TITLE: Wearable IoT health monitoring device for seizure and fall detection.

PURPOSE:

- To detect seizure, seizure duration
- To detect fall and fall location
- Overall health monitoring in epileptic patients and elderly citizens
- Alert the caregiver about their condition through a user-friendly mobile application.

END USER:

- Device: Epileptic patients and elderly citizens
- Mobile application: Their caregivers

PRIMARY RESEARCH:

Questions for doctors/nurses:

1. What are the major types of seizures?

Major types of seizures and their clinical presentation:

- Absence seizure: Sudden lapse of consciousness for a few seconds with minimal body movement.
- Atonic seizure: Characterized by sudden loss of muscle tone, leading to abnormal motor experiences.
- Myoclonic seizure: Brief shock-like jerks of muscles.
- Tonic seizure: Involves stiffness and restricted movements.
- Clonic seizure: Characterized by repeated jerking movements.
- Grand-mal seizure (Tonic-clonic seizure): Causes loss of consciousness and violent muscle contractions.
- Febrile seizures: Occur in children (6 months to 6 years) due to high fever.

2. Are seizures common/ when can we expect seizures to occur?

Seizures are more common in individuals with certain conditions like epilepsy, head injury, or neurological disorders.

3. How often does it occur?

The frequency of seizures varies depending on the underlying condition, and it can occur more frequently in individuals with a history of epilepsy.

4. What are the dangers of seizure?

Seizures can lead to complications such as tongue biting or choking if the tongue folds backward. Immediate first aid is crucial to prevent harm.

5. Does the duration of the seizure matter?

- If a seizure lasts for 5 minutes or more, it requires immediate medical attention as it can be life-threatening.

- Seizures lasting 2-3 minutes should be diagnosed to identify the underlying cause and initiate appropriate treatment.

5. Can the diagnosis be better if the health stats during and duration of seizure be provided?

Providing health stats during a seizure can help in assessing the intensity and impact of the seizure on the patient's body.

Questions for patients/caretakers:

1. What were the common symptoms you experienced before a seizure?
- Sudden exhaustion
- Twitching of arm/leg
- Increased heart rate

Post seizure: No memory of the event (which is why it is necessary to detect the duration and the conditions experienced by the patient)

2. If there existed a device as such, what would you expect it to offer?

- Duration of the seizure since patients might not be aware of it during the event.
- Location of the fall to ensure immediate assistance if needed.
- Immediate alert when a seizure begins or a fall happens to notify caregivers or healthcare providers.
- Time of the fall to establish a timeline of events.
- Call for a healthcare facility to provide timely medical help.
- Health stats during the seizure and until help is received to aid in better diagnosis and management.

DETAILS OF PEOPLE WHO WERE SURVEYED:

- M Kamala (Ex-staff nurse at JIPMER, worked with neurologists and treated patients with seizures) - Phone: 9003844407
- Dr Geeta S (KM Speciality) - Phone: 7299013228
- B A Basha (Patient) - Phone: 9597388388
- Rahamath Shabina (Caretaker) - Phone: 9597769177
- Mrs. Jayalakshmi (Patient)
- Dr Sedhu Madhavan – Phone: 9443143228

FUZZY LOGIC:

We will use a fuzzy logic to pass values from multiple sensors and based on the data it gives a crisp output.

INPUT/OUTPUTS:

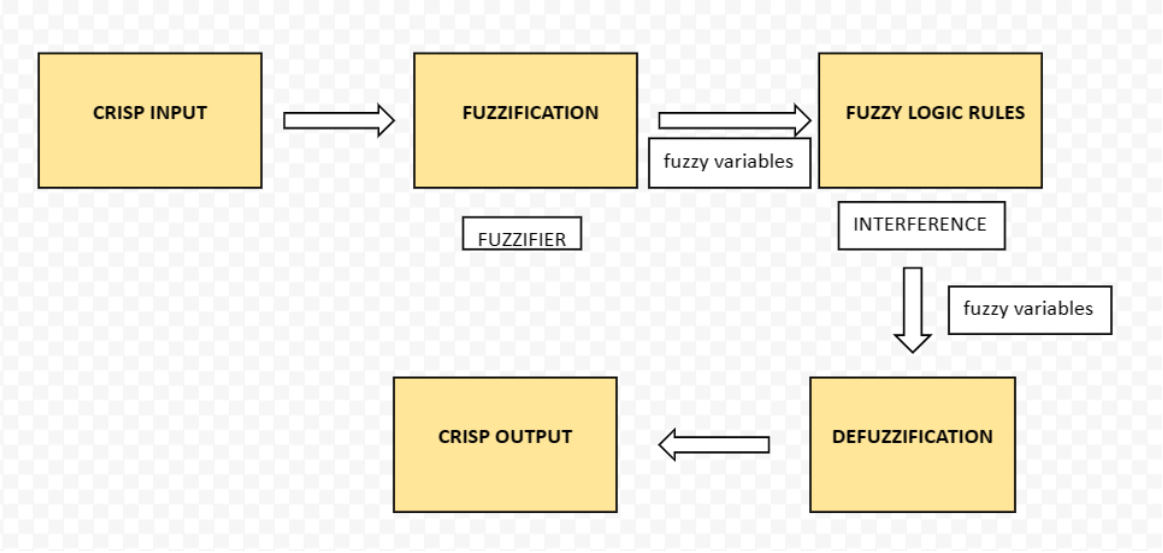
- Heart rate(ECG sensor) : Five lingustic variables- very low (VL), low (L), normal(N), high(H), very high(VH).

- Muscle spasms(EMG sensor) : Four linguistic variables – rest(R),start(S),end(E),relax(R)
- Fall detection(ACC): Three linguistic variables: Low,Medium, High
- Body temperature: Low, Normal, High

Fuzzy inference rules:

Rule 1: If (ECG is H) or (EMG is Start), then (Seizure Type is Clonic)
Rule 2: If (Temperature is High) and (EMG is Start), then (Seizure Type is Clonic)
Rule 3: If (ECG is N) and (EMG is Start), then (Seizure Type is Tonic)
Rule 4: If (ECG is H) and (EMG is Start) and (Accelerometer is Medium), then (Seizure Type is Tonic)
Rule 5: If (ECG is H) and (Temperature is Low) and (EMG is Start), then (Seizure Type is Tonic)
Rule 6: If (ECG is N) and (Temperature is Low) and (EMG is End) and (Accelerometer is High), then (Seizure Type is Atonic)
Rule 7: If (ECG is N) and (Temperature is Low) and (EMG is Relax) and (Accelerometer is High), then (Seizure Type is Atonic)
Rule 8: If (ECG is N) and (Accelerometer is High), then (Seizure Type is Atonic)
Rule 9: If (Temperature is High) and (EMG is Start), then (Seizure Type is Myoclonic)
Rule 10: If (ECG is N) and (Temperature is High) and (EMG is Start), then (Seizure Type is Myoclonic)
Rule 11: If (ECG is N) and (Temperature is High) and (EMG is Rest) and (Accelerometer is Medium), then (Seizure Type is Absence)
Rule 12: If (Temperature is High) then (Seizure Type is Absence)

FLOW CHART:



TECHNICAL DETAILS/COMPONENTS:

- ECG (Electrocardiogram) sensor- detect the electrical signals produced by the heart each time it beats, used to detect electrical activity of the heart
- EMG (Electromyogram) sensor- recording electrical activity produced by skeletal muscles

- Temperature sensor – DS18B20 – Dallas temperature sensor has built in 12-bit ADC with quoted accuracy of +-0.5 degree Celsius in the range of –10 degree to +85 degree Celsius.
- Accelerometer (3 axes) - Two accelerometers – one to detect fall and one for detecting the movement in patient's hands.
- ESP32 - SoC with integrated Wi-Fi and dual mode Bluetooth.
- GPS Module – To locate the place of fall
- Fuzzy logic – To send data and conclude and classify different results.

UN Goals involved in this project :

- Good Health and well-being