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Departments Visited	**Date**
Neurology	17/01/2025

I have attached photos of our visit, which were clicked after permission from the guiding doctor, assistant & patient. The images will only be used for educational Purposes.

During our visit, we were first taken to a diagnostic center specializing in various neurological tests, including Electroencephalogram (EEG), Electromyography (EMG), Evoked Potential (EP), and Transcranial Doppler (TCD). Each procedure was demonstrated on different patients, allowing us to observe cases involving epilepsy, delayed nerve conduction, gait abnormalities, visual cortex issues, and chronic headaches.

Patient 1: Diagnosed with Epilepsy

A female patient, approximately 50+ years old, was undergoing an EEG test to diagnose epilepsy. She was fitted with the 10-20 electrode system for EEG recording. Photic stimulation, involving a white flashlight flashing at specific frequencies, was used to amplify epileptic signals and locate the focal point of the epilepsy. The test lasted about an hour, during which the patient was instructed to sleep to minimize artifacts.

Patient 2: Diagnosed with Delayed Nerve Conduction.

A male patient underwent a nerve conduction test *Figure 1 This is the room view of Surface EMG for nerve conduction test.*. This involved the use of three surface electrodes and a stimulus probe to deliver electrical stimuli. The time taken for the stimulus to travel to the recording electrode was measured and compared to normalized data for the corresponding body part. The results, typically measured in milliseconds, were used to assess the condition of the patient's nerves.

Patient 3: Diagnosed with a Visual Cortex Issue.

A female patient was being evaluated for sensory pathway defects using Visual Evoked Potential (VEP) Figure 2 This room is for Evoked Potential testing room. A patient being tested for visual evoked potential.. She was instructed to focus on a point displayed on a screen while EEG signals were recorded using three electrodes: ground, reference, and active. VEP is used to measure the brain's response to external stimuli such as visual, auditory, and sensory inputs. The resulting signals were displayed on a monitor for analysis.

Patient 4: Gait problem (problem in adducting legs)

A male patient, presenting with difficulty in adducting his legs and a noticeable gait abnormality, was evaluated for muscle-related issues using needle electromyography (EMG) *Figure 3*. The procedure employed a three-electrode system to record muscle activity. Both the active and reference electrodes were concentric and embedded within the same needle. The needle was inserted into various muscle groups to capture EMG signals, which were displayed as plots and accompanied by sound waves

representing muscle twitches. The doctor used these auditory cues to manually assess and document the condition of each muscle group being tested.

Patient 5: Chronic Headache

A female patient with complaints of chronic headaches underwent diagnostic testing for a possible stroke using Transcranial Doppler (TCD) *Figure 4*. She was fitted with a head-mounted ultrasound device positioned horizontally across the frontal region of her head. The test was automated and included auditory cues to assist the clinicians during the procedure. To detect potential shunts (blockages), the patient was administered aerated IV fluid via the brachial artery. The aerated fluid introduced bubbles into the bloodstream, which, upon encountering a blockage, accumulated, and collapsed, causing a distinct change in sound frequency (a sharp noise). The TCD machine automatically detected these acoustic changes and recorded them as "hits," aiding in the diagnosis.

