REAL-TIME RISK ALERT SYSTEM FOR OLIGURIC DIALYSIS PATIENTS USING ARDUINO

BATCH NO-18

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ABSTRACT

Oliguria is a serious condition characterized by low urine output, posing risks for dialysis patients. Quick detection and management are essential to prevent complications like fluid overload, electrolyte imbalances, and cardiovascular issues. This project presents a real-time risk alert system using an Arduino platform to monitor dialysis patients with oliguria. The system incorporates sensors to track vital signs such as heart rate, blood pressure, and dialysis fluid flow. It sends alerts via GSM technology to caregivers' mobile devices and allows real-time data monitoring through a web dashboard. An LCD display offers immediate visual feedback in the facility, while a buzzer provides alerts for critical changes. This system enhances patient safety and care by enabling prompt responses, aiming to reduce severe complications during dialysis.

INTRODUCTION

- Kidney failure and chronic kidney disease (CKD) are serious health issues affecting millions of people worldwide.

- However, even during dialysis, patients can experience complications such as oliguria, a condition marked by abnormally low urine output.

- Oliguria may indicate worsening kidney function, fluid imbalance, or other critical issues, and if not addressed in time, it can lead to severe complications, including hospitalization or death.

LITERATURE REVIEW

Paper Title	Authors	Year	Key Findings
Real-Time Monitoring of Dialysis Patients	A. Smith et al.	2021	Proposed a wireless monitoring system for dialysis patients but lacked FPGA integration.
FPGA-Based Medical Alert System	B. Johnson et al.	2020	Demonstrated FPGA's efficiency in real-time medical alerts but not focused on dialysis patients.
IoT-Enabled Healthcare for Kidney Patients	C. Kumar et al.	2022	Developed an IoT-based solution for remote monitoring but had response delay issues.

Paper Title	Authors	Year	Key Findings
Automated Remote Cloud-Based Heart Rate Variability Monitoring System	Sari et al	2024	Proposes an Arduino-based system for real-time heart rate variability monitoring, with data sent to the cloud for further analysis.
IoT-Based Heart Failure Monitoring System Using RFID	Gupta et al.	2022	Introduces a monitoring system using IoT and RFID technology, which could be adapted for tracking dialysis patients' health parameters.

EXISTING SYSTEM

- Current dialysis monitoring systems rely on microcontrollers like FPGA and Raspberry Pi, which have limitations in real-time data processing.

- These systems often depend on cloud computing, which introduces latency.

- Additionally, some existing solutions lack automated alert mechanisms, requiring manual intervention to recognize risk conditions.

PROBLEM STATEMENT

Chronic kidney disease (CKD) patients undergoing dialysis are at risk of developing **oliguria**, a condition characterized by low urine output, which can be an early sign of kidney deterioration or fluid imbalance. There is a need for a **real-time, cost-effective, and automated risk alert system** that continuously monitors urine output and immediately alerts healthcare providers or caregivers when oliguria is detected.

