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emphasis on embedded

Case Study

Precision Temperature Monitoring System

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About the Client:

The U.S firm provides manufacturing support of medical equipment to many renowned companies in the medical sector.

The client is vertically integrated with design and engineering support located in U.S.A providing customers with convenient and on time support.

Client Requirement:

The primary goal is to design and develop a disposable medical device to measure real time core body temperature of patients during cardiac surgery. This measured temperature value shall be wirelessly transmitted to the monitoring device.

The client's requirement is to design and develop a precision temperature measurement, medical solution for the health care domain.

The client wanted Avench to work on hardware design and embedded software for the solution. The Project involves the design and development of a PCB meeting the small form factor requirement in order to achieve compact device size. The client's expectation was about 12 weeks to deliver the required design.

The client wanted the device to have the following specifications:

S.No.	Specifications	Description
1.	Sensor	Far Infrared
2.	Battery	CR2450
3.	Operational Life	6+ hours of continuous operation on CR2450
4.	Shelf life	8 years

Project Scope:

The identified scope of this project is listed below:

1. Hardware module development.
    a. Logic design
    b. Schematic capture
    c. PCB Layout
2. Firmware design & development
3. Manufacturing prototype units.

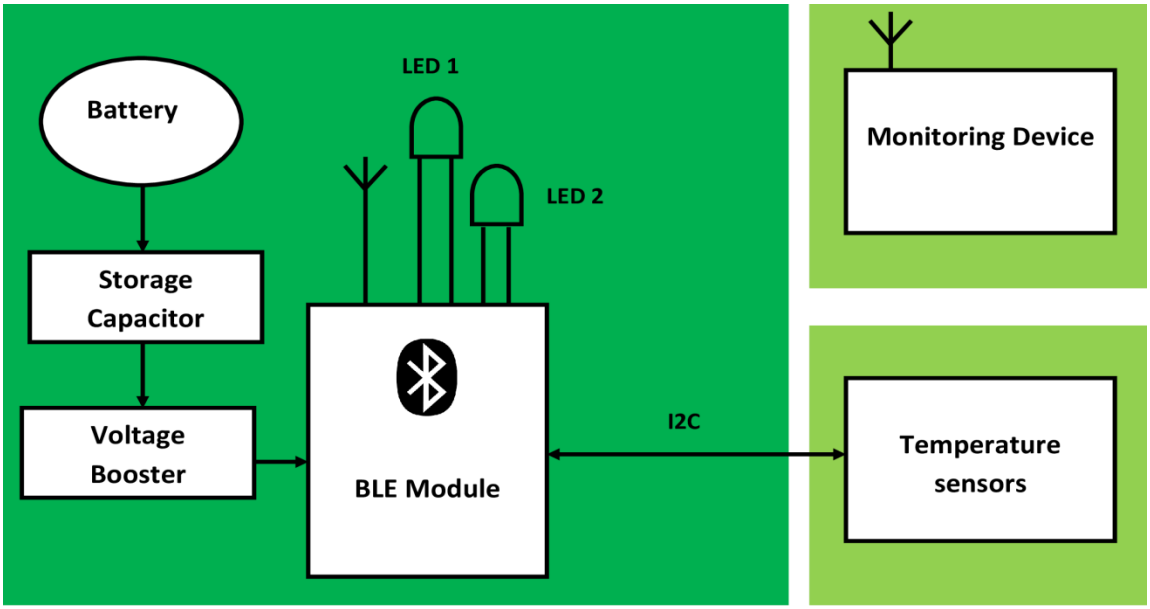
Solution Offered:

The solution offered can accommodate all the technical specifications of the client. The proposed design is a medical device that receives information on the patient's body cavity, it helps doctors to keep a close watch on core body temperature fluctuation and immediately take appropriate medicare actions. The far infrared temperature sensors will continuously read the temperature changes and display it in the monitoring system.

The designed module can collect information from different temperature sensor units, store it in a memory location and transmit it to the host system through BLE which is programmed periodically while the device is in operation. The device is powered with a coin cell maintaining a good battery life.

This temperature sensor stores the raw information in RAM after processing and the result of each measurement conversion is accessible via I2C. The external unit of the sensor utilizes the measurement data and calibration data to calculate both the sensor temperature and the object temperature. The sensed temperature was transferred to the BLE module by i2c bus and stored in order to perform calculations. The whole system is battery powered. Every time the device is turned on it first reads the current temperature status.

The basic working block diagram, of the device is shown as under.



All the modules used in the solution are FCC pre- certified so that the client saves time in the pre-certification process. We designed the hardware, including schematic capture, logic design, PCB Design, EMI and EMC, i2c temperature sensor interfacing, and embedded firmware development was done in parallel to ensure on time delivery of the solution. Basic electrical testing and functional & application testing was also done to check for errors before delivery of the product.

Challenges Faced:

The most challenging factor while designing this solution are:

- **Form Factor:**

  Achieving a small form factor of 35x35mm and that too, including a battery to realize very compact and miniature size device as per client requirement.

- **Isolation:**

  Battery is isolated from the whole circuitry so as nothing can become activated during sterilization prior to device usage, It is also a critical

requirement to maintain a good battery life, i.e. the device should have an overall battery backup of 6+ hours with single battery cell.

Software tools and technologies

- Bluetooth MCU (ARM Cortex)
- BLE SDK

Conclusion:

The implementation and technology, selection of any precision measurement system would depend upon several factors including environmental constraints, connectivity & performance requirements, regulatory requirements and many more. As new technologies evolve and user demand for convenience, the monitoring devices would become mainstream in medical & the health care industry. In the case of precision temperature monitoring system, finely tuned requirements and continuous client feedback helped Avench to deliver an efficient, cost-effective and enhanced solution to the customer.

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