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Health Monitoring System for Comatose Patients: A Survey

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Abstract: This survey paper outlines the existing and proposed system for a comatose patient health monitoring aid. In general, the comatose patients never respond for anything however they might abnormal movements are frequently encountered in patients with brain injury characterization of these movements and their underlying pathophysiology is difficult due to the comatose or uncooperative state of the patient. Thus, we reviewed the available literature regarding abnormal movements encountered in acutely ill patients with brain injuries. There are so many abnormal movements in the seen in each category as well as their epidemiologic, semiology and clinic pathologic correlates. We propose a practical paradigm that can be applied at the bedside for diagnosing abnormal movements in patients. Which they are self-conscious and that can make them reticent. The Hand Talk glove is a normal, cloth driving glove fitted with flex sensors. The sensors output a stream of data that varies with the degree of bend made by the fingers. Flex sensors are sensors that change in resistance depending on the amount of bend on the sensor. They convert the change in a bend to electrical resistance and send data to the doctor.

Keywords: Vegetative State, Hypothalamic, Pathos-physio-logy Anticonvulsant Treatment, Electroencephalogram Patterns, encephalopathies, Non-convulsive Status Epilepticus, and Neurophysiological.

1. INTRODUCTION

The document provides people world-wide in coma require the assistance of a sensor glove, to provide the sensor based on hand moment of the person's fingers. The aim of incorporating the modern way of sensor glove control it at the same time making it cost effective, so it is affordable to all the masses. The goal of the research is to develop a sensor glove were the communication development is necessary because of the movement of patient fingers. Sensors are embedded into a hand glove in order to achieve the desired goal. In this research, a prototype of an affordable and technologically advanced sensor glove is to be designed and developed. This is to aid the communication of severely comatose patient and enhance the man recovering from a coma with the use of hand movement. All the way its aim at incorporating the modern sensor glove for the speed diagnosing of a comatose patient.

2. OVERVIEW OF COMA AND IMPAIRED CONSCIOUSNESS

Coma is quality in that the patient can't be aroused. Impaired consciousness refers to similar, less severe disturbances of consciousness; these disturbances don't seem to be thought of coma. The mechanism for coma or impaired consciousness involves disfunction of each cerebral hemisphere or of the clathrate activating system (also called the ascending arousal system). Causes are also structural or nonfunctional (EG, harmful or metabolic disturbances). The injury is also focal or diffuse. The designation is clinical; identification of cause needs laboratory tests and neuroimaging. Treatment is immediate stabilization and specific management of the cause. For semi-permanent coma, connected treatment includes passive range-of-motion exercises, enteral feedings, and measures to forestall pressure ulcers.

Coma: The patient can't be aroused, and therefore the eyes don't open in response to any stimulation.

Stupor: The patient will wake up solely by vigorous physical stimulation. Less severely impaired levels of consciousness are frequently labeled as lethargy or, if more extreme, obtundation. However, differentiation between much less severely impaired degrees is frequently vague; the label is less important than a particular clinical description (e.g., "the exceptional level of reaction is partial limb withdrawal to nail bed strain"). Delirium differs because cognitive disturbances (in attention, cognition, and stage of recognition) vary more; additionally, delirium is normally reversible.

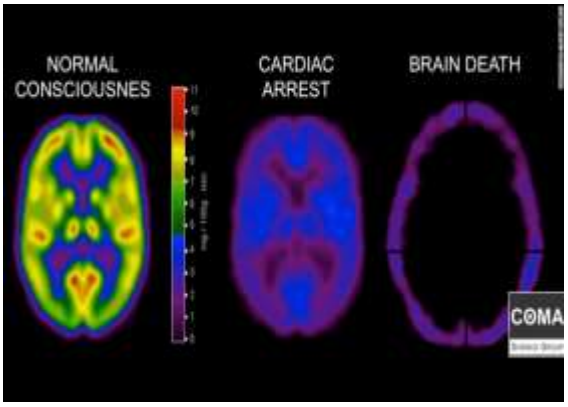

Figure 1: Brain MRI Image at Different Conditions

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https://www.google.co.in/search?biw=1517&bih=735&tbm=isch&q=vegetative+state+brain+activity&sa=X&ved=0ahUKEwimhInzifPWAhULMY8KHY39CZIQhyYIKA#imgrc=QBfs3ejdTY4ImM.

