IOHEAL

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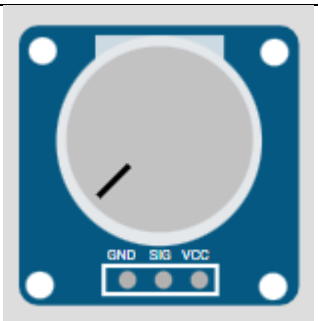
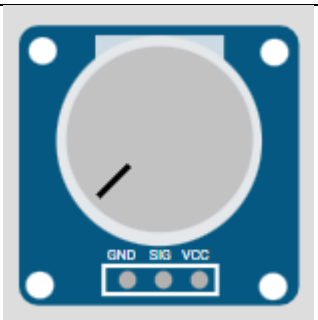
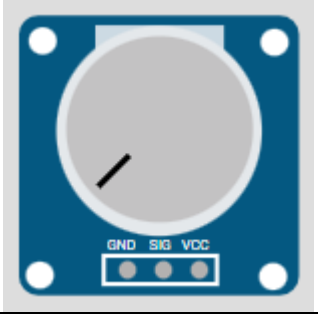
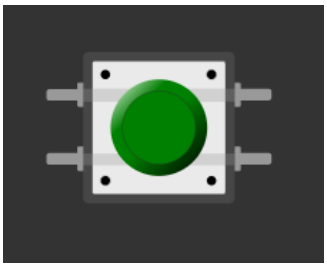
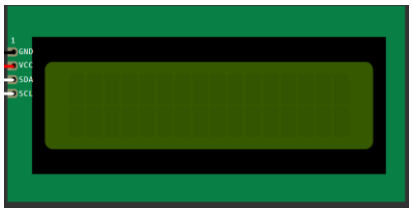
About IoHeal:

“IoHeal” is an IoT device designed to support patients during their post-surgery recovery. After surgery, patients require ongoing care to ensure proper healing. This is exactly what “IoHeal” provides—it helps patients take care of themselves effectively. For example, it monitors the patient’s heart rate to ensure they’re not overexerting themselves, reminds them to take medication on time, and notifies them when it's time to visit their doctor.

Wokwi

Sensors used in Wokwi:

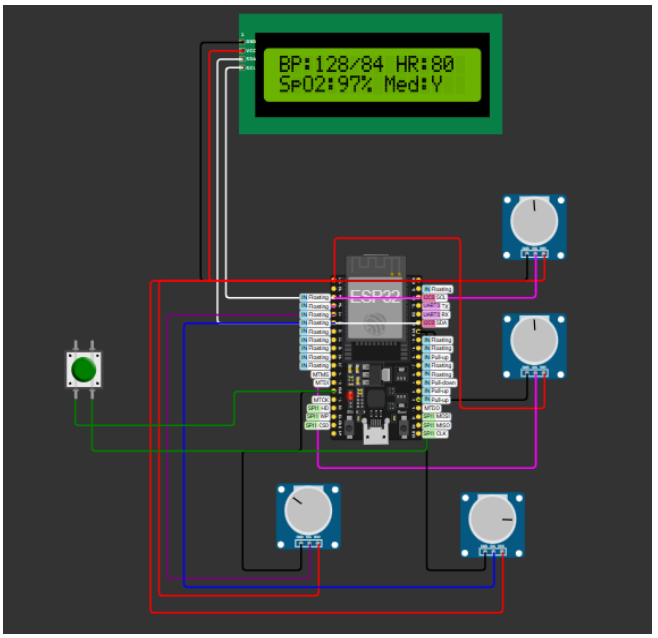
Sensor	Description	Picture
Blood Pressure (Bp) Sensor (Potentiometer)	Used to measure the force exerted by circulating blood on the walls of the body's arteries. 2 were used to stimulate the BP, one for systolic(top) and another for diastolic(bottom).	
Peripheral Oxygen Saturation (SpO2) (Potentiometer)	Used to measure the oxygen saturation in red blood cells.	
Heart Rate (HR) Sensor (Potentiometer)	Used to measure the amount of heartbeat per minute (BPM).	

Medicine Tracking (Push Button)	Used to stimulate the process of a patient taking medicine. Not pushed means No, pushed is Yes.	
16X2 LCD Screen	Used to output the readings from the sensors(BP, HR, SpO2, medicine).	
ESP32	Reads sensor data and button input, displays values on an LCD, and sends all data to ThingSpeak via Wi-Fi.	

