Overview of Biosensors and Their Application: a review

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Abstract

Biosensors like tissue based, DNA biosensors, thermal and piezoelectric biosensors .biosensors are used in food industry to check in its quality. And play an important role in medical sciences like heart diseases. Biosensors are portable, un-expensive tools for detecting proteins and other analytes, biosensors are techniques which can often used in existence with alive system to decrease cost and increase the profit oriented process rate. This review has comprised a cursory meta-analysis to grow a working visibility for biosensor regeneration. Some of the popular fields implementing the use of biosensors are food industry to keep a check on its quality and safety, to help distinguish between the natural and artificial; in the fermentation industry and in the saccharification process to detect precise glucose concentrations; in metabolic engineering to enable in vivo monitoring of cellular metabolism. Biosensors and their role in medical science including early stage detection of human interleukin-10 causing heart diseases, rapid detection of human papilloma virus, etc. are important aspects. Fluorescent biosensors play a vital role in drug discovery and in cancer. Biosensor applications are prevalent in the plant biology sector to find out the missing links required in metabolic processes. Other applications are involved in defence, clinical sector, and for marine applications.

Keywords: Biosensors, drugs, biology, defence, clinical sector

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Introduction

Biosensor is a device that changes biological response into an electrical signal, biosensor should be independent of physical properties like pH and temperature. The biosensor is used to determine the concentration of substances interest even where they do not make use of a biological system (Solnica, 2003). Biosensors are analytical devices that convert a biological response into an electrical signal. Quintessentially biosensors must be highly specific, independent of physical parameters such as pH and temperature, and should be reusable. The term ‘‘biosensor’’ was coined by Cammann, 1 and its definition was introduced by IUPAC. (Cammann , 1977; Thevenot, 1999; Thevenot, 2001; Thevenot, 2001). Immunosensors were established on the fact that antibodies have high affinity towards their respective antigens, i.e. the antibodies specifically bind to pathogens or toxins or interact with components of the host's immune system. The DNA biosensors were devised on the property that single-strand nucleic acid molecule is able to recognize and bind to its complementary strand in a sample. The interaction is due to the formation of stable hydrogen bonds between the two nucleic acid strands. Another consideration that fascinates lots of researchers regarding exploiting this particular field for exploration is its versatility. It is an interdisciplinary technology and involves the collaborative efforts of engineering, microbiology, physics, chemistry, biology, biotechnology and so on (Hinze, 1994). Technically speaking, biosensing is a phenomenon that withholds set techniques for the production of an accessible detection signal of interaction between biological molecules (such as a domain of protein and another molecule or analyte of interest like any other small molecule, another protein or an enzymatic activity). Such molecular device that enables sensing of these molecular interactions is called biosensors (Ibraheem, 2010). Biological sensors that we know today in the biochemical field of science have some great potential for detecting and monitoring the interaction of biological molecules inside and outside the cells. These sensors have provided easiness to the scientists of today in overcoming the undetectable levels of many harmful agents that would have otherwise remained undetected. Here, in the applications section of biosensors, some recent studies have been compiled to give an overall background of the most recent advantages that biosensors have provided in monitoring many harmful environmental agents that are responsible for the cause of some serious health hazards to humans and the ecosystem. Moreover these sensing agents can also be employed for bioremediation of pollutants from the areas where most of the problems occur due to pollution leading to unhealthy conditions affecting ecosystem in a negative manner.

