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IoT Course

Capstone Project Action Plan

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Course	IoT Course
Team Name	**The Red Warriors**
Team Leader/ Members	Phan Duy Hoàng Lý Tấn Lộc Ngô Thành Đạt Nguyễn Việt Hoàng Lưu Nguyễn Thảo Nguyên
Project Title	Home-based personal health monitoring system integrated with health advisory chatbot

Goal

- To develop an at-home personal health monitoring system utilizing an ESP32 to track temperature, heart rate, and SpO2 levels.
- To integrate a smart chatbot that provides users with their health data on demand, based on their unique ID.
- To create a centralized monitoring dashboard for nurses to view data from multiple Raspberry Pi data aggregators.

Abstract

This project presents an IoT-based health monitoring system designed for personal, at-home use. The system uses an ESP32 with multiple sensors to collect vital signs, which are then transmitted via MQTT to a Raspberry Pi acting as a local server and data aggregator. A key feature is a Flutter-based chatbot application that allows both patients and medical staff (nurses) to query real-time and historical health data through a conversational interface, with a central server providing a unified view of all monitored individuals.

Method

- **Data Acquisition**: An ESP32 microcontroller with temperature, heart rate, and SpO2 sensors captures user vitals. The data is packaged into a JSON format and published to a local MQTT topic.
- **Data Aggregation & Synchronization**: A Python script on each Raspberry Pi subscribes to the MQTT topic, saves data to a local MariaDB for redundancy, and pushes a copy to a central API server.
- **Backend Services**: A central FastAPI server, deployed on Render, provides secure RESTful APIs. It receives data from all Raspberry Pis, stores it in a central PostgreSQL database, and serves aggregated data to client applications.
- **Frontend Applications**: Two Flutter applications are developed: a mobile app for patients to view their own data and a Windows desktop app for nurses to monitor all patients across the system. Both apps use a chatbot interface powered by Google's Dialogflow for intent recognition and the Gemini API for general health inquiries.

Data

The primary data consists of real-time physiological metrics, including **body temperature**, **heart rate (BPM)**, and **blood oxygen saturation (SpO2)**.

- **Acquisition**: This data is acquired directly from the user via sensors connected to an ESP32 microcontroller. The ESP32 reads the sensor outputs at regular intervals.
- **Usage**: The collected data is transmitted to a central server for storage and analysis. It is primarily used to provide on-demand health status updates to users and medical staff through the chatbot interface and to generate alerts if any readings fall outside of normal ranges.

Expected Outcome

The expected outcome is a functional, end-to-end IoT health monitoring system that allows for seamless, remote tracking of personal vital signs.

- **Benefits**:
  - **For Patients**: Provides convenient access to their own health data, promoting proactive health management and enabling timely consultation.
  - **For Caregivers/Nurses**: Offers a centralized and efficient way to monitor multiple individuals, allowing for quicker responses to potential health issues and reducing the burden of manual check-ups.
  - **Overall**: The system enhances the quality of at-home care, provides a valuable data log for medical professionals, and serves as a scalable foundation for future telehealth innovations.

Role by Member

Đạt, Duy Hoàng: Responsible for setting up the Raspberry Pi, designing the MySQL database, developing the FastAPI backend, building the Flutter mobile application, and implementing the Intermediate (Directory) Server.
Việt Hoàng, Lý Lộc: In charge of programming the ESP32 to read sensor data, send data via Wi-Fi, and handle Bluetooth communication.
Duy Hoàng: Develops the chatbot, integrates it into the mobile application, and manages API communication.
Nguyên: Writes the report and organizes the project documentation.

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Schedule Summary

1/7/2025 - 4/7/2025	Analyze requirements and design overall system architecture
5/7/2025 - 24/7/2025	System Development
24/7/2025 - 28/7/2025	Finalize report and test the complete system in real-world scenarios

Comment & Assessment