Project 1: Wearable Biosensing Device for Dehydration Assessment

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The main objective of this project is to design and make a wearable sensor to measure skin impedance and communicate wirelessly with computing unit which is preferably mobile phone in which the bio-impedance values can be correlated to the hydration level of body calculate the hydration level of the body by. Dehydration is one of the leading causes of several symptoms such as a chronic headache which lower the quality of daily human activity. Also, dehydration has significant effect on the performance of athletes during their training and completions. Commercially available hydration measurement devices are not convenient and portable. Therefore, hydration level of the body cannot be measured in real time.   Six major factors to be taken into consideration are as follow:
- Choosing biocompatible and electroactive material for electrode.
- The design of the electrical circuit
- Design the sensor structure and fabrication method.
- Programing the microcontroller for wirelessly communication
- Design a user-friendly mobile application
- finding proper phantom model for testing and calibration

Project 2: Optimized Sensitivity of Surface Plasmon Biosensor Using different Shaped Nanoparticles

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Localized Surface Plasmon (LSP) resonance effect is mostly found in non-metal nanoparticles. The phenomenon happens with the oscillation of valence electrons when absorbing wavelengths from the ultra violet range. Using a spectrometer, such as Surface Plasmon would be the most efficient way to measure the effect of LSP. It is also mentioned in the research that some catalytic activities could be increased by this phenomenon. Specific activities could be controlled and optimized using different metallic and non-metallic nanoparticles of different sizes in the design.

On the other hand, research has shown that integration of electrochemical control into the Surface Plasmon Resonance could increase the oxidation state of some molecules and the molecular activity could happen under a desired controlled condition, while the kinetic analysis of the interaction is monitored via the SPR machine.
Given the well-known technique of electrochemical SPR (EC-SPR), the abovementioned design of several sizes of nanoparticles could be integrated into a device compatible sensor, or even could be introduced into the system through a fluid flow. Integration of nanoparticles in the design to trigger the LSPR effect, while controlling the interaction of the molecules and recording their kinetic activity via EC-SPR, will provide promising outcomes to be further used to model the in vivo environment of a normal or diseased cell/tissue, monitoring of specific analytes, drug delivery and medical diagnostics.