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Development of a pain detector using microwave radiometry method

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One of the greatest difficulties in treating patients with pain is the highly subjective nature of pain sensation. The measurement of pain intensity is primarily dependent on the patient's report, often with little physical evidence to provide objective corroboration. The need is thus clear and urgent for a reliable, non-invasive, non-painful, objective, readily adoptable and coefficient diagnostic platform that provides additional diagnostic information to supplement its current regime with more information to assist doctors in diagnosing these patients. Thus, our idea of developing a pain detector was conceived to take a step further for the detection and diagnosis of chronic and acute pain.

Scientific rationale of the idea: Rubrics evaluation of pain states that pain is accompanied by swelling, redness, inflammation, each of which increases with increase in the intensity of pain. Another major point to be noted here is that during pain, due to an injury or any physical damage to the region results in a direct effect on the arteries, causing them to dilate. This increase in diameter of the blood vessels (vasodilation) allows the flow of a larger volume of blood, thereby increasing the localized temperature, relative to the rest of the body. We have used a Microwave radiometer to detect and grade these signals. "Microwave Radiometer measurements are based on the principle that the intensity of the radiation is directly proportional to temperature in the tissue. It represents a new, non-invasive method that converts electromagnetic radiation from internal tissues at microwave frequencies and provides accurate measurements of the temperature of the patient's internal organs". The system of MR possesses an antenna with 2 sensors: a microwave and an infrared. The microwave sensor is 3.9 cm in diameter and detects microwave radiation at 2 to 5 GHz, which corresponds to 7 cm in depth, with accuracy for temperature measurements of 0.20°C. The sensor of MR filters all possible microwaves or radiofrequency waves that may be present in the room vicinity and may cause interference with the sensor. The "volume under investigation" has a rectangular area of 3 cm in width, 2 cm in length, and 3 to 7 cm in depth depending on the dielectric properties of the underlying tissues, the wavelength, and the water content of the tissue. The second sensor is used for infrared measurements from the skin, for calibrating the microwave sensor readings. The use of microwave sensor will increase the sensitivity of our measurement, and help us grade the intensity of pain as the change in temperature with the intensity is quite small, and requires highly sophisticated measurement devices. We aim to process these signals just like the thermo gram- the regions under pain will be colored significantly different from the rest of the body, which under ideal conditions will maintain uniform body temperature. None the less, the temperature of the body only serves as a baseline or reference point, in order to calibrate our instrument and acclimatize it to the patient. Such a system however, requires expensive materials and methods for fabrication. In an attempt to miniaturize the circuit we will attempt to device a single chip solution in order to achieve optimum integration.

Biography

Nanditha Rajamani, a student of BE Biotechnology (Bachelor of Engineering in Biotechnology) is currently pursuing her 4th year of education. Her research activities are relevant to subjects such as Bioinformatics, Neuroinformatics and Biomedical product development. She has been securing the highest percentage in her class throughout her under-graduation study. Her abstracts have been accepted by organizations such as IEEE-EMB, where she has emerged as one of the top five finalists among several other entries. She has been nominated for scholarships and merit awards, including the prestigious "Best Student Award-Tata Consultancy Services (TCS)".

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