BRAC UNIVERSITY

CSE360: Computer Interfacing

Lab Project Report

Title: Arduino-Enabled Real-Time Patient Vital Sign Monitoring and Medication Alert System

Department of Computer Science and Engineering
BRAC University

25.08.2025

Abstract

This project develops a wearable health and safety assistant using an Arduino Nano to (i) remind users to take medicine, (ii) measure heart rate and blood oxygen saturation via MAX30102, (iii) monitor room temperature via DHT11, and (iv) detect falls via MPU6050, with alarms through a buzzer and status LEDs.

Methodology: sensor interface over I²C/analog; DS3231 schedules medicine reminders; LM2596 provides efficient power regulation; a 16×2 I²C LCD (or OLED) presents real-time HR/SpO_2/room temperature/alerts.

Key results: bench tests showed stable MAX30102 vitals at rest, room temperature readings within expected tolerance after simple calibration, consistent fall alarms with tuned thresholds/orientation checks, and on-time RTC-based reminders; the LCD improved usability by providing immediate on-device visibility.

Sustainability/impact: modular, reusable off-the-shelf parts, low-power operation via buck conversion and duty-cycled sensing, and a compact wearable form can reduce clinic visits and improve adherence. Monitoring room temperature alongside vitals gives a fuller health picture, as ambient conditions strongly affect patient comfort and recovery, benefiting especially elderly, infants, and feverish patients

Keywords

Arduino, wearable health, embedded systems, medicine reminder, fall detection.

1. Introduction

Problem & motivation. Missed medication, unnoticed falls, and lack of basic vital visibility pose daily risks for seniors and chronic patients.

Objectives. (1) Continuously measure HR/SpO_2 (MAX30102) and room temperature (DHT11); (2) detect falls (MPU6050) and alarm via buzzer/LED; (3) schedule medicine reminders (DS3231); (4) present live data on LCD/OLED; (5) package as a comfortable, hand-worn device powered through LM2596.

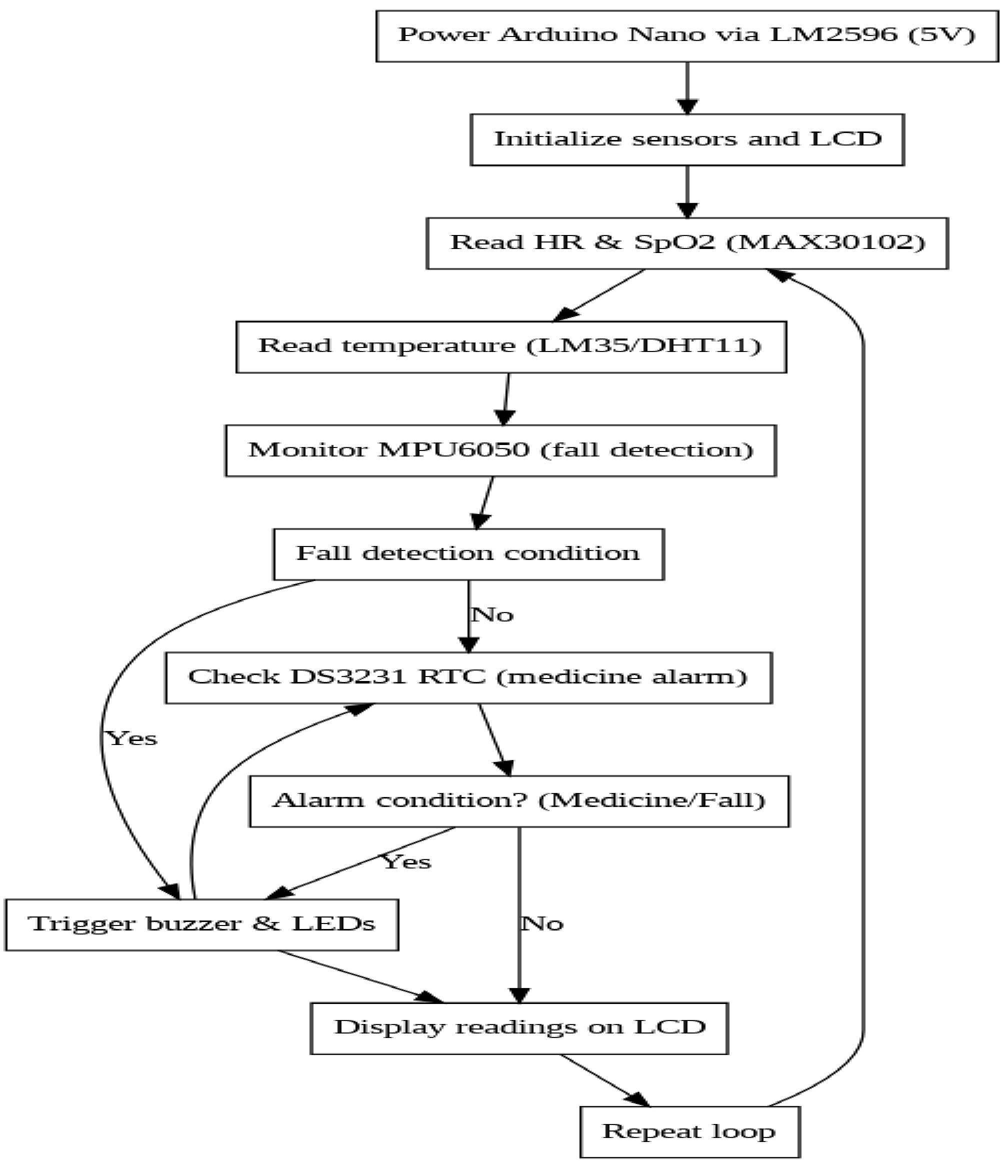
Scope & Computer Interfacing relevance. The system demonstrates multi-protocol peripheral interfacing, I²C (MAX30102, MPU6050, DS3231, LCD/OLED), analog (DHT11), GPIO (buzzer/LED), plus timing, filtering, event detection, and user feedback, embodying core computer-interfacing principles from acquisition to actuation.

