THE ROLE OF VARIOUS SENSORS IN PATIENT MONITORING SYSTEM USING IOT

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Abstract: In past patient suffering from any disease or physiological disorder is difficult to monitor patient health. Now a day's patients are monitored continuously through wireless network. In this paper various sensors used for patient monitoring system was analyzed. Wearable's like digital watches, Fitbit etc embedded or wear on clothes &accessories. Ingestible embedded in pills that got dissolved. Blood sampling sensors such as glucose meters. External sensors such as pulse oximeter & blood pressure cuffs etc. Epidermal sensors such as digital tattoos and patches. Tissue embedded sensors such as pacemakers & defibrillators. In this paper we have done the role of different types of use sensors used along with some of the resent methodologies used in the field of patient monitoring.

INTRODUCTION

What are sensors?

In medicine and biotechnology, sensors are tools that detect specific biological, chemical, or physical processes and then transmit or report this data. Some sensors work outside the body while others are designed to be implanted within the body. Some monitoring devices consist of multiple sensors that measure a number of physical or biological parameters. Other devices may be multifunctional, incorporating sensors and then delivering a drug or intervention based on the sensor data obtained. Sensors may also be components in systems that process clinical samples, such as increasingly common "chip devices". Sensors help health care providers and patients monitor health conditions and ensure that they can make informed decisions about treatment. Sensors are also often used to monitor the safety of medicines, food, environmental conditions, and other substances we may encounter.

HOW ARE SENSORS USED IN CURRENT MEDICAL PRACTICE

Thermometers are a type of sensor commonly used in health care

Many different types of sensors are already used in health care, including self-care at home. Thermometers translate the expansion of a fluid or bending of a metal strip in response to heat into a number corresponding to body temperature. Paper-based home pregnancy tests contain a substance that changes color in the presence of hormones indicating pregnancy. In hospitals and other provider-based settings, you can find more complex types of sensors like pulse oximeters (also known as blood-oxygen monitors), which measure changes in the body's absorption of special types of light to provide information on a patient's heart rate and the amount of oxygen in the blood.

How might novel sensors improve medical care or biomedical research?

Advances in technology, engineering, and materials science have opened the door for increasingly sophisticated sensors to be used in medical research. A group of NIBIB-funded researchers developed a compact, wireless, implantable brain sensor that can record and transmit brain activity data. Building on previously developed brain-computer interfaces that used wired connections, this new sensor may someday lead to unobtrusive, thought-controlled prosthetics and other assistive devices for people with amputated limbs, paralysis, or other movement impairments.

Test tubes containing purified proteins made to fluoresce in different colors. Source: NIBIB

Researchers at NIBIB aim to improve existing sensors through a variety of means, such as making fluorescent probes easier to see and increasing the capabilities and enhancing efficiency of individual sensors. Some scientists are exploring biological sensors, which rely on substances that occur naturally in the body, or artificial compounds that mimic natural substances, to capture molecules that are important to measure in the body. Biosensors may provide insights into disease processes that are hard to detect directly, such as dysfunctions in brain chemistry that are thought to playarole many mental disorders. example, one method for studying chemical processes in real-time uses engineered cells that can be "programmed" with receptors that latch onto specific brain chemicals. The resulting chain of activity causes a protein within the cell to change color that researchers can detect with a certain type of laser microscope. The biosensors remain active in the brain for several days, allowing scientists to study changes in brain chemistry over time, which may help inform efforts to improve drug treatments for mental disorders.
While many advanced sensors aren't practical for routine medical care, they allow researchers to study the basic foundations of disease in more detail than previously possible, and to develop new technologies that could dramatically improve the quality of life of people with severe disabilities.

what technologies are nibib-funded researchers developing with sensors

Sensors play key roles in all aspects of health care-prevention, diagnosis, disease monitoring, treatment monitoring-and the range of research involving sensors is equally broad. In addition to health-related applications, NIBIB funds studies to test new materials and technologies for building sensors, to develop new sensors that can advance medical research, and to promote healthy independent living through home-based and wearable sensors.

PRESSURE SENSORS

Pressure sensors are used in anesthesia delivery machines, oxygen concentrators, sleep apnea machines, ventilators, kidney dialysis machines, infusion and insulin pumps, blood analyzers, respiratory monitoring and blood pressure monitoring equipment, hospital beds, surgical fluid management systems, and pressure-operated dental instruments.

TEMPERATURE SENSORS

Temperature sensors are used in anesthesia delivery machines, sleep apnea machines, ventilators, kidney dialysis machines, blood analyzers, medical incubators, humidified oxygen heater temperature monitoring and control equipment, neonatal intensive care units to monitor patient temperature, digital thermometers, and for organ transplant system temperature monitoring and control.