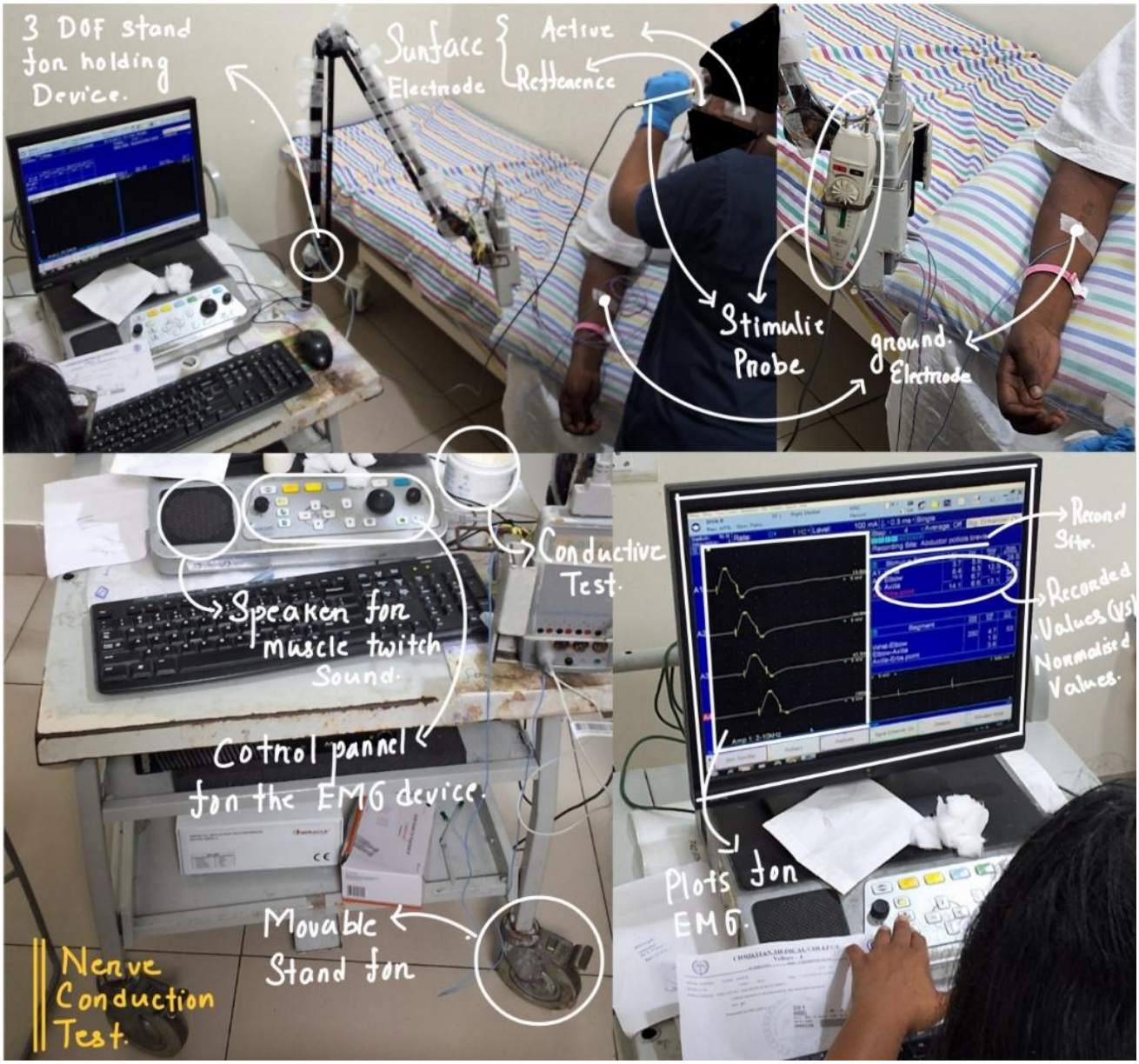


Figure 1 This is the room view of Surface EMG for nerve conduction test.