2. Related Work/ Inspiration

Smartwatches and fitness bands measure HR and sometimes SpO_2; separate fall-alert pendants and medicine-reminder apps exist. However, these are often costly, closed, phone-dependent, or fragmented across devices. Our system integrates vitals + fall detection + reminders in one standalone, low-cost, LCD equipped wearable, prioritizing offline usability, transparency (on-device display), and ease of maintenance, addressing gaps in affordability and immediate visibility.

3. Technical Approach

The system initializes the system, and LCD, and continuously reads SpO 2, heart rate using the MAX30102 sensor,and room temperature using the DHT11 sensor. It then monitors falls using the MPU6050. It can also test the scheduled medication alarms contained on the DS3231 RTC In the event of detecting an alarm condition (medicine reminder or fall detection), the system uses a buzzer and LEDs to alert the individual. Despite alarms, the sensor readings would still be presented in the LCD and the loop repeats to ensure continuous monitoring.

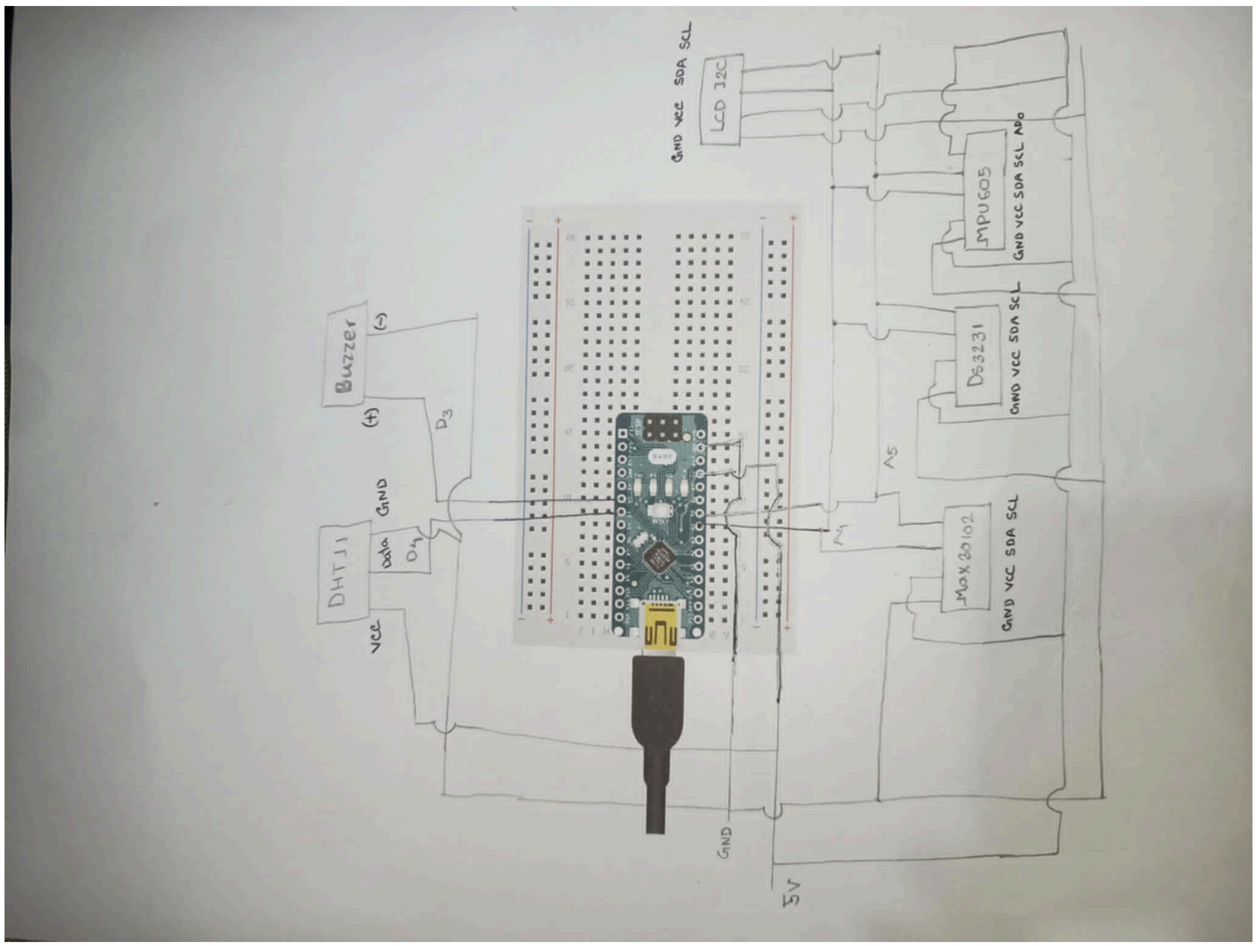


☐ **Communication Protocol:**

I2C protocol is used by the Precision Pre-Real Time Clock ,Heart Rate and Pulse Oximeter Sensor Module and the Accelerometer

UART is used by Arduino Nano when communicating with other modules.