IOHeal Simulation (WOKWI)

Brief description

This IoT-based health monitoring system was built using ESP32 on WOKWI. It simulates vital signs using potentiometers and medication tracking using a pushbutton. The system displays readings on an LCD and sends real-time data to ThingSpeak for cloud visualization



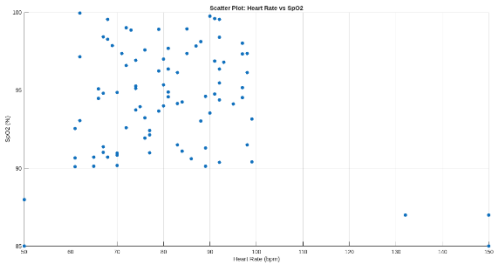
How it works

- The ESP32 reads analog input from four potentiometers representing:
  - Systolic and Diastolic Blood Pressure
  - Heart Rate

    - SpO_2 Level
- A pushbutton is connected to detect when medication is taken.
- All values are shown on an I2C 16x2 LCD screen in real time.
- The ESP32 connects to Wi-Fi (Wokwi-GUEST) and sends the data to ThingSpeak.
- ThingSpeak dashboards include:
    - Line plots for each sensor
    - Medication tracking indicator
    - A dual-axis chart to compare sensor trends
    - Scatter Plots showing measurements

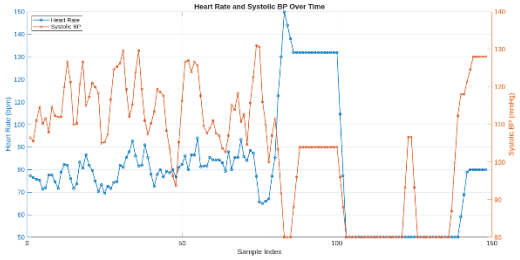
Visualizations Used

Heart Rate vs SpO_2 (Scatter)



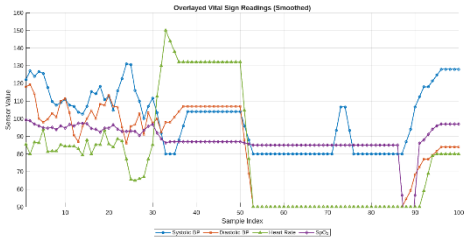
This plot illustrates the correlation between heart rate and systolic pressure. It can help detect cardiovascular strain or stress when both increase simultaneously.

Heart Rate and Systolic BP Over Time



A dual-axis line chart that tracks both heart rate and systolic pressure across time. This makes it easy to monitor trends and sudden spikes or drops in these two vitals.

Overlayed Vital Sign Readings (Smoothed)



All four vitals, systolic, diastolic, heart rate, and SpO_2, are shown in a smoothed line chart for comparison. This helps track the overall health trend and detect anomalies in any parameter.

Link to the WOKWI Simulation

https://wokwi.com/projects/431846727393930241

Thingspeak Channel

Dataset Summary

For this project, we used two datasets. The first is a health monitoring dataset. The second is a formatted version of the same data, structured to fit ThingSpeak's field format.

Original Dataset:

- **Purpose**: Primary source of medical data used for development, testing, and preprocessing.
- **Contents**: Includes 500 records and 12 features such as:
  - Systolic and Diastolic Blood Pressure
  - Heart Rate (HR)
  - Blood Oxygen Saturation (SpO_2)
  - Medication Taken Indicator (1 = taken, 0 = not taken)
- **Source:** Kaggle
- **Usage**: Design and validate the analysis scripts before deploying them live.

ThingSpeak Dataset:

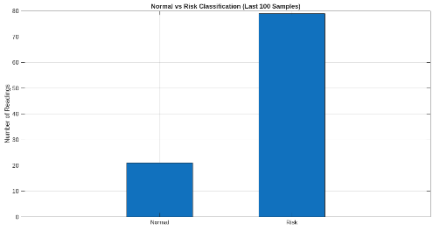
- **Purpose**: Formatted dataset uploaded to ThingSpeak channel for real-time monitoring and analysis.
- **Contents**: 8 features split into fields (1–8) & 500 records.
- **Source**: Derived from the original dataset.
- **Usage**: Used for feeding the ThingSpeak IoT platform and running live MATLAB analytics like:
  - Critical Value Detection
  - Heart Rate Stability
  - Medication Impact
  - Risk Classification
  - Trend Analysis

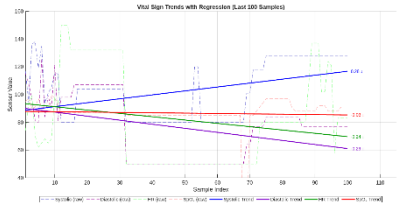
MATLAB Visualizations

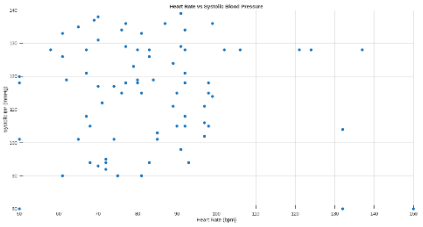
- Scatter Plots: Shows relationships between vital signs, such as heart rate vs SpO_2 and heart rate vs systolic BP. These help visually identify any potential correlations or outliers between variables.