2.1 Symptoms and Signs

2.1.1 Vegetative State

Sufferers display no proof of consciousness of self or environment and cannot interact with different people. Practical responses to outside stimuli are absent, as are language comprehension and expression. Signs of an intact reticular formation (EG, eye beginning) and an intact mind stem (EG, reactive scholars, oculocephalic reflex) are a gift. Sleep-wake cycles occur but do no longer necessarily replicate a specific circadian rhythm and aren't related to the environment. Extra complex mind stem reflexes, inclusive of yawning, chewing, swallowing, and, uncommonly, guttural vocalizations, also gift. Arousal and startle reflexes can be preserved; EG, loud sounds or blinking with vivid lighting may also elicit eye establishing. Eyes may water and convey tears. Patients may additionally seem to grin or frown. spontaneous roving eye movements—normally gradual, of consistent pace, and without saccadic jerks—may be misinterpreted as volitional monitoring and can be misinterpreted via own family members as evidence of focus.

Patients can't react to visible danger and can't observe instructions. The limbs may additionally pass, however, the only functional motor responses that occur are primitive (eg, greedy an object that contacts the hand). Ache typically elicits a motor reaction (normally decorticate or decerebrate posturing) but no functional avoidance. Patients have fecal and urinary incontinence. Cranial nerve and spinal reflexes are normally preserved.

2.1.2 Minimally Conscious State

Fragments of significant interaction with the surroundings are preserved. Patients may also set up eye touch, purposefully hold close at gadgets, respond to commands in a stereotypic manner, or solution with the equal phrase.

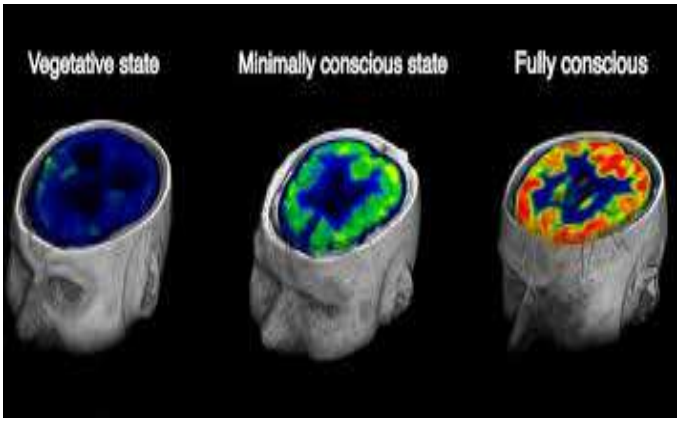

Figure 2: Different States of Brain

Source:
https://www.google.co.in/search?biw=1517&bih=735&tbm=isch&q=vegetative+state+brain+activity&sa=X&ved=0ahUKEwimhInzifPWAhULMY8KHY39CZIQhyYIKA#imgrc=bQ0CsAUgJ_9MYM.

Most sufferers tend to recover awareness however to a confined quantity relying on how lengthy the minimally conscious kingdom has lasted. The longer it has lasted, the much less hazard of sufferers recuperating higher cortical characteristic. Diagnosis can be higher if the motive is demanding brain injury.

Rarely, patients regain clear but limited awareness after years of coma, called awakenings by the news media.

2.2 Coma Diagnosis

2.2.1 Physical & Neurological Evaluation

Medical doctors use physical examinations as well as medical technologies to evaluate head accidents and diagnose comas. When they have dealt with open wounds and established proper respiratory and blood drift to the mind, they evaluate a patient's medical history to test for medicines, conditions which include diabetes, and medical activities along with strokes. Then, they take a look at a patient's reflexes and student size to determine the extent of recognition. Doctors additionally take a blood sample to test blood matter, electrolytes, and glucose degrees and look for any remnants of medicine or pollutants including carbon monoxide.

2.2.2 X-Rays and Imaging

Medical technology permits medical doctors to discover the region and severity of the injury sustained. CT scans, MRI scans, and EEG exams check for hemorrhaging, swelling, mind stem harm and non-convulsive seizures, an underlying purpose of comas. Further, they permit medical doctors to perceive the level of focus and create suitable remedy plans.

