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Wearable Devices for Improved Health Care Systems Based on Biomedical Technology

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Affordable health care is an issue of concern for both the public and governments. In the latter years we have seen a shift in the approach of medical technology companies to deliver products providing cheap, fast and more efficient patient care. There are constant emerging technologies that will facilitate the development of such systems and aid the patients in their everyday life. The field of biomedical engineering is interdisciplinary, merging biological research with engineering, imaging and sense technology, which has seen the birth of several systems that aid in the monitoring and cure of the health of humans.

In several areas of research biomedical systems have evolved into user-friendly devices that monitor a patients' performance remotely. With such systems in place it reduces the amount of doctor's visits by the patient, while the patient is still monitored by health professionals. Wearable computing has been applied in various fields within the healthcare sector to monitor the health and the welfare of patients. It has been implemented in the use of prosthetic control devices where the movements of the prosthetic device are controlled. Some advantages of such systems are to be continuously useful in various mobile settings, being always available, embedded in an item of clothing without being noticeable to the user, be context-aware and provide proactive support in information processing, have the attributes of not distracting user attention, be controllable by the user and work as a communication tool between patient and health care professionals. However, it is required that the user follows the instructions carefully and has knowledge of using the system for it to be a reliable and accurate monitoring system, in addition to, ensuring that the communication between the user and the wearable computer is private, avoiding disclosure in a public domain.

One application of wearable devices is that of so-called body area network health systems, where various communication devices are worn on the body to provide personalized services for the user. Such systems make use of SEMG sensors, local biofeedback devices and a personal data assistant, which receives and processes data from the sensors and uses Wi-Fi, GPRS and/or UMTS to transmit the data to a remote health professional. These systems have the potential to monitor patients at home, which may be extremely important for high risk patients with cardiovascular disease for example. A system to facilitate independent and autonomous living of the elderly is being developed by using a predictive dynamic model based on machine learning techniques to investigate physiological muscular recruitments, muscular fatigue and physiological conditions. To develop a cost-effective system with plug and play features, unobtrusive integrated sensors have been utilized to record posture and kinematic variables, as well as to acquire SEMG data. This multisensorial platform analyses and combines SEMG signals with kinematics variables, thus giving simple and coherent dynamic information about the movements of the individual.

Newly developed wearable sensors have also provided a biomedical system that can detect the emotional state of the use through electro thermal activity, electrocardiogram, facial SEMG and respiration. Such a system can detect stress levels of the user by detecting physiological changes. Although these systems have great potential, it still remains to develop a detection system with bio-sensors that are not obtrusive to the user and can be comfortable implemented in their daily lives.

For sport science and occupational therapy several researchers have developed a real-time muscle fatigue monitor incorporated in a biomedical system. A ubiquitous wearable unit for controlling muscular fatigue during cycling exercise sessions has been developed and proved sufficient in controlling the workload in an exercise machine to prevent the occurrence of fatigue. Most of these fatigue detection models are based on the analysis and classification of SEMG (Surface electromyography) signals. Several systems, which are also automated, are capable of detecting and even predicting the occurrence of muscle fatigue emanating from isometric contractions. However, a small device needs to be developed that can analyses, detect and/or predict muscle fatigue in movement related activities (dynamic) which increases the usability of such systems in daily exercise and work related tasks. There are some newer, interesting researches on developing these systems, although further testing is required before a practical, user friendly device is available.

A variety of classification methods have been used in the development of wearable devices, such as recognition algorithm, support vector machine, LDA, ANN, probalistic neural networks as well as Features such as spectral energy bands and cepstral and linear predictive coefficients. It is difficult to determine the most optimal technique for use in any particular study, since it is dependent upon the nature of the system itself, the sensors used and the desired outcome of the classification. Choice of classification method often relies on previous experience and knowledge that other researchers have successfully used the same method for similar studies.

New technologies are emerging constantly that change the way we deliver the health care for patients. Although many of the devices are developed for remote health care monitoring, there are also new developments that improve surgeries and patient treatment, e.g. The Sapien Trans catheter aortic valve and Electronic Aspirin. The development of new biomedical systems has potential to improve our living in terms of health and facilitating our daily activities. I believe it is only the curiosity and the exploration of researcher that bring this interesting field forward.

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