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Role and Impact of Biomedical Engineering Discipline for Developing Country Perspective

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***Abstract*—For a developing and largely populated country, it is quite difficult to solve all healthcare related issues using existing technology with affordable cost and desired precision. Moreover, to carry out biomedical research and design to improve biomedical equipment, devices and maintenance are usually very expensive. Thus, it is imperative and possible to extent indigenous technologies and raw materials for the research activities to design and develop sustained biomedical devices and equipment, artificial organ and tissue, prosthetics and implants, image modalities and healthcare related software at low-cost. Thus, the research and study related to biomedical engineering need to improve to understand the role and impact of this subject as a discipline.**

Keywords: Dengue fever, dengue virus (DenV), promoter, bioinformatics, NCBI, Bangladesh

I. INTRODUCTION

Biomedical engineering (BME) is an interdisciplinary, open, emerging, and challenging field which is experiencing remarkable expansion and recognition at present.

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Some recent cutting-edge research became successful in the development of artificial kidneys, improved medical imaging and nanotechnology for cancer diagnosis and treatment, development of surgical tiny robots for clearing clogged arteries, and advanced algorithm development for disease diagnosis [1-4].

II. ROLE AND IMPACT OF BIOMEDICAL ENGINEERING AS A DISCIPLINE

Some of the fields related to BME are listed below.

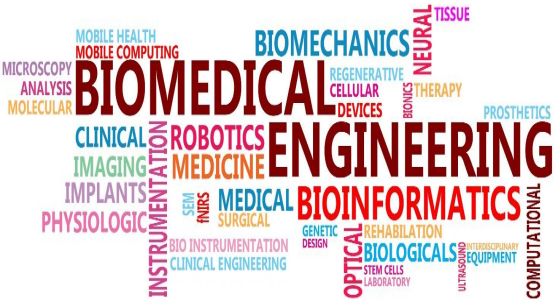

Figure 1: Interdisciplinary fields of biomedical engineering.

A. Biomedical imaging

Biomedical imagingincludes the processes and techniques for interior visual representation of organs or tissues formedical intervention and clinical analysis. It also involves the required technologies for diagnostics. Available diagnostic instruments help to detect diseases more precisely whichimprove the medical treatment in quality[6-7].

B. Computational medicine (CM)

CMusing the application of mathematics, computational science and engineering it finds the quantitative approach to understanding the diagnosis, mechanisms, and treatment of human disease. To develop computational models of physiology, molecular biology, and anatomy of disease, and apply those models to improve patient care is the main concept of computational medicine [8]. CM obtainment can provide insight into and across different areas of biology, including, genomics, molecular networks, genetics, organ systems, cellular and tissue physiology, and whole-body pharmacology[9]. Moreover, this emerging discipline uses simulation and modeling technologies to address medical issues relating to the clinical assessment process. This application could relate to disease prevention, diagnosis, management,

prognosis, treatment planning, and support medical decisions[8-10].

C. Cell and tissue engineering

Cell and tissue engineeringhave a critical importance in the field of medicine for the creation of engineered replacements of damaged tissues. It incorporates the development of functional tissues/grafts that have the ability to generate living tissue for therapeutic or replacement applications through biochemical manipulations, genetic engineering, cell culture, and material development [11-12]. It also assesses the processing condition effects including sterilization, decellularization, and biomimetic coating on the behaviors of the biological tissues/grafts. Tissue engineering engages the demeanor of tissue scaffold which is used for the formation of new sustainable tissue for the medical purpose [13]. This area has a significant impact on society for the development of prosthetic devices and artificial organs.

D. Digital microscopy

It is a variation of traditional optical microscope that uses a digital camera and optics to produce an image to a monitor usually done by software [14]. Using signal and image processing techniques it can automatically classify histology slides for example, malignant/benign breast tumor cell [15-16].

E. Biomedical signal processing

Biomedical signal processing aims to develop machine learning algorithms and signal to process on bio-signals and images for diagnosis, prognosis, and detection of various medical situations [17]. This field is essential for acquiring medical data after applying biomedical instrumentation and imaging process [18-19]. Using those data essential medical report is generated. This signal processing approach can be used in various data such as MRI, EMG, ECG, and Ultrasound [20].