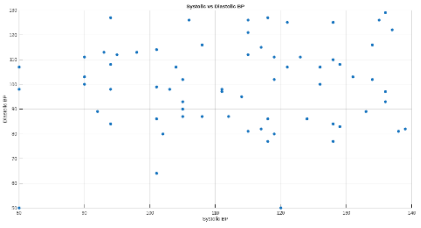
- Dual-Axis Line Charts: Like heart rate and systolic BP over time, and heart rate vs SpO_2 trend. These are useful to observe fluctuations and patterns in a patient's condition across readings.
- Medication Impact Plot: Shows heart rate alongside medication intake (0 or 1). It visually explores whether taking medication affects heart rate trends.
- Box Plot: Summarizes the distribution of all vital signs based on whether the patient took medication. Chose it because it clearly shows variability and medians, making comparison easier.
- Overlay Plot Smoothed overlay of all four key vitals to give a quick overview of how values behave together in a single view.
- Normal vs Risk Bar Plot: This highlights how many of the last 100 samples were classified as risky. It helps quantify risk levels in a very clear way.
- Trend Regression Plot: Used this to calculate and display the linear trend slopes of all four vitals. It helps show if vitals are improving, worsening, or staying stable.

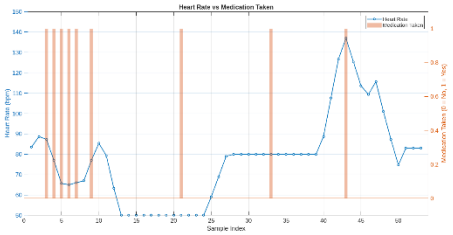
Each of these visualizations was selected to support specific insights, such as correlation, medication effect, anomaly detection, or long-term trend analysis.

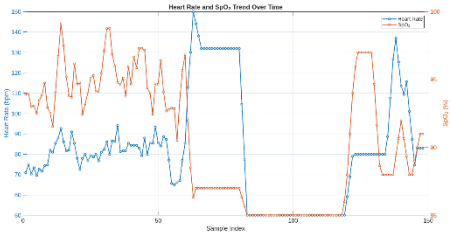


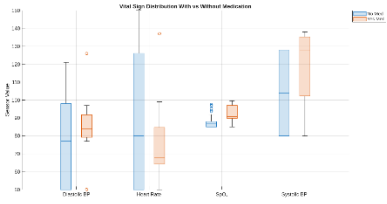






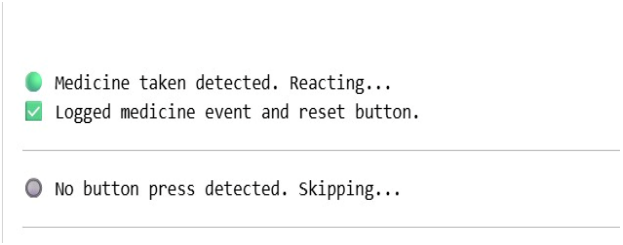






MATLAB Action

The medication tracking mechanism uses a pushbutton to confirm medication intake. When the button is pressed, MATLAB records the event and updates the cloud channel on ThingSpeak, allowing real-time monitoring. This ensures accountability and supports remote supervision for post-surgical recovery.



Conclusion

This channel successfully achieves the objectives of the project; create a smart health monitoring and medication tracking system using IoT and real-time analytics. It collects vital signs and uploads them to ThingSpeak in real time. The channel integrates multiple MATLAB Analysis apps that act on this data automatically.

The MATLAB actions applied include:

- Critical Value Detection: Flags readings that exceed medical risk thresholds (e.g., high BP, low SpO_2).
- Heart Rate Stability Check: Detects sudden heart rate spikes using difference analysis.
- Normal vs Risk Classification: Categorizes each reading into normal or risk based on thresholds.
- Medication Impact Analysis: Compares average heart rate and SpO_2 with and without medication taken.
- Trend Analysis with Linear Regression: Tracks whether vital signs are improving, stable, or declining over time.
- ThingSpeak React Action: Alerts can be triggered when risk values are detected.

Together, the channel performs not just monitoring but intelligent processing and decision support, meeting the project's goal of building an active and responsive health tracking system.

Thingspeak Channels

We have added you to the private channels through your university email.

Resources

Youtube, Kaggle, Mathworks Documentation, Wokwi