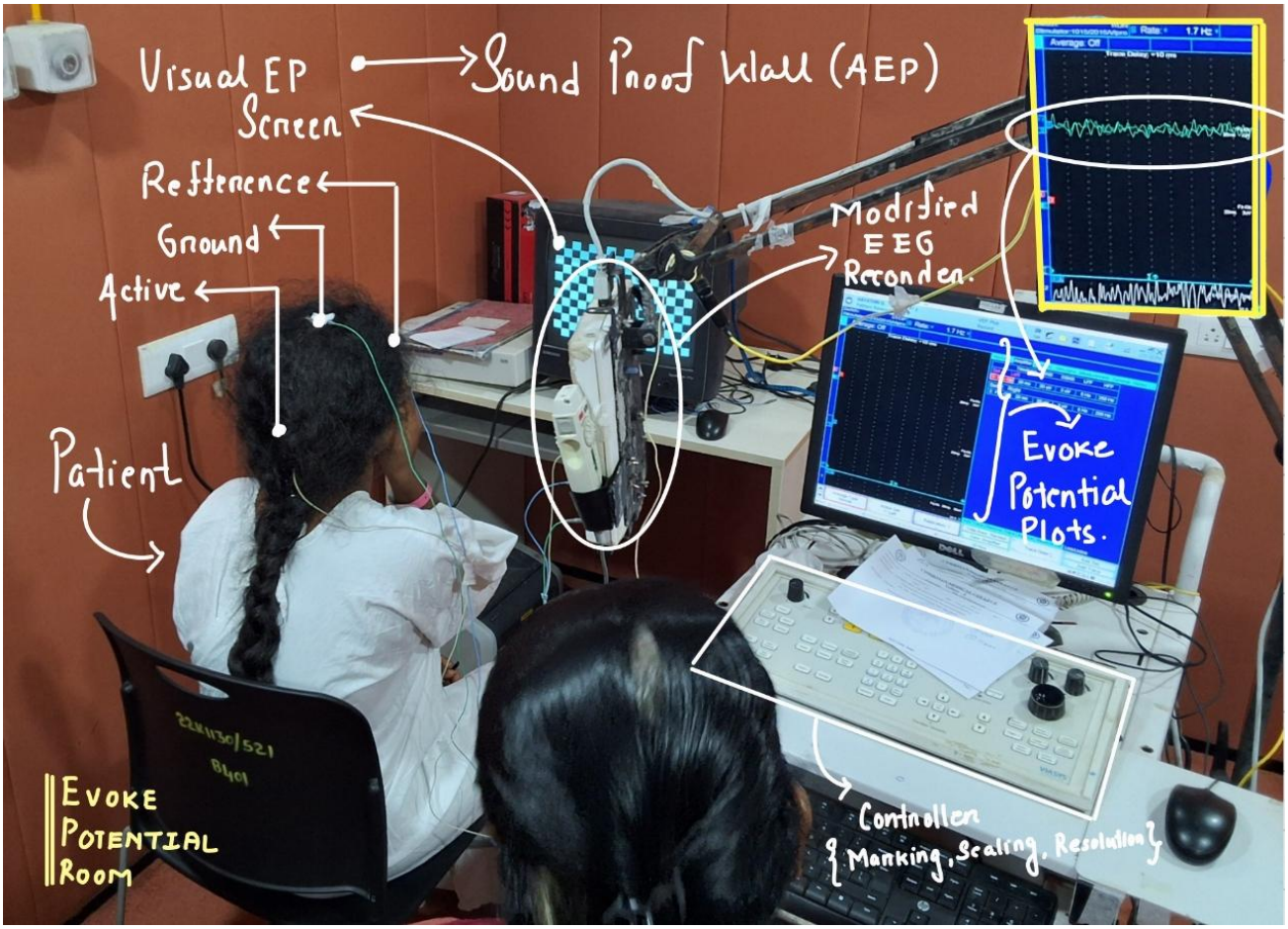


Figure 2 This room is for Evoked Potential testing room. A patient being tested for visual evoked potential.

Pathophysiology of Epilepsy

Epilepsy is a neurological disorder characterized by abnormal electrical activity in the brain, leading to recurrent seizures. The key processes involved in the pathophysiology are:

Abnormal Neuronal Excitability

Neurons in the brain communicate through electrical signals. In epilepsy, there is an imbalance between excitatory (glutamate) and inhibitory (GABA) neurotransmitters. This leads to excessive neuronal firing (hyperexcitability).

Hyper-synchronization of Neurons

Normally, neurons fire in a controlled and unsynchronized manner. In epilepsy, large groups of neurons fire abnormally at the same time, causing seizures. This is known as hyper synchronization.

Ion Channel Dysfunction

Ion channels regulate the flow of ions (like sodium, potassium, and calcium) across cell membranes, which controls neuronal activity. In epilepsy, genetic mutations or acquired changes in these channels disrupt their normal function, contributing to seizures.

Neuroinflammation

Inflammation in the brain, caused by infections, autoimmune responses, or injuries, can make neurons more excitable and lead to seizures.

Changes in Neural Networks

Long-term epilepsy can cause changes in how different regions of the brain connect and communicate, worsening the condition over time.

Triggers

Specific triggers, like stress, sleep deprivation, flashing lights, or alcohol withdrawal, can initiate seizures in individuals with epilepsy.

