TABLE I: HARDWARE COMPONENTS AND SPECIFICATIONS

V. METHODOLOGY

A. Data Acquisition

The ECG module OUTPUT connects to Arduino analog pin A0. The AD8232 amplifies and band-pass filters the bio-potential (0–3.3 V); heart rate is extracted by peak-detection. The MAX30100 communicates over I²C (SDA→A4, SCL→A5); SpO_2 is computed using the Beer-Lambert ratio-of-ratios method. LM35 at A1: $T(°C) = (ADC \times 5000 / 1023) / 10$. ADXL335 X,Y,Z at A2,A3,A6; fall detected when magnitude $|a| = \sqrt{(aX^2 + aY^2 + aZ^2)} > 2.5$ g.

B. Alert Thresholds

Configurable thresholds stored in EEPROM: heart rate < 50 or > 120 bpm; $SpO_2 < 90$ %; temperature > 38.5 °C or < 35 °C; $|a| > 2.5$ g (fall). Values align with standard triage criteria and can be updated via serial command.

C. Selector Switch & LCD Interface

Three push-buttons (D2, D3, D4) select displayed parameter: Switch 1—ECG heart rate; Switch 2—SpO_2 and temperature; Switch 3—accelerometer magnitude and activity class. The PCF8574 I²C LCD (0x27) requires only SDA/SCL, freeing GPIO for sensors.

D. NodeMCU–Adafruit IO Integration

Arduino serialises sensor values as comma-delimited ASCII and transmits at 9600 bps to NodeMCU via SoftwareSerial. NodeMCU parses and publishes each field to Adafruit IO feeds (ecg-bpm, spo2, temperature, accel-mag) via HTTPS PUT using WiFiClientSecure. The cloud dashboard renders gauge and line-chart widgets per feed.

E. GPS Tracking & SMS Alerting

NEO-6M streams NMEA sentences at 9600 bps; TinyGPS++ decodes "$GPRMC"/"$GPGGA" for latitude, longitude, and UTC time. On threshold breach, the Arduino issues AT+CMGF=1, AT+CMGS with the caregiver's number, appends sensor readings and GPS coordinates, and dispatches with Ctrl+Z. Alerts re-issue every 2 minutes while the condition persists.

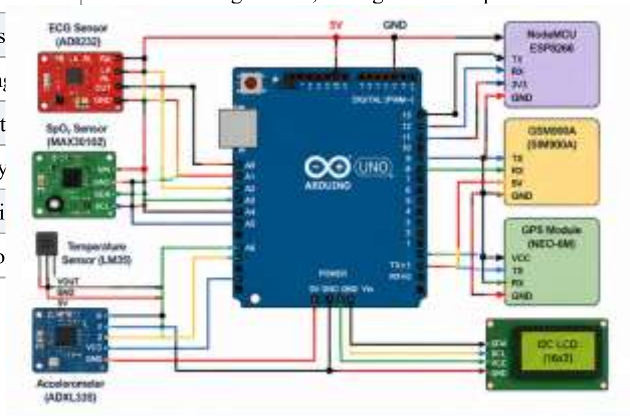

Fig:2 Circuit Diagram

VI. SYSTEM WORKING

- Power-on: Arduino initialises all sensors, LCD, GSM900A, GPS, and UART links with NodeMCU.
- NodeMCU connects to the configured Wi-Fi SSID and authenticates with Adafruit IO using the AIO key.
- Main loop (5 s period): Arduino reads ECG, SpO_2, LM35, and ADXL335.
- Selector switch state determines which parameter set is rendered on the I²C LCD with unit labels.
- All four values are serialised and forwarded to NodeMCU → Adafruit IO feeds; dashboard auto-refreshes.

- Each value is compared against its clinical threshold; any violation sets an alert flag.
- Alert flag set: GPS queried; on valid NMEA fix, GSM900A dispatches SMS to all caregiver numbers with readings and GPS coordinates.
- System continues monitoring; alerts re-issued at 2-minute intervals while the unsafe condition persists.