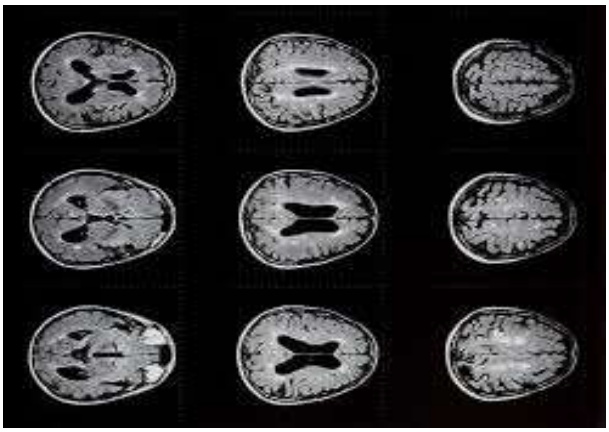

Figure 3: Brain Dead vs Coma vs Vegetative State

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https://www.google.co.in/search?q=braindead+vs+comavs+vegitavive+state&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiqybq9ifPWAhXFu48KHWOmDfoQ_AUIDCgD&biw=1517&bih=735#imgrc=zeeo0XwyTIJUhM.

3. ABNORMAL MOVEMENT

3.1 Chorea

Involuntary, purposeless, non-rhythmic, non-sustained movements that flow from one body part to the other.

3.1.1 Hemiballismus

A severe form of chorea is characterized by vigorous irregular high amplitude movements on one side of the body.

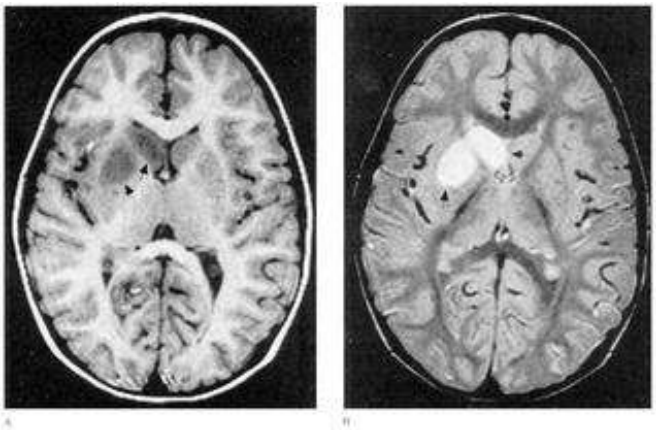

Figure 4: Syndenham's Chorea

Source

https://www.google.co.in/search?biw=1517&bih=735&tbm=isch&sa=1&q=chorea&oq=chorea&gs_l=psy-ab.3..0l10.19739.20530.0.20884.2.2.0.0.0.0.86.168.2.2.0....0...1.1.64.psy-ab..0.2.168...0i67k1.0.mubeopfvsEs#imgdii=-nV3MYLBUaFfJM:&imgrc=LMg_QrzGmVs3FM.

3.2 Clonus

Rhythmic involuntary muscular contractions and relaxations.

➢ **Dystonia**

Sustained twisting movements that are often frequent and progresses to prolonged abnormal postures.

➢ **Myoclonus**

Sudden, brief involuntary movements which may be caused by muscle contractions (Positive Myoclonus).

4. NONCONVULSIVE STATUS EPILEPTICUS

Unilateral Eye Deviation, Lip Smacking, Automatisms and Some Movements of the Fingers