FLOW SENSORS

Applications for flow sensors include anesthesia delivery machines, oxygen concentrators, sleep apnea machines, ventilators, respiratory monitoring, gas mixing, and electro-surgery, in which high-frequency electric current is applied to tissue to cut, cause coagulation, desiccation, or destroy tissue such as tumors.

IMAGE SENSOR

Image sensor applications include radiography, fluoroscopy, cardiology, mammography, dental imaging, endoscopy, external observation, minimally invasive surgery, laboratory equipment, ocular surgery and observation, and artificial retinas.

Robotic angiography system for 3D mapping of blood vessels during vascular surgery. (Courtesy of Siemens AG)

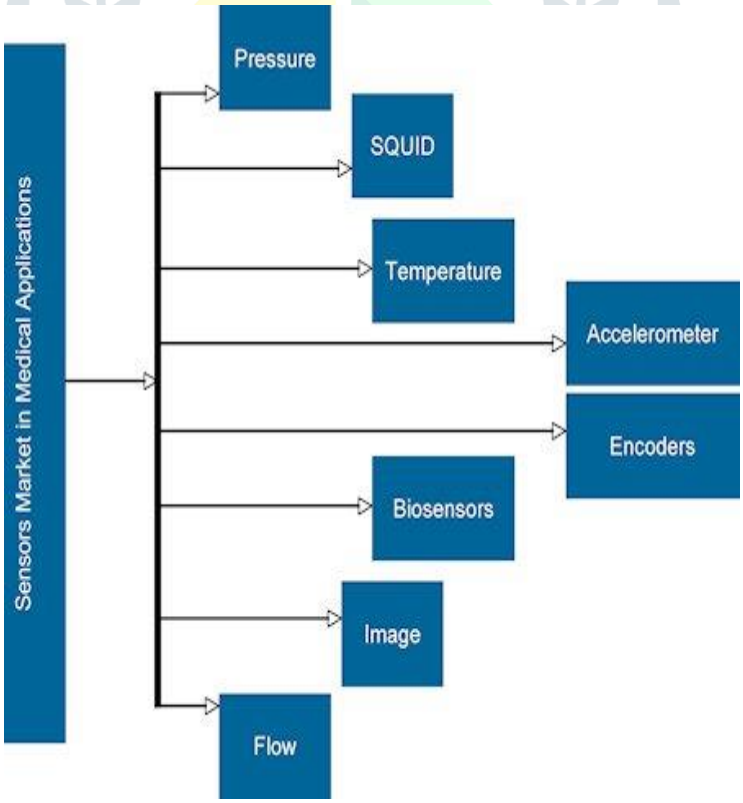
ACCELEROMETERS

Accelerometers are used in heart pacemakers and defibrillators, patient monitoring equipment, blood pressure monitors, and other integrated health monitoring equipment.

BIOSENSORS

Biosensors find applications in blood glucose and cholesterol testing, as well as for testing for drug abuse, infectious diseases, and pregnancy.

Encoders can be found in X-ray machines, magnetic resonance imaging (MRI) machines, computer-assisted tomography equipment, medical imaging systems, blood analyzers, surgical robotics, laboratory sample-handling equipment, sports and healthcare equipment, and other noncritical medical devices.

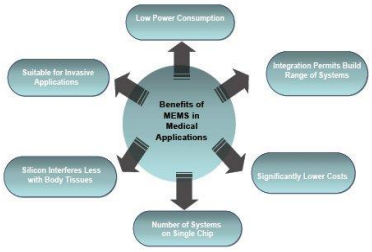


Sensors for medical applications are expected to see developments in the following areas: inherent accuracy, intelligence, capability, reliability, small size, power consumption, packaging, cost, and the elimination of lead. Developments are

expected to be mainly in the areas of MEMS and nanotechnologies. Market challenges include regulatory compliance, extended product lifecycles, reduced product development time, and product safety.

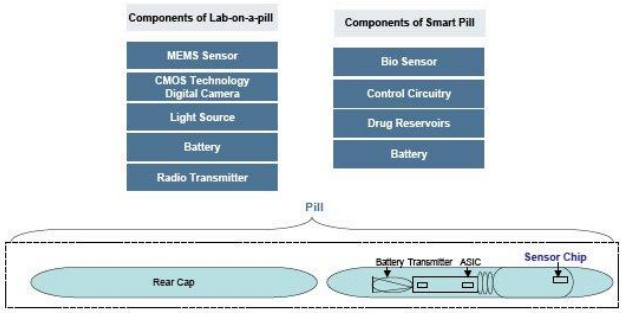
MEMs SENSORS

MEMS sensors offer several benefits that support the increasing penetration of MEMS technology into the medical applications market (**Figure 3**). MEMS sensors are typically low power, their silicon interferes less with body tissues, integration permits a large number of systems to be built on a single chip, and their small size enables less invasive (and therefore less painful) instruments.



