Sending Data from Microcontroller to Cloud via WiFi (Mobile Hotspot)

1. Introduction

In this project, the **ESP32 microcontroller** reads sensor data (heart rate, SpO_2, temperature) from the patient and sends it to **Firebase Realtime Database**. The data is transmitted using **WiFi**, which can be provided via a **mobile hotspot** if no other internet connection is available.

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2. Why Use Mobile Hotspot

- Mobile hotspot provides **temporary internet access** for ESP32.
- Useful in remote areas or during testing where a router or fixed WiFi is unavailable.
- ESP32 can connect to the hotspot just like a normal WiFi network.

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3. ESP32 Connection Process

1. **WiFi Credentials:**
    - ESP32 stores the **SSID (network name)** and **password** of the mobile hotspot.
    - When powered on, it searches for the hotspot and connects.
2. **Connection Check:**
    - ESP32 continuously checks whether it is **successfully connected** to the hotspot.
    - If connection fails, it can **retry automatically** until connected.
3. **Internet Access:**
    - Once connected, ESP32 gains access to the internet.
    - It can now communicate with **Firebase servers** through the cloud.

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4. Sending Data to Firebase

- After WiFi is connected, ESP32 uses the **Firebase ESP Client library** to authenticate with Firebase.
- Data from sensors is read and prepared in the **JSON format**.
- ESP32 sends the data to specific paths in Firebase (e.g., `patients/P102/heart_rate`).
- Firebase updates instantly, allowing **real-time monitoring**.

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5. Data Flow Summary

1. ESP32 reads sensor values.
2. ESP32 connects to mobile hotspot WiFi.

3. WiFi provides internet access to ESP32.
4. ESP32 authenticates with Firebase using **API Key** and **Database URL**.
5. Sensor data is sent to Firebase in **JSON tree format**.
6. Firebase updates **live**, pushing data to connected applications (Android/web dashboard).

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6. Advantages of Using Mobile Hotspot

- Provides **flexible connectivity** without relying on home or office WiFi.
- Useful for **testing and field deployment**.
- Works anywhere a mobile network is available.
- Allows **real-time data upload** for patient monitoring.

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7. Considerations

- Mobile hotspot must have a **stable internet connection**.
- Power consumption on ESP32 may increase if WiFi connection is weak.
- For multiple patients or long-term monitoring, a **dedicated WiFi network** is more reliable.

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8. Conclusion

Using a **mobile hotspot** enables the ESP32 to send real-time patient data to Firebase efficiently, making the system flexible and deployable in areas without fixed internet. This setup ensures **live monitoring, instant updates, and secure cloud storage** for patient health information.