F. Scanning electron microscope (SEM)

SEMpicture of carbonated hydroxyapatite (CHA) demonstrating the globular appearance of the apatite with a molecule size of around 50 nm [21]. In case of visualizing the external morphological characteristics of our body SEM technique has been used widely such as parasite study [22]. It is also used in observing the human embryo development [22].

G. Biomanufacturing

Taking the advantage of biological systems it produces biomolecules or biomaterials which is widely used in medicines, foods, beverage processing, industrial applications and many more. Natural sources such as blood, cultures from animal/plant cells etc. are used for biomanufacturing with specialized equipment [23].Moreover, it has an essential use for outlining and fabricate of the lost tooth. Tooth substitution winds up fundamental when the tooth and its foundations have been hopelessly harmed, and the tooth has been lost or should be evacuated [24]. And, biomanufacturing field is expanding tremendously and numerous companiesare investing for their research [25]. For example, Bio-manufacturing Research Institute & Technology Enterprise (BRITE) at North Carolina Central University, USAoffers a hands-on acquiring experience for undergraduate and graduate students attracted in professions in the state's rising biotechnology industry [26-27].

H. Elastography

Elastography which isanother therapeutic imaging methodology for diagnosing tumors by estimating their solidness of delicate tissue [28-29]. It has been used to find abnormalities of both muscle and breast tissue. Ultrasound elastography can detect early stage of heart disease. Magnetic resonance (MR) based elastography has become popular nowadays [30]. It is a non-invasive medical imaging technique [30].

I. Mobile Health (mHealth) and telemedicine

The territory of mHealth centers on the use of cell phones (cell phone, tablet, and so on.) to address different general medical issues [31]. One specific result of mHealth research can be through telemedicine, which expects to convey propelled human services administrations to the majority. These examination regions include vigorously on theelectrical circuit and gadget plan, prototyping, usage of calculations on microcontrollers and additionally keen gadgets, lastly, flag preparing and machine learning framework outline [32-35].

J. Clinical research unit (CRU)

CRU helps to direct clinical research with quiet information all together to improve ailment analysis and grow new advances. And, its spotlight on i) disease look into, e.g. bosom, prostate, skin, and liver, ii) directed medication conveyance for tumor treatment (pre-clinical), iii) clinical informatics, iv) walk and clinical development research, and v) versatile wellbeing and telemedicine. This examination unit will help in improving the nature of determination and treatment in developing country, in this way, diminishing the pattern of traveling to another country for such administrations [36].

K. Bioinformatics

Bioinformatics is an interdisciplinary area where we need biological along with technological and mathematical knowledge to discover new information. Different tools and techniques can be applied to identify a new pattern. Its application area is vast. It can be used in predicting the DNA and RNA sequence, identifying the chemical components as well in disease predictions [37]. Bioinformatics is a science which can be used in molecular medicine, forensic analysis, bio-weapon creation, drug development, preventative medicine and so on [38].

L. Bio-instrumentation

Bio-instrumentation is a newly emerging field to develop new devices related to medical science. It basically deals with three components: transducer, sensors, and actuators [39]. A transducer is basically a device that transforms a primary method of energy into a corresponding signal with a dissimilar energy method. On the other hand, sensors detect a change in a physical stimulus or parameter and turn it into a signal which can be computed or recorded and actuator shows the output of transducer [39]. The applications of this field are vast and it still increasing day by day.

III. FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (FNIRS)

Functional near-infrared spectroscopy is ainnovative imaging technique, similar to EEG. It is a non-invasive and continuous optical brain monitoring technique based on the measurement of oxygen saturation of the blood in the brain [40]. It detects oxygen levels provides real-time values (of BOLD Signal) for HbO2 and dHb as the subject performs different tasks. fNIRS techniques can be used in lie detection, cognitive reasoning, problem-solving and so on [40-41].

IV. CONCLUSION

Biomedical Engineering is a discipline that uses advance knowledge in engineering principles in biology and medicine to improve human health through cross disciplinary activities that integrate the engineering science with the biomedical science and clinical practice. Biomedical engineers work with physicians, therapist and researchers to develop system, equipment and device in order to solve clinical problem.The future role and prospects of biomedical engineering are to discover new devices, tools, inventions, and upgrade the discovered devices for the mankind.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical approval

This article does not contain any studies with animals performed by any of the authors.

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