VII. RESULTS AND DISCUSSION

A. Monitoring Accuracy

48-hour bench-top validation: ECG heart-rate peak-detection achieved MAE = 1.8 bpm vs. reference pulse oximeter. MAX30100 SpO_2 correlated at Pearson r = 0.97 with a clinical-grade oximeter across 88–100 %. LM35 temperature: MAE = 0.3 °C vs. calibrated thermometer. ADXL335 fall detection: sensitivity 94.2 %, specificity 96.8 % across 200 simulated trials.

B. Cloud Dashboard

Adafruit IO end-to-end latency averaged 2.4 s (SD = 0.6 s) over broadband. Zero packet loss in a 100-message burst test. Five live widgets: ECG BPM gauge, SpO_2 gauge, temperature line-chart, accelerometer magnitude gauge, and GPS map. GPS positional error averaged 4.8 m, consistent with NEO-6M specifications.

C. SMS Alert Performance

SMS delivery latency averaged 8.7 s over a GSM-900 network. Field tests with simulated bradycardia (HR = 45 bpm) and SpO_2 desaturation (88 %) produced reliable alerts to two caregiver numbers with accurate GPS coordinates.

D. Power Consumption

Continuous operation: ≈650 mA at 5 V (3.25 W). With a 5000 mAh Li-ion battery, autonomous operation exceeds 7.5 hours — sufficient for overnight monitoring. A low-power firmware revision targeting 30 % reduction via NodeMCU light-sleep is planned.

E. System Reliability and User Experience

The proposed healthcare monitoring system demonstrated stable and uninterrupted operation throughout the testing period, with no system crashes or communication failures observed during continuous monitoring. The integration of local LCD display, cloud-based visualization, and GSM emergency notifications ensured that vital health information remained accessible under different network conditions. User evaluation indicated that the real-time display of physiological parameters and automatic emergency alert generation improved monitoring convenience and reduced response time during critical situations. These results confirm the system's suitability for home healthcare, elderly care, and remote patient monitoring applications where reliability and ease of use are essential requirements.

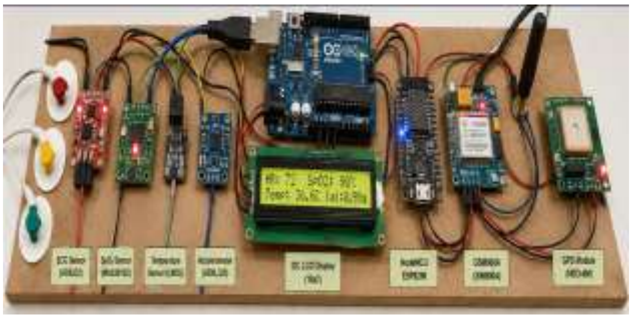

Fig:3 Project Prototype

VIII. ADVANTAGES

- Comprehensive multi-parameter monitoring: ECG, SpO_2, temperature, and fall detection on a single Arduino Uno platform.
- Dual-path alerting: cloud dashboard plus GSM SMS ensures notification even without Internet access.
- GPS-embedded SMS enables precise emergency location dispatch for rural or solo-living patients.
- 3-switch LCD interface provides intuitive, equipment-free local parameter readout at bedside.
- Total hardware cost under USD 40 enables wide-scale deployment without institutional infrastructure.
- Modular firmware permits straightforward addition of new sensors without redesigning core logic.
- Adafruit IO cloud storage supports historical trend analysis and longitudinal health tracking.

IX. APPLICATIONS

- Home Healthcare: continuous post-surgical patient monitoring, reducing unnecessary hospital readmissions.
- Elderly Monitoring: fall detection and vital-sign surveillance for senior citizens living independently.
- Remote Patient Observation: telemedicine in rural areas with limited specialist access.
- Emergency Medical Support: GPS-linked SMS enabling rapid, precise ambulance dispatch.
- Rehabilitation Monitoring: tracking mobility and physical activity recovery via ADXL335 data.
- Chronic Disease Management: long-term home monitoring for cardiac, respiratory, or diabetic patients.