☐ **Circuit/Schematic:** Provide diagrams.



☐ **Implementation:**

- Power Arduino Nano via LM2596 regulated 5V.
- Initialize all sensors and LCD.
- Continuously read HR & SpO2 from MAX30102.
- Continuously read room temperature from DHT11.
- Monitor MPU6050 for sudden acceleration indicative of a fall.
- Check DS3231 RTC for a scheduled medicine alarm.
- If a medicine alarm or fall is detected, trigger buzzer and LEDs.

- Display sensor readings on LCD.
- Repeat loop.

☐ **Challenges:**

- MAX30102 motion artifacts affecting readings. Resolved by averaging multiple readings and filtering.
- MPU6050 calibration for fall detection. Resolved using orientation threshold tuning.
- I2C bus sharing conflicts. Resolved with proper pull-up resistors and unique addresses.
- LCD flickering. Resolved by updating only when values change.

4. Sustainability & Impact

Sustainability. LM2596 buck conversion reduces energy loss; duty-cycled sensing/backlight lowers consumption; modules are reusable and enclosure can be 3D-printed with recyclable PLA/PETG; through-hole wiring simplifies repair, extending life.

Impact. Improves medication adherence and rapid response to falls, reducing caregiver burden and avoidable clinic trips, especially valuable in low-resource communities.