OBJECTIVE

The main objective of this project is to develop a real-time risk alert system for oliguric dialysis patients using Arduino-based technology. The system will continuously monitor patient parameters, including urine flow rate, heartbeat, temperature, and blood pressure. It will provide alerts via IoT and GSM to caregivers and medical professionals when critical values are detected.
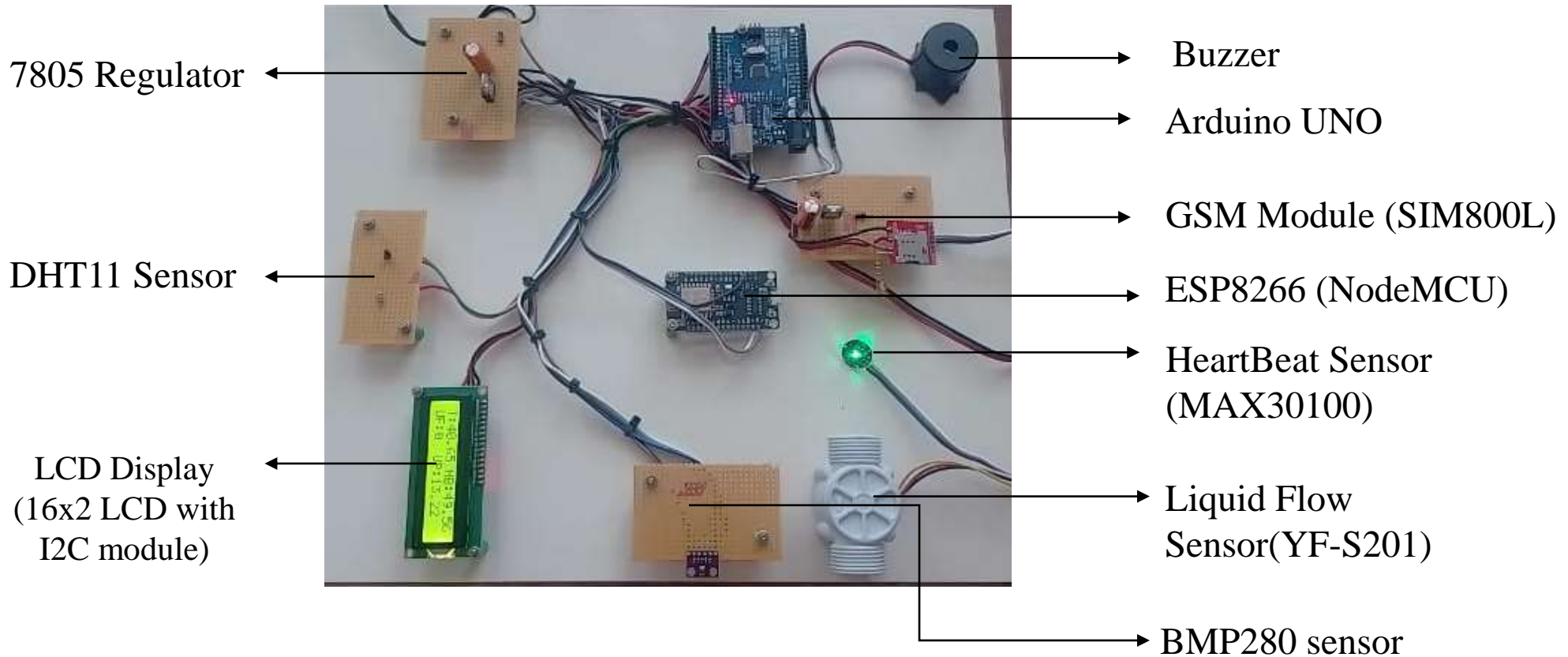
PROPOSED METHODOLOGY

- The proposed system incorporates sensors to track vital signs such as heart rate, blood pressure, and dialysis fluid flow.

- The Arduino processes the data, comparing it to predefined thresholds. If any parameter exceeds the set threshold, the system triggers an alert via visual (LED), audible (buzzer), or SMS notifications.