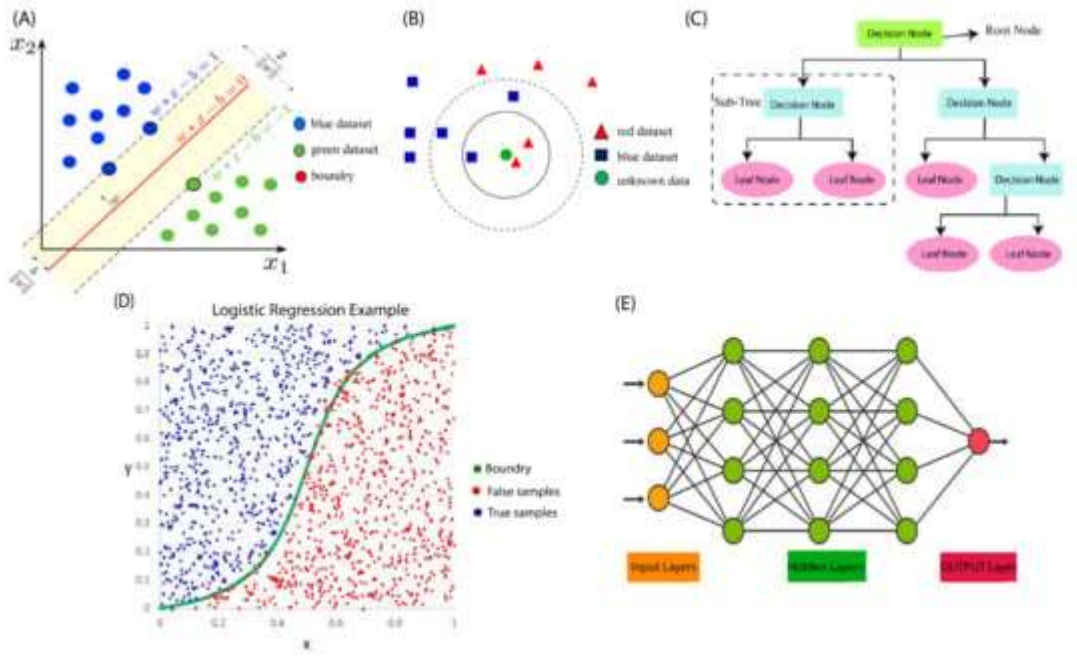

Figure 1. Schematic illustrations of supervised machine learning algorithms. (**A**) SVM model. Reprinted from [43]. (**B**) KNN model Reprinted from [44]. (**C**) DT model. Reprinted from [45]. (**D**) LR model Reprinted from [46]. (**E**) ANN model. Reprinted from [47]. Source and copyright from MDPI

Types of biosensors:

The various types of biosensors such as enzyme-based, tissue-based, immunosensors, DNA biosensors, thermal and piezoelectric biosensors have been deliberated here to highlight their indispensable applications in multitudinous fields. Few are Bioreceptors, Antibody/antigen interactions, Artificial binding proteins, Enzymatic interactions, Affinity binding receptors, Nucleic acid interactions, Epigenetics, Organelles, Cells, Tissue, Biosensors started by the lyons land pioneers clark in the 1960's different type of biosensors are used i.e, tissue-based DNA biosensor , piezoelectric biosensor . The enzyme based sensor was investigated by hicks and updike in 1967. They have been originate on immobilization method i.e., ionic bonding and covalent bonding. The enzyme used for this motive peroxidases and oxidoreductases. DNA biosensors have single nucleic acid molecule and have a hydrogen bonding between the two nucleic acid.

Piezoelectric biosensors are generally two types:- 1. quartz crystal microbalance. 2. Wave device.

The function of analyte:- It is a chemical substance constituents are being measured.

Transducer:- It is device that converts energy from one form to another. example microphases, pressure sensor . Biomaterials can be incorporated into a support or bound chemically or physically to the transducer surface, which depends on the immobilization method of the biomaterial on the transducer. Immobilization methods include adsorption, entrapment, covalent attachment, microencapsulation, inclusion, cross-linking etc. (Korotkaya, 2014).

Signal output:- signal that comes out of an electronic device.

Biosensors having better stability in traditional methods.

1. Fermentation process:- In the presence of biomass, by-products, enzymes. The biosensors are used to monitor. This process having a maximum efficiency nowdays it is available in market and mainly it is used in china country. (Venuhopal, 2002)
2. Biosensing technology:- In this technology we detect the quality of food like its smell, taste, freshness, flavour.
3. Glucose monitoring system:- This is analysis goal of glucose sensor . This sensor is used for the physical properties of light. This is approved by the US FDA.
4. Glucose biosensors:- This is glucose biosensors during the food storage and this is German studied of electrochemistry.

The importance of biosensors in healthcare:-

The maintenance of health is most important for prevention of disease .It is used to maintenance the food stuff and monitoring. It tells about the percentage of human death over the coming 19 years. It tells about the HIV/AIDS diseases which cause human death. SNP detectors are play important role in personalised medicines. It tells about the absence and presence of KRAS which is a genetic mutation.

Applications of Biosensors:

Huge field where different types of biosensors have been currently often applied is medicine and natural sciences. Wide spectrum of biosensor applications includes identification of microorganisms for determination of various diseases origin, identification of genome

deviations for inborn defect assay or determination of biochemical markers indicated some metabolic disorders and pathological states of organism.

1. Heavy metals reduction
2. Biosensors in food industry
3. Biosensors as a Diagnostic tool
4. Biosensors in Environmental Monitoring
5. Biosensors in Drug Discovery
6. Biosensors in agriculture
7. Biosensors in water quality
8. Applications for Biosensors published in some reputed Journals are mentioned in the Journal and books reference citations.

Conclusion:-

Glucose biosensors are used to measure the blood glucose level in the body. In this include the POC device, monitoring system where the generality of diabetes. This biosensor are more reliable, accurate and ease to use. As the demand and need for using biosensor for rapid analysis with cost-effectiveness require bio-fabrication that will pave way to identify cellular to whole animal activity with a detection limit of high accuracy for single molecules. Next, the biosensors should be targeted to work under multiplex conditions. In that situation, both 2D and 3D detection are required with sophisticated transducers for targeting and quantifying small analytes of interest (Dias et al., 2014). Taken together, combination of nanomaterials and polymers with various types of biosensors will provide hybrid devices for better usage in the aforementioned applications (Citartan et al., 2013; Turner, 2013).

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

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Conflicts of Interest

The authors declare no conflict of interest.

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