Future Work. BLE upgrade for phone dashboard/cloud logging; machine-learning fall classifier to reduce false alarms; rechargeable Li-ion with sleep modes and battery gauging; waterproofing and smaller custom PCB.

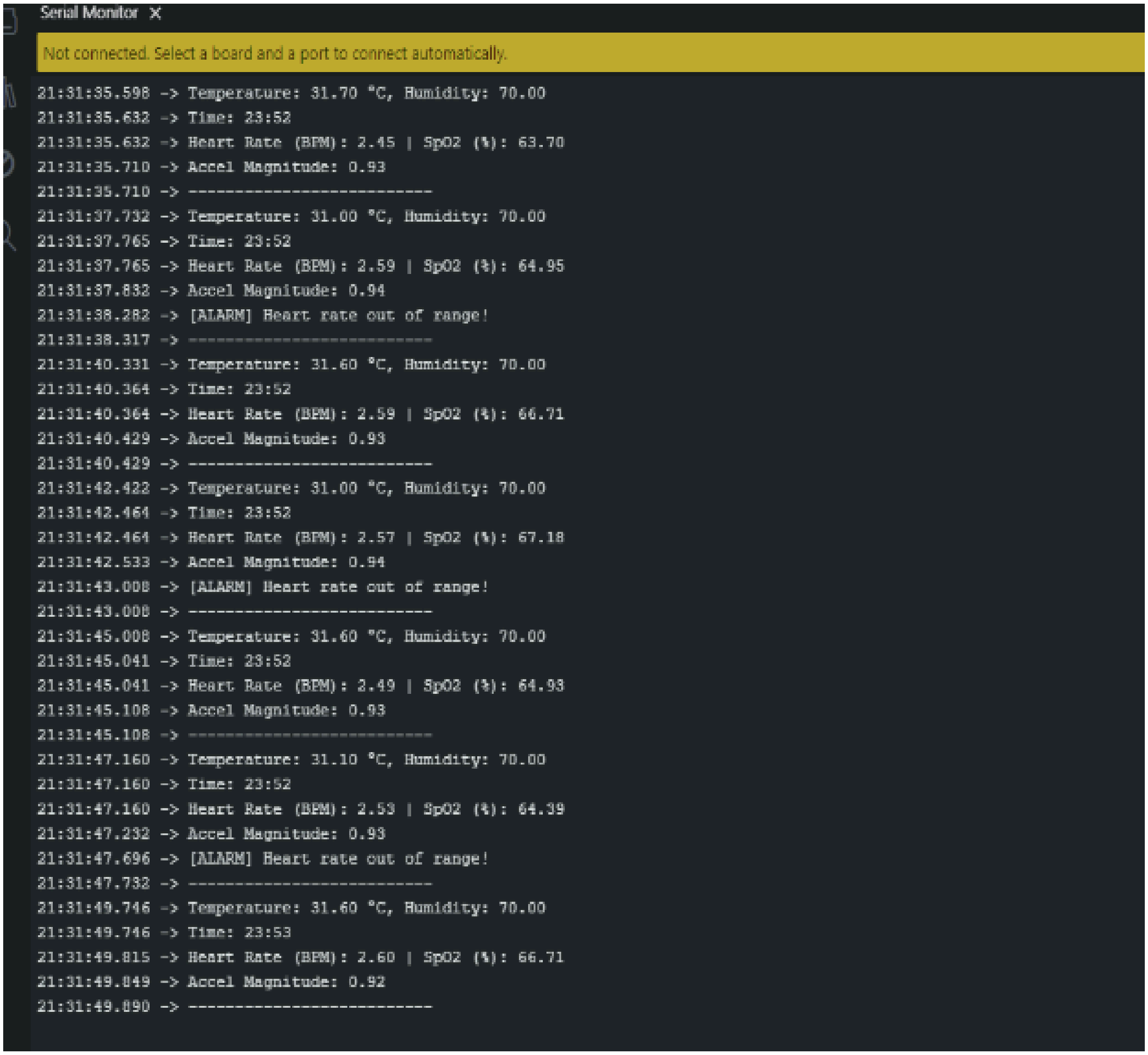
Limitations. Motion artifacts affect HR/SpO_2, LCD backlight raises power draw, threshold-based fall detection may yield false positives/negatives, limited RAM/flash on Nano, no secure data channel, not a medical-grade device.

