The Quad Chips

Lung sound recorder
for portable healthcare devices

The Team!

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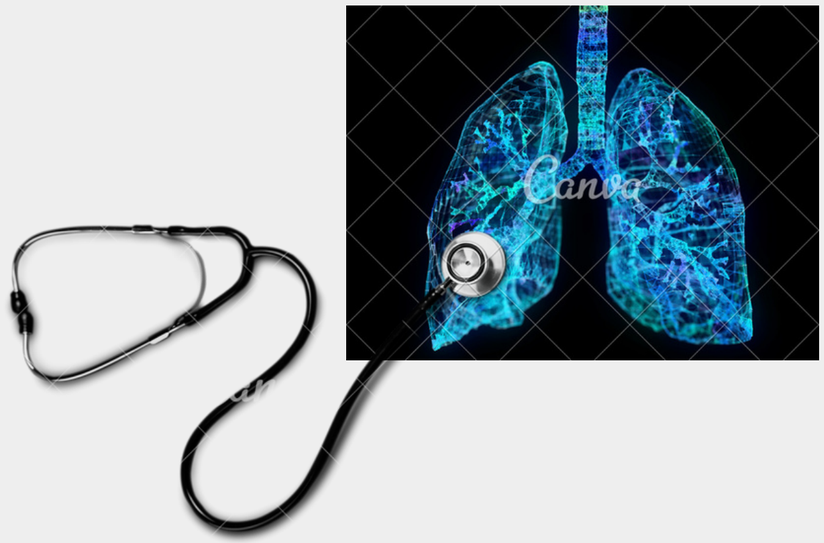
Motivation

The early diagnosis of respiratory related diseases in children below the age of 5 is crucial

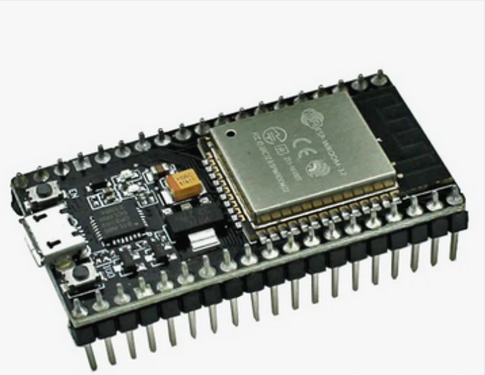
- for effective treatment
- lung sounds provide valuable
- essential to develop a device that can extract and record these sounds.



Aim

To design a portable healthcare device that will capture lung sounds and temperature readings using a microphone and stethoscope, and transmits them to dashboard for further analysis.

