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NFC Based Smart Biosensor – An Introduction to Battery-less Enzymatic Amperometric Glucose Sensor Based on NFC Technology

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Abstract

Biosensors are widely used as analytical devices for determination of medically relevant parameters, e.g. glucose, lactate and histamine. The possibility of easily available and low-cost sensors is a central need in mobile diagnostics and personal health monitoring. Therefore, biosensors combined with near field communication (NFC) technology enable simple and smart sensor solutions for electrical and non-electrical parameter measurements.

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Keywords: Mobile diagnostics; Personal health monitoring; enzymatic amperometric glucose sensor; battery-less biosensor; Near field communication (NFC)

1. Introduction

NFC is a wireless technology to transmit data and energy over short distances. NFC is a future-oriented and upcoming technology well known in payment and access control. It also provides different applications in the sensing and personal health monitoring area. NFC is based on inductive coupling between two devices and operates at a frequency of 13.56 MHz. The transmitted energy is used for energy harvesting and in conjunction with low power electronics there is no need of an additional external power source like a battery. Therefore, size and costs of the resulting sensor can be minimized.

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Diabetes mellitus is one of the most frequent metabolic disorders worldwide. Blood glucose self-monitoring helps diabetics to manage their disease successfully and increases the quality of life and patient safety. In addition to NFC the high availability of NFC-enabled smartphones allows using additional features of the smartphone (high readability of the display, data processing, data storage).

2. Methods

In contrast to the single detection of the presence of an analyte (ammonium) by de-tuning the NFC antenna; we developed a smart glucose meter based on a multi-chip solution, containing NFC-frontend, low power microcontroller and measurement unit to measure blood glucose quantitatively. The NFC glucose sensor system is based on an amperometric measurement and uses a common blood glucose test strip. The NFC energy harvesting provides the required potential for the electrochemical reaction of glucose and glucose oxidase (GOD) in the range of -128mV. The electrochemical reaction takes place on a common enzymatic-amperometric glucose test strip and the resulting electrical current is measured. The resulting current is in a range up to 80µA.

3. Results and Discussion

The current NFC-glucometer prototype is powered by the NFC interface of a mobile device. A user friendly and intuitive mobile app completes the smart sensor system and shows the measured blood glucose level on the display and stores the determined data in a diary. In contrast to classical glucose meters our NFC glucose sensor system only performs the blood glucose measurement. Data processing tasks, displaying the results and data storage are performed by the NFC-enabled smartphone.

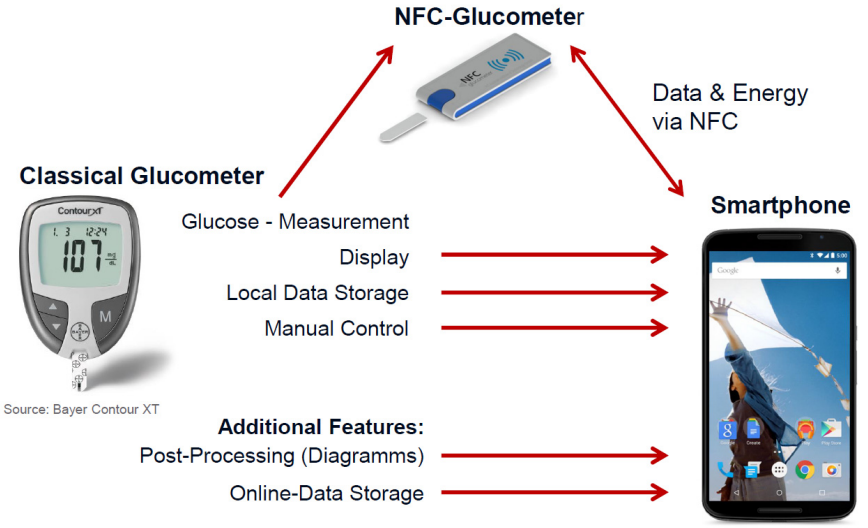

Fig. 1. .Classical glucose meter vs. NFC glucose meter

Supplementary laboratory tests with histamine had shown promising behavior in a similar sensor arrangement. Therefore, NFC based smart biosensors can open a wide field for further analytes.