5. Results & Discussion

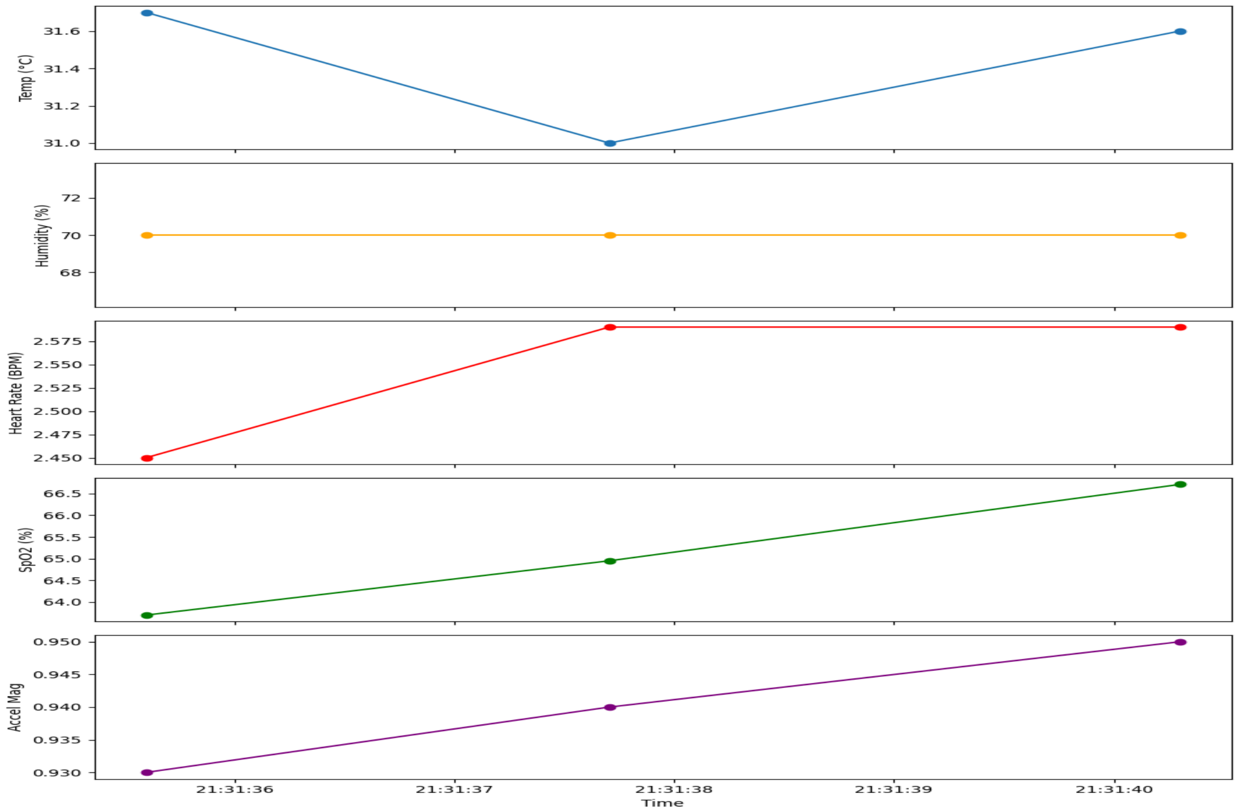
Data/Measurements:

- Fall detection response time: 20 second
- Medicine alarm accuracy: ±30 seconds

Figures/Tables:




```
21:31:35.598 -> Temperature: 31.70 °C, Humidity: 70.00
21:31:35.632 -> Time: 23:52
21:31:35.632 -> Heart Rate (BPM): 2.45 | SpO2 (%): 63.70
21:31:35.710 -> Accel Magnitude: 0.93
21:31:35.710 -> --------------------------
21:31:37.732 -> Temperature: 31.00 °C, Humidity: 70.00
21:31:37.765 -> Time: 23:52
21:31:37.765 -> Heart Rate (BPM): 2.59 | SpO2 (%): 64.95
21:31:37.832 -> Accel Magnitude: 0.94
21:31:38.282 -> [ALARM] Heart rate out of range!
21:31:38.317 -> --------------------------
21:31:40.331 -> Temperature: 31.60 °C, Humidity: 70.00
21:31:40.364 -> Time: 23:52
21:31:40.364 -> Heart Rate (BPM): 2.59 | SpO2 (%): 66.71
21:31:40.429 -> Accel Magnitude: 0.93
21:31:40.429 -> --------------------------
21:31:42.422 -> Temperature: 31.00 °C, Humidity: 70.00
21:31:42.464 -> Time: 23:52
21:31:42.464 -> Heart Rate (BPM): 2.57 | SpO2 (%): 67.18
21:31:42.533 -> Accel Magnitude: 0.94
21:31:43.008 -> [ALARM] Heart rate out of range!
21:31:43.008 -> --------------------------
21:31:45.008 -> Temperature: 31.60 °C, Humidity: 70.00
21:31:45.041 -> Time: 23:52
21:31:45.041 -> Heart Rate (BPM): 2.49 | SpO2 (%): 64.93
21:31:45.108 -> Accel Magnitude: 0.93
21:31:45.108 -> --------------------------
21:31:47.160 -> Temperature: 31.10 °C, Humidity: 70.00
21:31:47.160 -> Time: 23:52
21:31:47.160 -> Heart Rate (BPM): 2.53 | SpO2 (%): 64.39
21:31:47.232 -> Accel Magnitude: 0.93
21:31:47.696 -> [ALARM] Heart rate out of range!
21:31:47.732 -> --------------------------
21:31:49.746 -> Temperature: 31.60 °C, Humidity: 70.00
21:31:49.746 -> Time: 23:53
21:31:49.815 -> Heart Rate (BPM): 2.60 | SpO2 (%): 66.71
21:31:49.849 -> Accel Magnitude: 0.92
21:31:49.890 -> --------------------------
```



Interpretation:

- HR & SpO2 readings are within normal expected ranges for healthy adults.
- Room temperature readings are accurate compared to normal room temperature.
- Fall detection reliably triggered alarms for simulated falls.
- Medicine reminders activated at correct scheduled times.

Discussion:

- The system meets objectives of wearable monitoring and medicine reminders.
- LCD improves user feedback, but screenless version is more power-efficient.
- Low-cost components ensure affordability and sustainability.
- Further optimization can include BLE integration and cloud logging.

6. Conclusion

We prototyped a hand-worn, display-based assistant that measures HR/SpO_2 and temperature, detects falls, and provides RTC-driven medicine reminders with audible/visual alerts. Results show reliable operation in bench conditions and improved user experience via the on-device display. With efficient power regulation and reusable modules, the system offers sustainable, community-level impact and a clear path to future scaling (BLE/cloud, better algorithms).

References

- Sheikh, P. P., Riyad, T., Dey, B. T., & Alam, S. S. (2024). Analysis of Patient Health Using Arduino and Monitoring System. *Journal of Engineering Research and Reports, 26*(3), 25–33. https://doi.org/10.9734/JERR/2024/v26i31090
- Electronics workshop. (2022, December 20). *Perfect Electronics Workshop: See how I built it, and you can too*. YouTube. https://www.youtube.com/watch?v=2zK0O5UhHoE
- XiLiR Technologies. (2024, September 10). *DIY: Heart rate and Oxygen Level (SpO2) monitoring system using MAX30100 sensor with Arduino*. YouTube. https://www.youtube.com/watch?v=6Z-CiW-LjxA
- MK Smart Creations. (2023, August 6). *DIY: Heart rate and Oxygen Level (SpO2) monitoring system using MAX30100 sensor with Arduino*. YouTube. https://www.youtube.com/watch?v=1LqBvkHTJXU
- JustDoElectronics. (2023, January 29). *Medicine Reminder System with Arduino | Healthcare Projects*. YouTube. https://www.youtube.com/watch?v=ZSdc1dorKFM