- This system enhances patient safety and care by enabling prompt responses, aiming to reduce severe complications during dialysis.
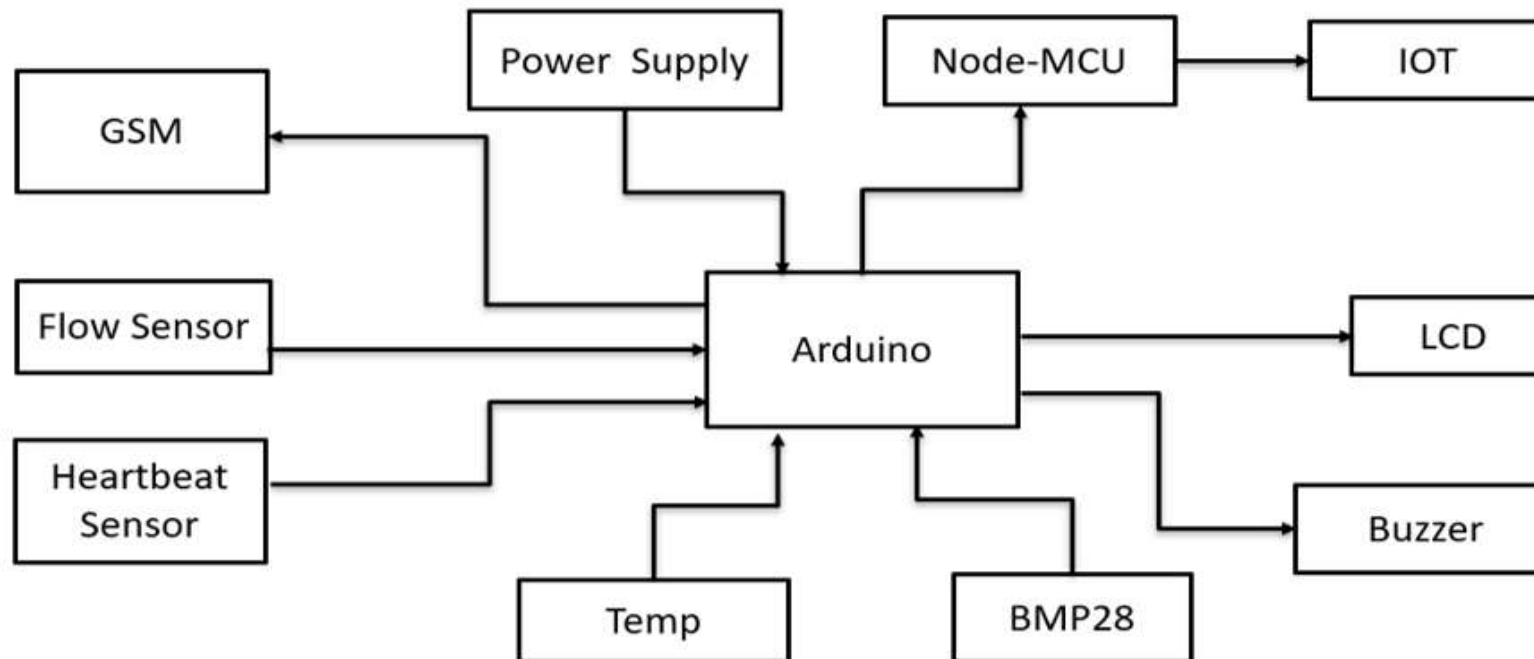
PROPOSED METHODOLOGY EXPLANATION

- The BMP280 pressure sensor monitors blood pressure, measuring systolic and diastolic levels to adjust treatment plans during dialysis

- The Arduino microcontroller is essential for real time data collection from sensors. It continuously gathers information, processes incoming signals into usable data, and ensures clarity and accuracy.

- Local alerts activate an immediate buzzer when safety parameters exceed or fall below safe limits, prompting quick action to protect individuals. Additionally, the system includes remote alerts via a GSM module, which sends SMS notifications to caregivers for timely intervention.

- The Node MCU uploads real-time data to an IoT platform, enabling continuous remote monitoring.

7805 Regulator

DHT11 Sensor

LCD Display
(16x2 LCD with
I2C module)

Buzzer

Arduino UNO

GSM Module (SIM800L)

ESP8266 (NodeMCU)

HeartBeat Sensor
(MAX30100)

Liquid Flow
Sensor(YF-S201)

BMP280 sensor

BLOCK DIAGRAM

ADVANTAGES

- Real-time processing

- Improved response time in critical situations.

- Reduced dependency on manual monitoring.

- Scalability for additional sensors or functionalities.

APPLICATIONS

- Hospitals and dialysis centers for real-time patient monitoring.

- Home healthcare systems for kidney patients.

- Remote monitoring solutions for critical care patients.

RESULTS AND DISCUSSION

- The recorded temperatures exhibit notable changes, reaching a peak of 38.93°C before dropping to 35.92°C, suggesting potential infection or other systemic issues.

- Heartbeat rates range from a low of 60 bpm to a high of 100 bpm, which could have serious implications for the patient's cardiovascular health. A resting heart rate below 60 bpm is generally considered bradycardia. persistent bradycardia can sometimes indicate a medical issue.