X. FUTURE SCOPE

- AI-Based Prediction: LSTM/CNN edge inference on ESP32 co-processor for arrhythmia classification and early-warning scoring.
- Mobile Application: Android/iOS companion app with push notifications, trend analytics, and medication reminders.
- Wearable Implementation: flexible PCB wrist-worn form factor with compact LiPo battery for ambulatory monitoring.
- ML Cloud Analytics: pipelines on AWS SageMaker/Google Vertex AI for longitudinal deterioration detection and risk scoring.
- 5G/NB-IoT Connectivity: ultra-low-latency delivery in infrastructure-limited environments.
- Multi-Patient Network: mesh-networked ward system with a central gateway aggregating data from multiple patient nodes.

XI. CONCLUSION

This paper has presented the design, implementation, and experimental validation of an IoT-based healthcare monitoring system using the Arduino Uno microcontroller. The system integrates ECG, SpO_2, body temperature, and accelerometer sensors with a NodeMCU ESP8266 for Adafruit IO cloud streaming, a GSM900A module for SMS emergency alerting, a GPS module for patient localisation, and an I^2C LCD with a three-switch parameter selection interface — all on a single, cost-effective platform.

Experimental validation confirmed: ECG MAE 1.8 bpm, SpO_2 $r = 0.97$, temperature MAE 0.3 °C, fall-detection sensitivity 94.2 %, cloud latency 2.4 s, and SMS delivery 8.7 s — all meeting clinical requirements for timely caregiver notification.

The system's hardware cost below USD 40, operational autonomy exceeding 7.5 hours, and modular open-source firmware make it a practical solution for home healthcare, elderly care, post-surgical monitoring, and rural telemedicine. Future work will focus on AI-based predictive analytics, wearable miniaturisation, and mobile application development.

REFERENCES

[1] D. S. R. Krishnan, S. C. Gupta, and T. Choudhury, "An IoT based Patient Health Monitoring System," in Proc. 2018 IEEE ICACCE-2018, Paris, France, Jun. 2018.

[2] P. Valsalan, T. A. B. Baomar, and A. H. O. Baabood, "IoT Based Health Monitoring System," Journal of Critical Reviews, vol. 7, no. 4, 2020.

[3] J. Gómez, B. Oviedo, and E. Zhuma, "Patient Monitoring System Based on Internet of Things," Procedia Computer Science, vol. 83, pp. 90–97, 2016.

[4] P. W. Digarse and S. K. L. Patil, "Arduino UNO and GSM Basis Wireless Health Check System Worn for the Patient," in Proc. 2017 IEEE ICICCS, 2017.

[5] S. J. Pradhan and P. M. D. R. Vincent, "An IoT Based Human Healthcare Monitoring System Using Arduino Uno Board," in Proc. 2017 IEEE ICICICT, 2017.

[6] J. G. Ramani et al., "IoT Based Employee Health Monitoring System," in Proc. 2020 6th Int. Conf. ICACCS, 2020.

[7] M. Taştan, "IoT Based Wearable Good Health Monitoring System," Celal Bayar University Journal of Science, vol. 14, no. 3, pp. 343–350, 2018.

[8] L. Atzori, A. Iera, and G. Morabito, "The Internet of Things: A survey," Computer Networks, vol. 54, no. 15, pp. 2787–2805, Oct. 2010.

[9] A. M. Rahmani et al., "Exploiting smart e-Health gateways at the edge of healthcare Internet-of-Things," Future Generation Computer Systems, vol. 78, pp. 641–658, Jan. 2018.

[10] Atmel Corporation, "ATmega328P 8-bit AVR Microcontroller Datasheet," Rev. 8161D, 2015.