The benefits of MEMS technology in medical applications

For instance, MEMS accelerometers can alert medical professionals when a patient falls. Elderly patients, in particular, may suffer serious injuries from an unobserved fall. Wearable, intelligent devices equipped with MEMS inertial sensors can be used to detect and assess the severity of a fall and signal for help, aided by a GPS to provide location information. Precise control of the scalpel is an important requirement in any surgery. MEMS pressure sensors can be incorporated into the scalpel where they measure the force exerted on the tissues and provide feedback to the surgeon about scalpel pressure. MEMS sensors are one of the components in the lab-on-a-pill, which samples body fluids and picks up patient data such as temperature, dissolved oxygen levels, and pH. An incorporated image sensor allows the device to show a view of the entire small intestine, which can aid in early detection of colon cancers.



MEMS sensor technology in the lab-on-a-pill and smart pill

Similarly, the smart pill is a highly specialized MEMS micro pump that can be implanted in the human body for monitoring and medication dosage control. Its biosensors sense the substance to be measured, such as insulin, and the pill releases the drug once the quantity of the substance falls below a certain amount required by the body

Biosensors contributed the bulk of the sales increase. Because sensors are critical components in medical devices, the absence of substitutes makes the threat to the existing product line low. In addition, the level of technology is continuously improving, which is likely to sustain high demand.

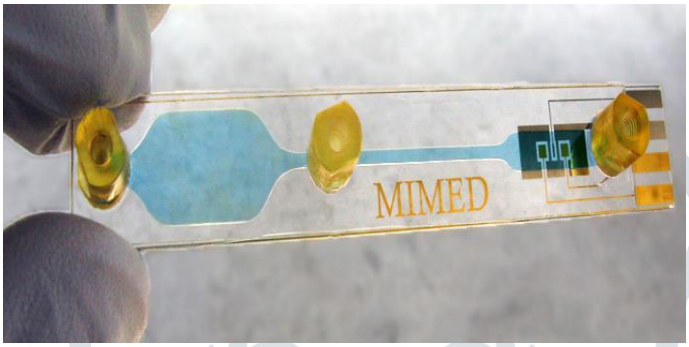
Healthy Independent Living

Environmental and mobile sensors are already a part of many people's everyday lives. For example, faucets that automatically start when you place your hands under them and shut off when you're done washing. Lights that turn themselves on when you enter a room. Wearable bands that track your daily activity, perhaps even coordinating with your smartphone to allow you to track data over time or share your information with others. NIBIB supports initiatives to develop improved sensor and related information technologies for home and mobile use that will sustain wellness and facilitate coordinated management of chronic

diseases. For example, one research team is working to improve the ability of "smart homes" to make sense of real-time sensor data and to recognize changes in a resident's activity patterns that may signal changes in well-being, such as a fall or disrupted meal schedule.

What are important areas for future research on sensors

types of sensors being developed and studied currently may play key roles in expanding and greatly changing the delivery of health care. One area in particular that may benefit from sensor research is (POC) technologies. Point-of-care refers to the place where patients receive health care, which may be anywhere from primary care offices or community clinics to emergency rooms or even patients' own homes. POC research seeks to address barriers to health care that have arisen from the concentration of services in highly specialized medical centers and labs. POC technologies may allow providers to diagnose and treat a particular health condition in a single visit, so patients don't need to make additional appointments or wait for test results.



The MIMED system is a universal point-of-care pathogen detection system. The 6x1 cm disposable chip integrates sample preparation and sequence-specific detection and can identify microbes in unprocessed biological, water, food, and forensic samples.

Besides funding studies seeking to improve the manufacturing process for low-cost POC technologies, NIBIB-funded efforts are already underway to develop cost-effective POC solutions for detecting a range of medical conditions, including H5N1 influenza and allergies and other autoimmune diseases. Miniature, implantable sensors could continuously monitor a person's health status, providing more accurate information than conventional disease screening and a clearer sense of when a doctor's visit is needed. Integrating compact, wireless sensing technologies into medical devices or chronic treatments like long-term oxygen therapy may help lower treatment costs and be easier for patients to use. Such technologies may also be compatible with mobile devices, allowing for remote monitoring and assessments in real-time. Some of the challenges to sensor research include simplifying and automating the preparation of patient samples to be used at the point-of-care and overcoming the body's natural rejection response to implantable or minimally invasive sensors.

CONCLUSION

Health care services are important part of our society; automating these services lessens the burden on humans and eases the measuring process. Also the transparency of this system helps patients to trust it. There has already been a host of clinical applications involving SWS that have been analyzed, including but not limited to blood pressure, cardiac monitoring, respiratory rate, blood electrolyte and glucose concentration systems, neurological monitoring, and physical therapy and rehabilitation medicine. These changes will alter the way that countries utilize funds on healthcare, set guidelines for protocols regarding preventative and post-operative monitoring, and augment the physician-patient relationship.

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