- Urinary flow (UF) remains consistently below 200 ml/s , while urinary pressure (UP) varies slightly but remains within a narrow range, suggesting stable renal function despite other abnormalities

NORMAL RESULTS

Timeline(UST)	Temp(celcius)	Heartbeat(BPM)	UF	UP
2025-01-03T08:20:07+00:00	38.18	60.46	145.38	12.37
2025-01-03T08:20:24+00:00	38.25	65.66	148.96	12.36
2025-01-03T08:21:15+00:00	38.25	95.89	147.85	12.33
2025-01-03T08:21:32+00:00	38.25	65.95	145.35	12.4
2025-01-03T08:22:06+00:00	38.18	65.36	147.85	12.44
2025-01-03T08:22:40+00:00	38.18	69.46	148.53	12.32
2025-01-03T08:24:06+00:00	38.32	65.46	149.96	12.28
2025-01-03T08:24:23+00:00	38.32	69.66	149.85	12.3
2025-01-03T08:24:58+00:00	38.32	69.56	147.65	12.28
2025-01-03T08:26:05+00:00	38.25	69.56	150.25	12.26
2025-01-03T08:27:29+00:00	38.32	65.56	149.28	12.3
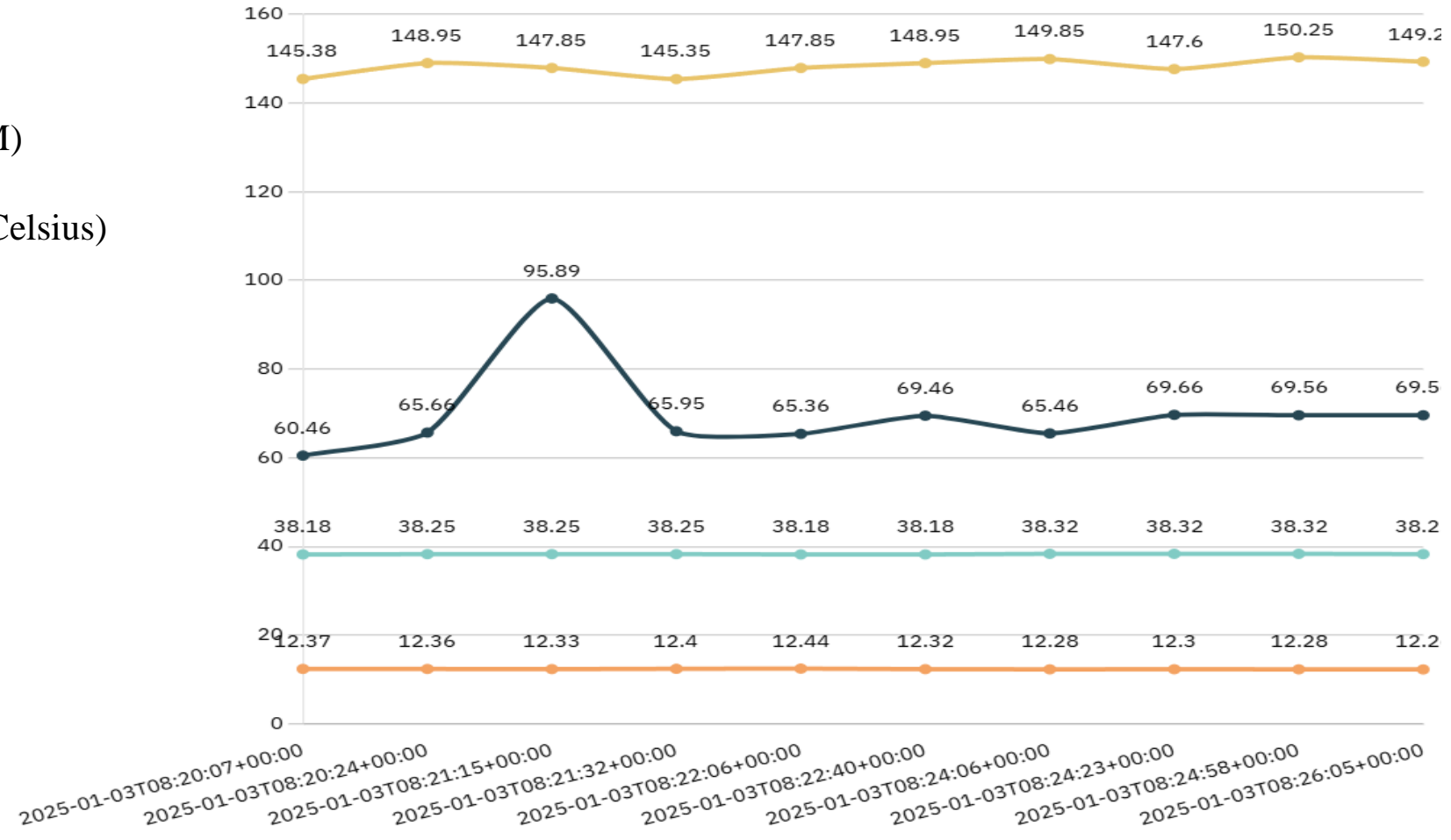
ABNORMAL RESULTS