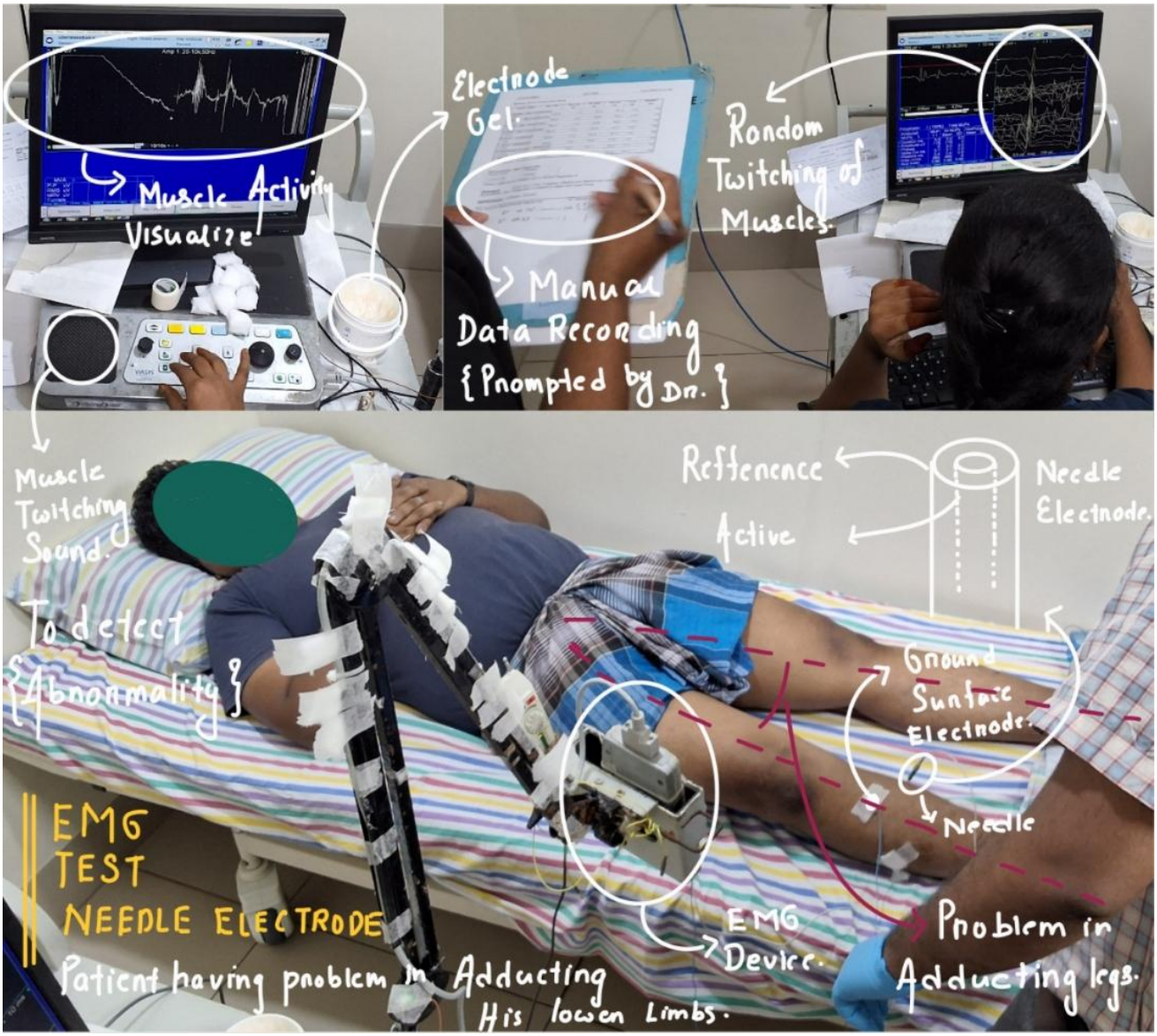


Figure 3 EMG room with needle-based electrode being used to record muscle movement and speaker to generate sound.

