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Editorial

Editorial Note on Clinical Sensing

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With the advancement in technology, newer and newer sensing systems are being developed, day by day, for various biomedical and other applications. These new systems are evolved for solving medical problems lying unexplored. In the sensor systems, there is a good development in the miniaturisation from micro to nano-systems and beyond. Design and development of sensing mechanisms with possible clinical applications are described here.

Development of novel sensing systems is described, particularly for clinical sensing of the clinical parameters. Reliability, sensitivity, accuracy and quick speed of diagnosis and clinical treatment are presented for better use. Nano-sensors and devices are used for reliable measurements. Study of environmental issues is important. Effect of temperature, humidity, vibration, stress, electrical and magnetic fields in the surroundings, is required to be nullified, to get smooth and reliable measurement output.

The sensors and their uses include: biosensors, scans during pregnancy, ultrasound pressure sensors, oxygen concentrators, temperature sensors, ventilators and Image sensors in cardiology and other fields, etc. Some sensors with low power need to be especially small, lightweight and compatible with body mass.

In health monitoring, pressure sensors are used in anaesthesia delivery machines, oxygen concentrators, ventilators, kidney dialysis machines, infusion systems, insulin pumps, sleep apnea machines, blood analysers and, respiratory monitoring, blood pressure monitoring equipment, hospital beds, surgical fluid management system, and pressure controls. The pressure sensors and devices are also used for temperature, flow, level, chemical parameters and position measurements. Medical bioMEMS (Micro-Electro-Mechanical Systems) are used in clinical healthcare.

In the environments of hospital, home, office, laboratories and open environment, different types to sensors are used to sense and control the information automatically to avoid any unwanted effects. Visitors have to be kept away to avoid any infection to the patient, nurse, doctor or attendant. Information is obtained by the physician on patient's blood pressure, temperature, ECG, blood chemistry etc. by using smart devices for protection, say, from the effect of AIDS, etc.

Development of a particular sensor device also depends upon the type of material used. Optimisation is, however, required for an appropriate material for getting proper output. Conventional materials are piezo-resistive/semiconductor silicon or germanium, piezo-electric/ultrasonic type and optical, magnetic and electronic/electrical types of materials. Polymer wafers are saturated with therapeutic agents like drugs. The insulin contains the enzyme, wafer changes the pH and solubility of the insulin in response to changes in blood glucose concentrations. Smart wafers are tested on animals and use magnetism or ultrasound to alter the dose of drug or to switch to another drug. Johns Hopkins Institute has developed a biochip photo-sensor that can be implanted in the eye as an artificial retina for patients with macular degeneration and retinitis pigments.

Nano-bio sensors are useful in the detection of the virus including Corona-virus. Nano-chips are used for diagnostic applications. Nano-cancer technology research is for both diagnosis and treatment of cancer in an effective manner. As an example, gold nano-particles detect the condition/stage of the cancer in an effective manner. Nano-robotic systems are useful in surgical treatment of clinical abnormalities. POCT (Point-of-Care) devices are used to diagnose and treat abnormality at the bed- site of the patient.

Biotelemetry of abnormality is taken up for the patients living in isolated areas like hills. Telemedicine with sensors is used to transmit the physiological and biological parameters from the test laboratory to the doctor's room and vice versa. Remote monitoring systems, mobile cardiac telemetry devices, mobile personal digital assistant (PDA) systems, ambulatory wireless EEG recorders, and ambulatory event monitors are some of the examples of the growth. Availability of wireless monitoring devices and the rising incidence of lifestyle and chronic diseases are helpful in the further growth.

U-healthcare sensing systems are also developed for a quick and reliable measurement, for any device, any time and for anyone. IOT (Internet-of-Things) based sensors connected to medical devices can easily monitor the processes and communicate with the network and other data systems for further analysis.

Biomedical sensors include sensors for measuring temperature, pressure, blood glucose, blood oxygen, etc. for monitoring, diagnostic imaging, implants, in both invasive and non-invasive manner. Microfluidic nitrite sensor is used for the regulation of vascular system in response to hypoxia assays in clinical research. Clinical sensors with dynamic range and low SNR (signal-to-noise) ratio are good to use in healthcare. Glucose sensors are good for clinical applications. Wearable sensors are good for clinical development services with good efficiency. Continuous recording of tissue glucose concentrations in diabetic patients is made with a subcutaneous system is read by the remote hand held devices or desktops.

Spatial data for the accurate reconstruction of ultrasound images of the heart, blood vessels, stomach, and other organs can be obtained by using newly developed miniaturised sensors. Blood analysis of neonates in critical care is possible with. closed loop fully automatic devices (VIA with Medical, San Diego, CA, USA). Pathogens are detected with a biosensor, with integrated optics, immunoassay techniques and surface chemistry, to find the presence of specific bacteria in in hours.

A highly stable and sensitive biosensor operates by switching the ion channels in a lipid membrane and when activated, biological receptors such as antibodies and DNA convert a chemical event into an electric signals. An electronic nose is used to detect bacteria causing ear, nose, and throat infections and to differentiate the odours of growing bacteria.

Continuous glucose monitoring is used in diabetic patients in insulin therapy and metabolic control, while stot glucose is for instant use. New glucose electrode is good for diabetic patients on daily basis. Open tissue miro-perfusion sensing measures glucose concentration in the interstitial fluid of the skin or subcutis. Non-invasive optical glucose sensor is used to measure glucose changes in the skin by putting light in it with accuracy. Implantable glucose sensors are very popular.

New cardiac pacemakers, smart in nature, can measure different places in the body like oxygen saturation in the blood and cardiac wall pressure to allow the pacemaker to adjust the heart's pacing to those real time measurements. Implantation of auditory sensors has been made to bypass the non-functioning parts of the hearing mechanism. The device interfaced with the human brain is the totally implantable with a battery which is digitally programmed and is rechargeable by a portable inductive charging unit.

In future, the sensors will have a transforming effect on health care to give impact in the short term but is realistic in long term, by changing the roles of hospitals, outpatient sites, homes, and ambulatory programmes outside the home. for home-based medical care, technological advancements in the medical device industry, increasing adoption of IoT-based medical devices and rising expenditure on healthcare across the world.

Novel sensing systems will be very useful in the ongoing clinical measurements and in exploring of new applications.

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