Timeline(UST)	Temp(celcius)	Heartbeat(BPM)	UF	UP
2025-01-06T20:45:28+05:30	38.76	101.32	50.62	18.47
2025-01-06T20:45:46+05:30	38.82	100.54	53.25	18.48
2025-01-06T20:46:03+05:30	38.93	109.76	48.98	18.46
2025-01-06T20:46:20+05:30	35.92	105.05	45.63	18.47
2025-01-06T20:46:38+05:30	35.99	109.95	60.09	18.47
2025-01-06T20:46:55+05:30	35.99	108.97	55.45	18.48
2025-01-06T20:47:13+05:30	37.09	100.93	52.25	18.47
2025-01-06T20:47:31+05:30	37.57	105.93	48.95	18.47
2025-01-06T20:47:49+05:30	37.29	109.36	65.02	18.47
2025-01-06T20:48:06+05:30	36.95	106.95	46.99	18.46
2025-01-06T20:48:23+05:30	36.68	107.83	50.67	18.48
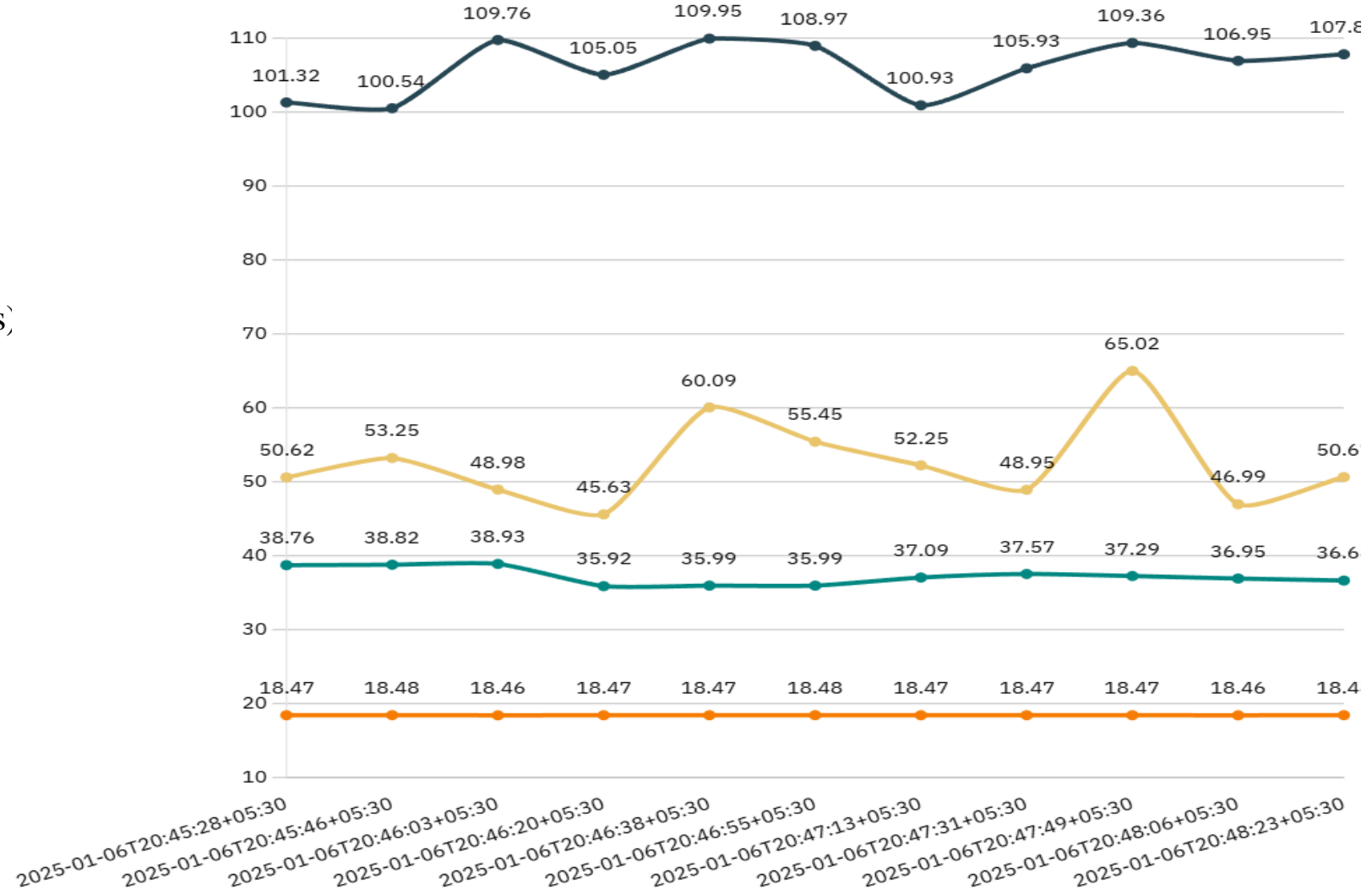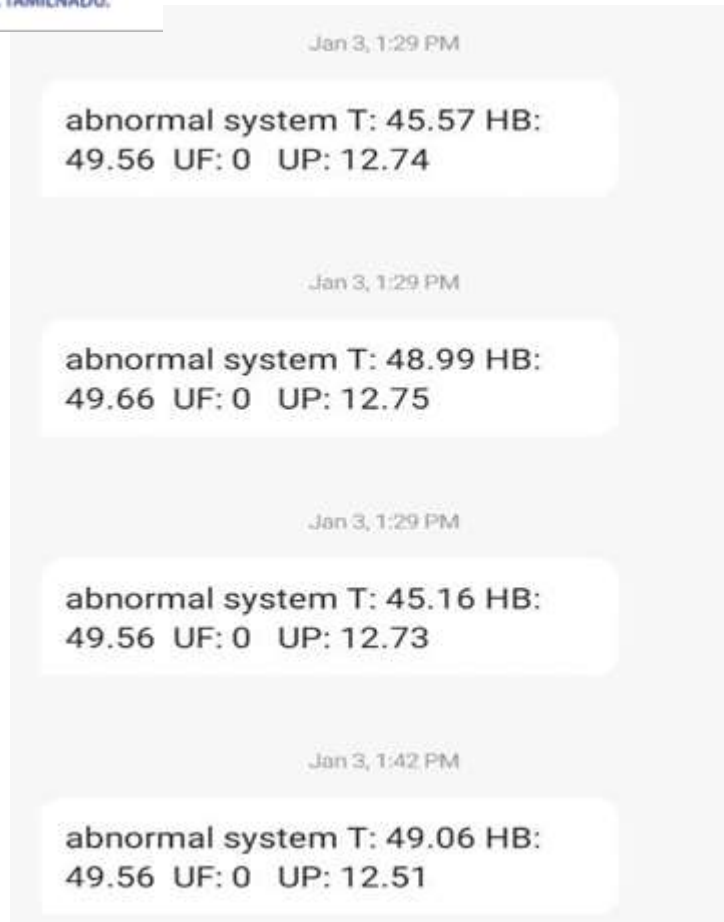
SMS Alert

(a)

(b)

(a)(b) LCD Output

PROJECT MODULE COMPLETION STATUS

Module	Completion Status
Sensor Integration	100%
Arduino Processing	100%
IoT & GSM Alert System	100%
Testing & Validation	100%

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CONCLUSION

- This system allows for constant monitoring of patients' vital signs and other critical metrics related to their dialysis treatment. By providing immediate alerts, it enhances patient safety significantly.

- Quick notifications can lead to faster responses from healthcare providers, which is essential for preventing complications that might arise from delayed treatment.

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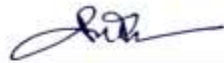
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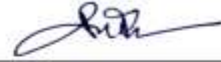For presenting the research article titled

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