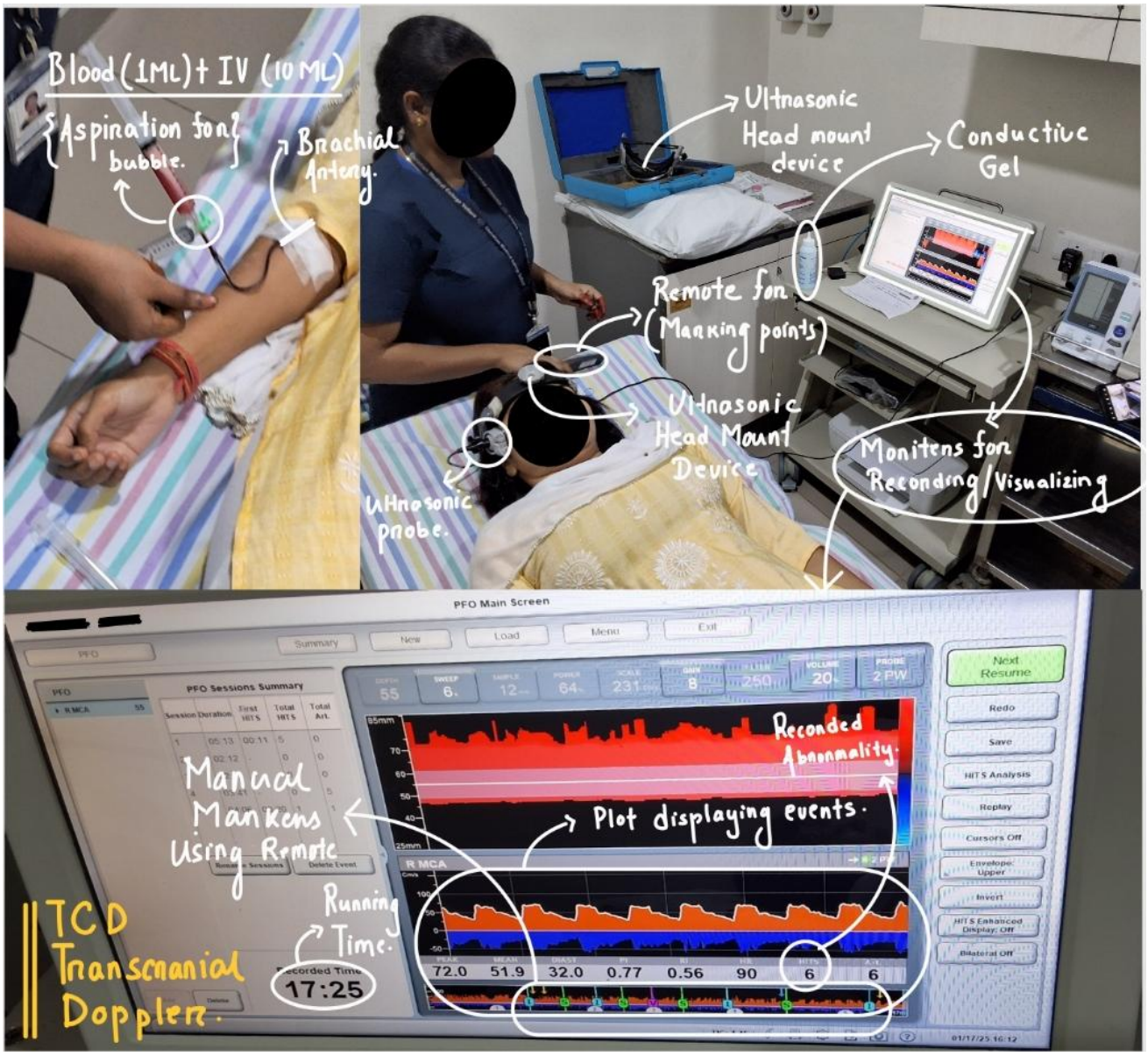


Figure 4 TCD room view, a patient being diagnosed for blockage in brain blood vessels.

Technology Used

Here the listed technologies were used for diagnostic purpose in the clinics.