Sensors and Components



01 Stethoscope -

02 Microphone AFE - MAX4466

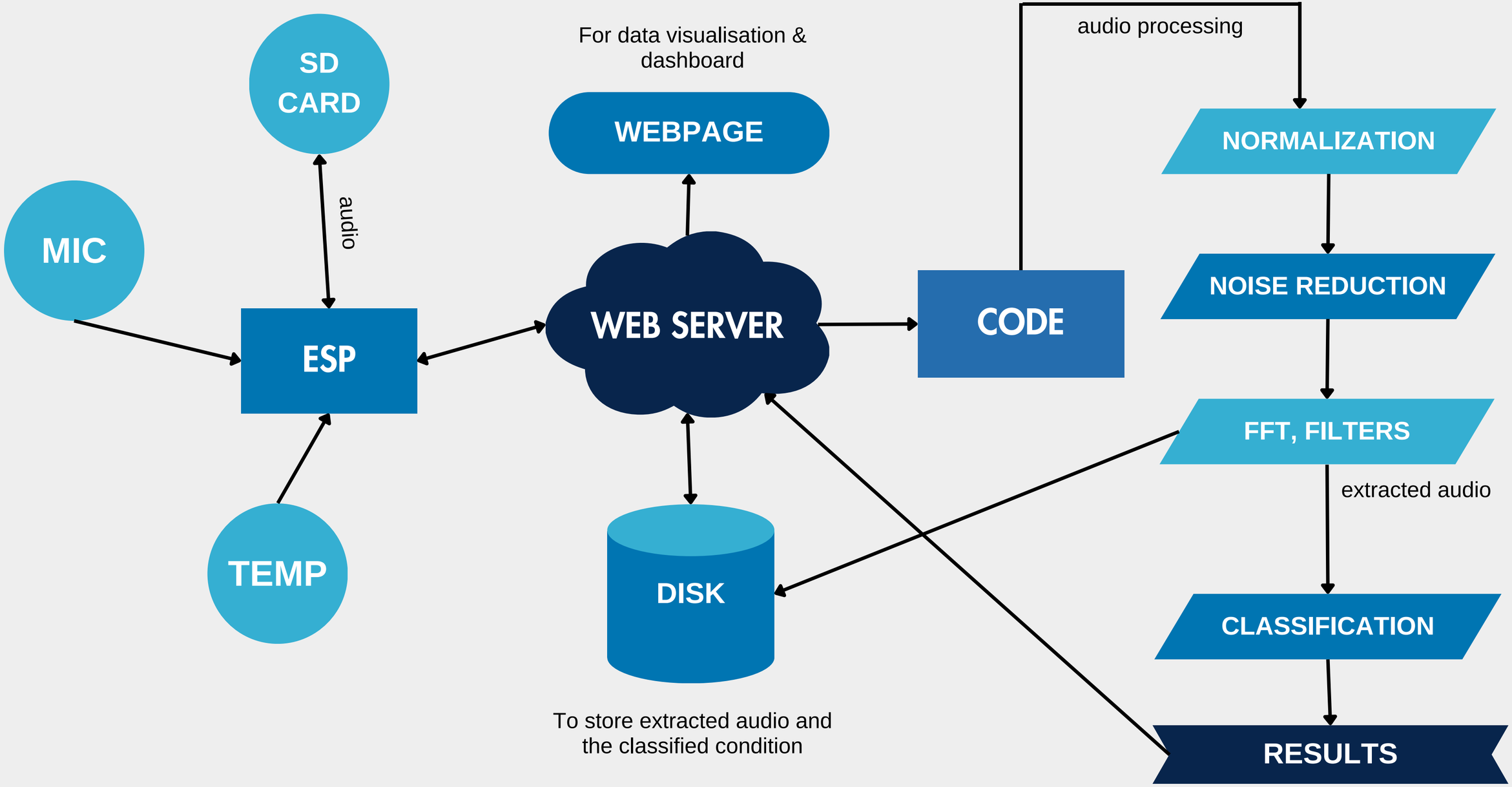
03 DS18B20 temperature sensor

04 ESP32

05 MicroSD Card module + SD card

Implementation

- Hardware setup.
- Creating ESP32 firmware for data acquisition
- Normalize the audio to bring amplitudes to the same range
- Implementing Noise reduction on the audio
- Applying FFT on the audio which is used to filter frequency
- Pattern matching with lung sounds (from a dataset)
- Building a web based dashboard for data visualization
- Testing hardware functionality
- Validating software performance and data transmission


SD CARD
audio
MIC
ESP
TEMP
For data visualisation & dashboard
WEBPAGE
WEB SERVER
DISK
To store extracted audio and the classified condition
audio processing
CODE
NORMALIZATION
NOISE REDUCTION
FFT, FILTERS
extracted audio
CLASSIFICATION
RESULTS

Data Analysis

Normalizing

Adjusting its amplitude to a standard level (-3 dB) to ensure consistent volume without distortion.

Noise Reduction

Noise Reduction to enhance signal clarity and minimise unwanted background noise. Techniques like “Spectral Gating can be used” which computes based on spectrogram formed by the signal.

Performing FFT

Use Fast Fourier Transform to convert the audio signals from the time domain to the frequency domain. Then, we apply compatible filters for lung sounds.

Pattern Matching with lung sounds

After the audio of lung sounds are extracted, we use pattern matching with a dataset of lung sounds.

Classification for abnormal lung sounds

Wheezing: dominant frequency of 400 Hz or more
Crackles: frequency range 60 - 2000 Hz, with the major contribution in the range of 60 - 1200 Hz
Stridor: 400-800 Hz frequency range
Rhonchi:dominant frequency of about 200 Hz or less.

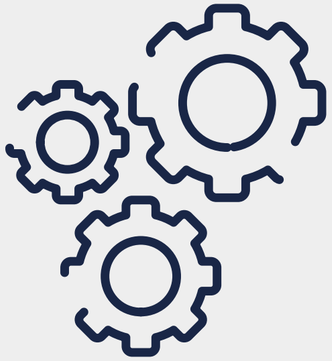
Temperature Data Analysis

Detecting anomalies or patterns in temperature data that may correlate with lung sound abnormalities or respiratory conditions

*RESOURCE: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4518345/

WEEK	TASKS	DISTRIBUTION
WEEK 1	Project Discussion, Preparing the presentation	All
WEEK 2	Finalizing the hardware components, researching about compatible software tools and libraries	All
WEEK 3	Building the hardware component, testing it	Jahnavi
WEEK 4	Building server, handling the audio files	Praneeth
WEEK 5	Normalization & Noise reduction	Vaishnavi

WEEK 6	Implementing FFT & frequency filters	Divya
WEEK 7	Pattern Matching Algorithms & testing the model with various lung sounds	Praneeth
WEEK 8	Classifier for different type of lung sounds	Divya
WEEK 9	Building the frontend, audio visualization,	Vaishnavi
WEEK 10	Test-build another system, which runs locally (cases of no network)	Jahnavi



Deliverables

Recorded raw sounds are stored locally on an SD card.

A web based dashboard which displays temperature reading and visualized audio signals of the patient.

Web server which handles the routes, requests from ESP, does the Signal processing methods on the audio

Final audios after noise reduction, normalization, and FFT are stored in a dedicated folder

Displays real-time status of the lung sounds (Normal / Abnormal), an alerting system if it goes abnormal