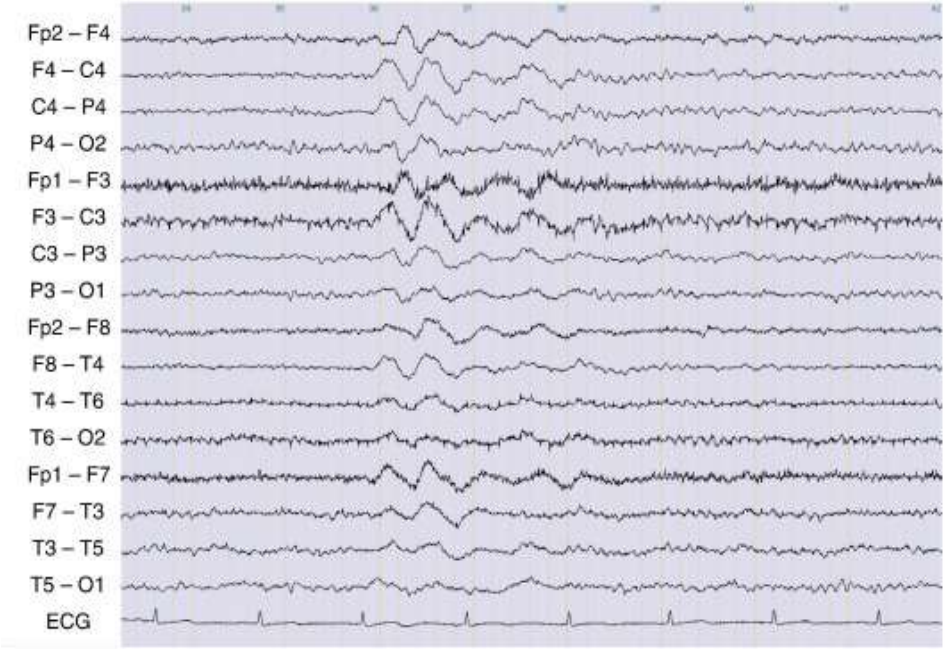

Figure 5: ECG Pattran in Coma When There Is a Sudden Movements in Comatose Patient (NCSE)

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(https://www.google.co.in/search?q=ncse+ecg&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjw2u6CifPWAhUJNI8KHfqRAJwQ_AUICigB&biw=1517&bih=735#imgrc=XFwMrMTkS0PeVM)

5. LITERATURE REVIEW

[A] Communication protocol survey
[B] Neurological assessment of coma

5.1[A] (1997-2002)

Nature of the correspondence frameworks and conventions is expanding continually, while the correspondence items time-to-business sector is getting to be shorter. Reconsiderations correspondence framework upgrade because of the absence of execution is monetarily and time costly, and it is unsuitable. This paper proposes a technique for enhancing correspondence framework by the method for the conventions they depend. The proposed paper of correspondence framework depends on the formal strategy and it gives an early stage execution assessment of the hidden correspondence convention, the philosophy is represented through a hand on the contextual investigation on a current remote correspondence framework. The convention is to impart what calculations programming dialect is to calculation [2, 19].

This analogy has important consequence for both design and development of protocols.one has to consider the fact that, algorithm, programs, and protocol are a just different way of describing expected behavior of interacting objects [4].

Communication system operates in parallel. The programing tools and techniques for dealing with parallel processes are collectively called concurrent programming [8, 16, 20].

The system does not use a single protocol to handle a transmission. Instead, they use a set of cooperating protocol l, sometime called protocol family are protocol suite [3], protocol has to communicate with each other, so some kind of conceptual framework is needed to make this communication possible. (i.e., software is needed to implement both) [9].

The project per se good but its execution has to deal with a lot of hicks. The flux sensor which is gone work by the movements of some part in human should be more calibratable. Signals information received are to be sent to GSM in order to allow the signals to reach the receiver [5, 6].

5.1.1[B] (1997-2002)

The section is understanding, diagnosing and care of the comatose patient. It with a cohesive history of concept coma and its mechanism, sign, symptoms, and pattern. The neuroscience of the awaken state looks at the anatomy and chemistry of unconscious ness when a bilateral cortical and intrinsic lesion or displacement of the brain stem cause unconsciousness [23].

Medical managements of the comatose patient begin with (Air, Breathing, Circulations) and expand to cover the intensive care of the patient's health.it defines the patient's brain characteristic with the help of that brain characteristic the patient's treatment will be performed [24,25].

5.2 [A] (2002-2007)

A communication protocol is designed, developed and implemented on the FloSwitch [21], for receiving the data from flex through the GSM, to perform the required operation and to transmit the result to the destination. Convention usage comprises of two sections, (I) on the server - actualized in C dialect and (ii) on FloSwitch - executed in HDL and inserted C dialect. The convention header data contains the administration order alongside the other data. The header and information which is sent by the through flex sensor by means of GSM are gotten by the FloSwitch into the beneficiary support - RX-FIFO of the relating optical connection in the FPGA. As per the process, the FloSwitch plays out the required operation on the information and after that transmits the resultant back to the predefined optical connection/joins as per the destination is given in the header.

FloSwitch Implementation: The FloSwitch execution is done on the FPGA, having two sections and is actualized in Hardware Description Language (HDL) for hardware and implanted C dialect for software. The FloSwitch searches for the administration charge; once it gets the order the accompanying undertakings are performed [7]

5.2.1 [B] (2002-2007)

The neurologist is regularly required to evaluate the unconscious patient from each the diagnostic and prognostic angle. Information on the anatomical basis of coma is critical for assessment, however, must be blended with a know-how of the various, frequently multi-factorial, medical situations that result in impaired consciousness [29].