1. ***EEG (Electroencephalogram)***
2. ***EMG(Electromyogram)***
    a. *Surface EMG*
    b. *Needle Electrode*
3. ***EV (Evoke Potential)***
    a. *Visual*
    b. *Auditory*

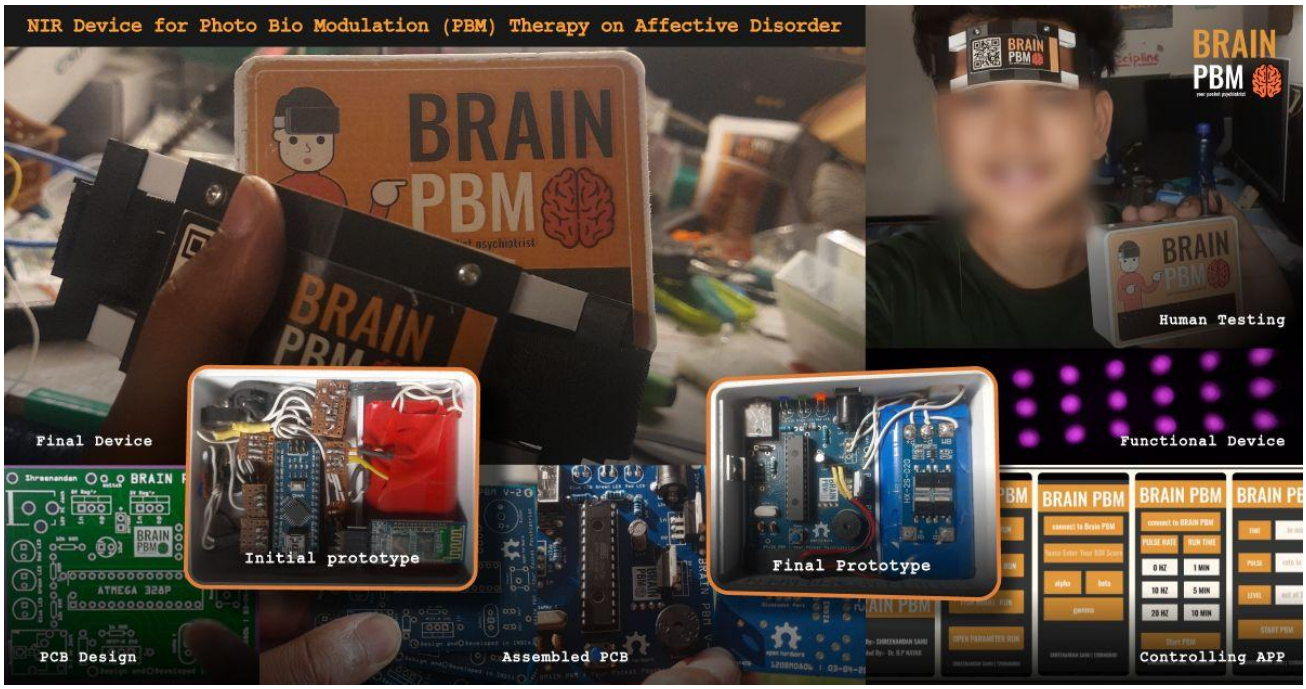
   c. *Sensory*
      i. *Upper Limb*
      ii. *Lower Limb*
4. ***TCD (Transcranial Doppler)***
5. ***Ultrasound Imaging***
6. ***Nerve Conduction Test***
   a. ***EEG***
   b. ***Stimuli Probe***
7. ***TMS (Transcranial Magnetic Stimulation)***

These were the main technologies used for diagnostic purposes in the neurological department.

Limitations/Problems and their Solution.

Problem: While in the department we saw the room of TMS which was closed due to problem in the device. This is used to treat psychiatric patients or people with stroke. This is also a bulky and heavy device which needs doctors to treat the patient. Here the patient must come to the hospital frequently to get treated.

Solution: We can use IR LED (830nm) to treat the stroke patients and psychiatric patients. The basic principle of is to take use of ***Photo biomodulation.*** Where we use light to heal the damaged and hypoxic cells. This was my B. Tech final year project which was to develop device for patients with psychiatric and stroke. I have attached the device below.



Problem: In the TCD room the nurse had to manually aspirate the blood with the IV fluid. It had various problem while doing that

Solution: We can take use of syringe pump and aspirate the blood and push it through the brachial artery which will be faster and safer for the patient.

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