Consciousness is a state of awareness of self and the environment. This state is determined by two separate functions:

- Awareness (Content of Consciousness).
- Arousal (Level of Consciousness).

These are dependent upon separate physiological and anatomical systems. Coma is caused by disordered arousal as opposed to impairment of the content material of attention, this being the sum of cognitive and affective intellectual characteristic, depending on an intact cerebral cortex. The absence of all content material of consciousness is the basis for the vegetative state [33, 35].

5.3 [A] (2007-2012)

Data Processing

i. The BRAM is packed with zero records. Then the DPU (Data Processing Unit) is configured based on the quantity of operands given in the header.

ii. The records are brought with the content material of BRAM and the end result is saved lower back in the BRAM. The operation is repeated for the range of servers concerned. The qualitity of servers concerned can be random, however, the operation may be completed in step with the list. The ensuing statistics from BRAM is transmitted to the receiver.

iii. Configure the CTU (control& Timing Unit), with the statistics from the header. Then the subsequent steps are done by way of the HDL. Reads the information from the RX FIFO in order of the listing. The primary packet (size is 1 to 1008 words) of data is introduced with the content material of the BRAM. The end result is stored returned within the BRAM. The addition is repeated in keeping with the listing and the end result is stored lower back in the BRAM. An Interrupt is generated, indicating the processing is complete

iv. As soon as the Interrupt is generated, the following steps are completed for transmitting the consequent information to receiver person optical. TX Interrupt is generated after the transfer is finished, indicating the cease of the transfer. The flow diagram of the implementation is given in segment 4. The waft consists of HDL for hardware and embedded interval for 'software program' inside the FPGA.

The conversation protocol has been developed for the serial link and it has been tested effectively

5.3.1 [B] (2007-2012)
Neuroanatomical Basis of Coma
Neurophysiological experimentation has proven that coma is as a result of diffuse bilateral hemisphere damage, failure of the ascending reticular activating device, or both.

The reticular activating machine is a center of grey count number non-stop caudally with the reticular intermediate gray lamina of the spinal twine and rostral with the subthalamus, hypothalamus, and thalamic nuclei. It runs within the dorsal part of the brain stem within the paramedian tegmental zone.

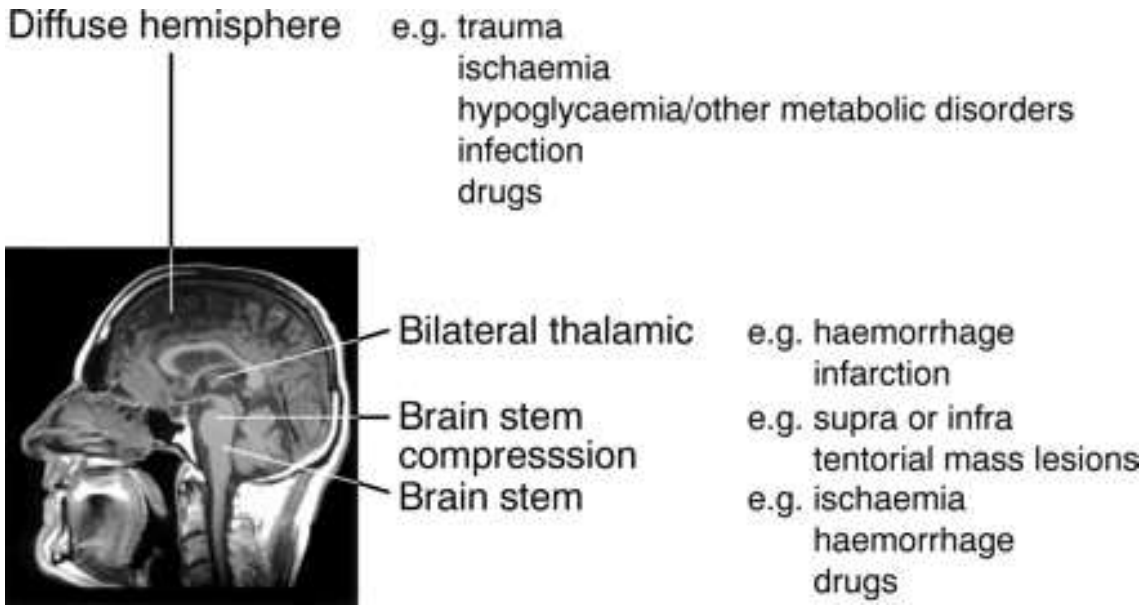

Figure 6: Neuroanatomical Human Brain Structure on Basics of Coma

Source: http://jnnp.bmj.com/content/71/suppl_1/i13

A unilateral hemisphere lesion will no longer result in a coma except there's secondary brain stem compression, caused by herniation, compromising the ascending reticular activating system. Massive bilateral harm or disturbance of the hemisphere function is needed to provide coma. Drugs and metabolic disease produce coma by a depression of both cortex and ascending reticular activating system function [39].

5.4 [A] (2012 -2017)
When disaster poor signals are occurring, the primary technological undertaking is to rapidly deploy a caution system brief response and disaster control. No matter whether or not conversation networks are destroyed or partly destroyed (consisting of power, phone, cell base station, and/or other community connectivity infrastructure), the cautioning system needs to be able to connect to the network outside the disaster areas. Some other technological assignment is the multi-organizational radio inter-operability trouble [48] [49]. This is special companies or era may additionally use the distinct radio. If the conversation community is destroyed, gadgets with dual-use generation should be active in operational modes, regular and emergency operational modes. all through normal occasions, the tool works on normal mode while throughout the poor network, the tool might input the emergency operational mode, wherein the receiver get admission to the community and get particular statistics from the community[53].

5.4.1 [B] (2012-2017)
There are two principal categories of neurological syndromes in the field of movement disorders those with a voluntary or automatic movement (hyperkinesia) and those with excessive unnatural movements (interchangeably referred to as hyperkinesia, dyskinesia, or abnormal involuntary movements). For the purpose of this review and to create a practical approach for ICU patients, the term "abnormal movements" will refer to the variety of movements seen in the ICU accompanying different types of brain injuries, including the motor findings of NCSE, paroxysmal posturing movements accompanying cerebral herniation, shivering, clonus and the five major categories of dyskinesia in the field of movement disorders [37, 38, 43]

Non-Convulsive Status Epilepticus (NCSE): This is a sudden movement in the patient which makes sense there is and certain EEG change in the without major motor sings. NCSE is an abnormal movement of fingers, lips .were the movements help us to make this project using sensor glove. Subtle motor signs (e.g. twitching, blinking) may be present. There are some other abnormal movements shown in below table [43].

Abnormal Movements	Definition
Paroxysmal	Involuntary Flexor with Pain.
Posturing	Hyperextension of the Neck and Back
Tics	Sounds (phonic) which can be simple muscle jerks or complex when they consist of sequential movements in different parts of the body
Shivering	High involuntary muscular contractions involving one group or more of muscles

6. PROPOSED SENSOR BASED GLOVE TO SENSE THIS (NCSE)

To know the sudden movements in the patient occurred by (NCSE), .and to detect the heartbeat range during the immediate movement the proposed idea is planned to be implemented. The prototype has taken from the idea of particular stimulus. In particular condition, for every stimulus that acts upon the living beings responds.

The proposed system is to work by receiving the response from the patient and send the particular information to the controlling place (i.e., information receiver). Practically the communication parts heap the major roll.

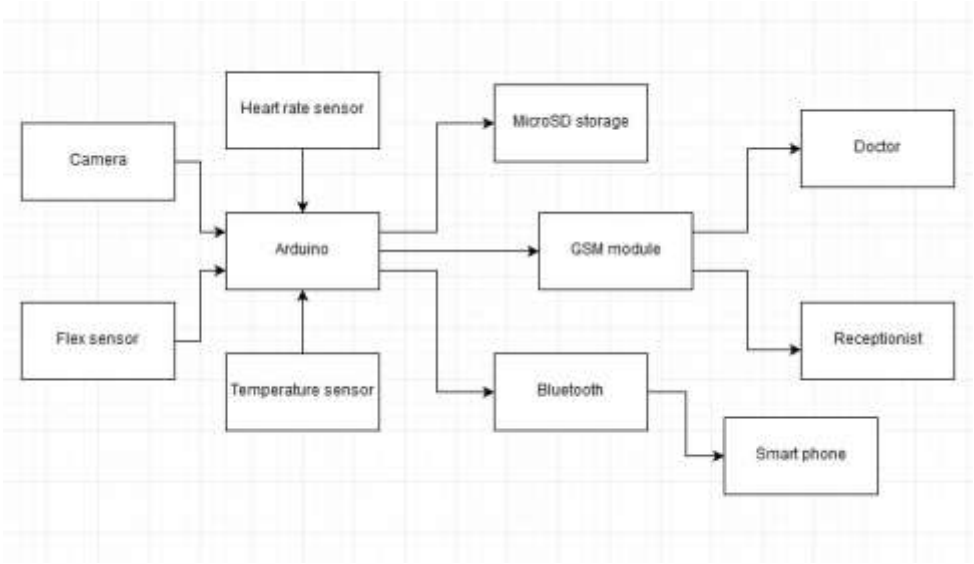

Figure7: Block Diagram

Literally, the block diagram [fig: 7] give you the information. That is the entire prototype is gone work on communication and Electronics.

As Arduino and GSM module will be the main working function in the system. As you see in the block diagram all the input (i.e., flex sensor, temperature sensor, heart rate sensor) are delivering the information.

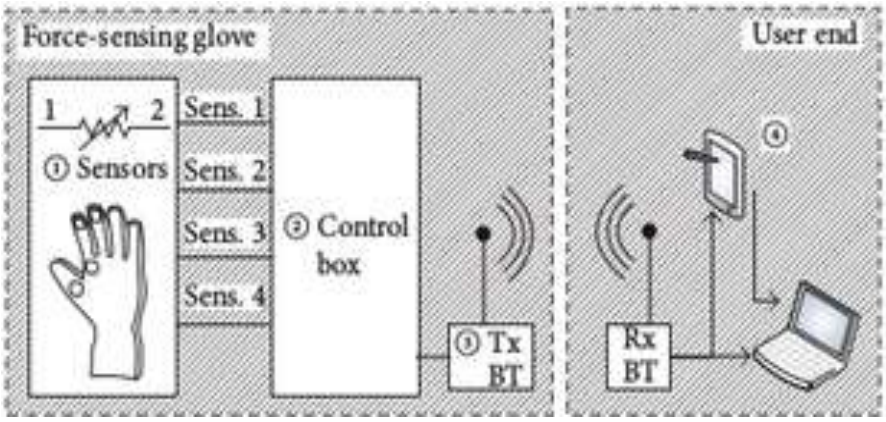

Figure 8: Transmitting and Receiving Information System via GSM Module

GSM transmit the information to the controlling receiver section (i.e., doctor) basically this sensor is used in different criteria, for example, the temperature sensor is used to sense the room temperature of the allotted area of the patient. And also pen downs the body temperature of the patient.

Information to the Arduino and basically all the information is sent to the GSM (Global sensor module). This similarly, the heart sensor also works in the same process. That calibrates the speed of heart at the sudden change in the comatose patient (bending of fingers, Toes)

All this sensor is the major part of the system. Which are based on the communication part with the help of the Arduino it lets to know the appropriate condition of the patient. The GSM module alerts the doctor about the patient were the camera capture the conditions faced by the patient.

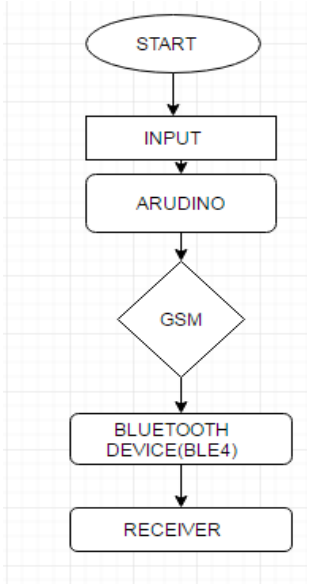

Figure 7: Flow Chart for [How GPRS signals transformation to receiver section]

CONCLUSION

The proposed work has given a detailed survey of the health monitoring system and proposed novel idea for a comatose patient health monitoring aid. The above information showed the configuration of convention substances from non-useful administration particulars towards executable basic projects. The proposed work investigates how the deductions can be carried out in a formal calculus using an interactive verification system. Hardware implementation of the functional logic of the project is planned to be executed with the embedded c-program. The paper demonstrates that circulated framework improvement from formal necessities to executable projects is conceivable in focus.

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