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Automated Detection of Intelligent Diseases Self Management with Mobile Technology

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ABSTRACT: Cost-effective mobile health care must consider not only technological performance, but also the division of responsibilities between the patient care provider, the context of the patient's condition, and ways to implement patient decision support and tailored interaction. Designed a set of new electronic monitor that, came up with complete solutions of hardware, software achieved the real-time transmission of patient self-tested blood pressure, sugar level, heart rate level, body temperature, apnea/hypopnea events, in the presence of artifacts and breathing irregularities datum to patients. This data is able to provide evidence to the patient's diagnosis and treatment. This system has good expansibility and it's very convenient to use for doctors and patients. It lays a solid foundation for disease surveillance, tracking treatment, analysis and study.

KEYWORDS: Hypopnea syndrome, Blood Pressure Sensor, Glucose Sensor, Temperture Sensor, Breath sesor, COPD

I. INTRODUCTION

Mobile technology is a promising way to transfer aspects of clinical care support from the caregiver physician, nurse, nurse practitioner, or physical therapist to the patient, thus enabling disease self-management. It has almost limitless potential to inform and engage the patient in treatment decisions, to monitor the patient's condition, and to alert caregivers about any unexpected changes. However, continued and active patient involvement in mobile healthcare (m-health) requires considerable insight into disease self-management as a process, which requires accommodating a shift in the patient's role. In contrast, we built two m-health systems-one for patients with chronic obstructive pulmonary disease (COPD) and one for patients with pregnancy complications-primarily to explore how mobile technology can support the patient. Our focus was on embedding disease-specific Bayesian network models within a smart phone to enable on-the-fly patient data interpretation. In this way, the system could assess the patient's health status and advise the patient on what action to take- all without the care provider's direct involvement.
SLEEP apnea/hypopnea syndrome (SAHS) is a sleep breathing disorder characterized by repetitive episodes of complete obstruction (sleep apnea event) or partial obstruction (hypopnea event) of the upper airway, resulting in a blood oxygen desaturation or arousals leading to sleep fragmentation. The usual daytime manifestation is excessive sleepiness, fatigue, and poor concentration, which can escalate to traffic accidents, depression, and memory loss. The major risk factors for the disorder include obesity, male gender, and age. Untreated SAHS may lead to cardiovascular dysfunction, stroke, and possibly (since this supposition is still not well documented) to the ischemic heart disease.

Currently, in sleep laboratories, there are carried out overnight polysomnographic studies (PSG) aimed at the early detection and assessment of the severity of SAHS in patients. PSG study is considered as the "gold standard" method for SAHS diagnosis. It involves recording and studying simultaneously many signals such as electrocardiogram (ECG), nasal airflow (NAF), and blood oxygen saturation (SaO2). Numerous methods exist, based on the evaluation of various signals, for detection of SAH events. This includes methods based on analysis of airflow signals, ECG signals, pulse oximetry (SaO2) signals, tracheal sound signals, or some combinations of signals listed previously. A number of portable devices for sleep apnea monitoring and diagnosis are available, such as annealing, SleepStrip, and LifeShirt, to name only the most popular solution. All signals mentioned previously provide only supportive evidence of SAH

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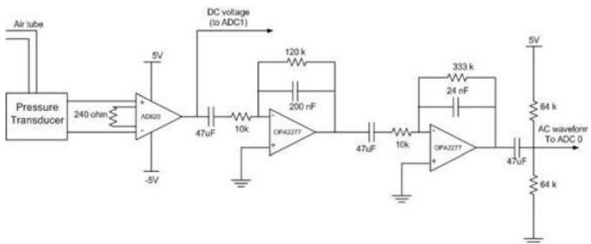
events and do not allow one to localize precisely their beginning and end. It often happens that the primary evidence (significant reduction in the NAF signal) is not observed. In the case of an SaO2 signal, the supporting evidence, in the form of a blood oxygen desaturation, is delayed in time in relation to the moments of occurrence of SAH events.

A major challenge in disease self-management is determining the optimal complexity level for representing and interpreting context-specific clinical data to support patient-tailored interaction, decision making, and responses. We believe that an integrated approach like ours is the best way to evolve cost-effective m-health systems that can augment or even replace traditional disease management and thus lead to greater numbers of individuals who enjoy improved health at a lower cost. We also believe an integrated approach will stimulate the scientific, technological, and business development of mobile, patient-oriented decision-support systems.

II. METHOD

A. BLOOD PRESSURE SENSOR

Blood pressure (BP) is the pressure exerted by circulating blood on the walls of blood vessels, and is one of the principal vital signs. During each heartbeat, BP varies between a maximum (systolic) and a minimum (diastolic) pressure. The mean BP decreases as the circulating blood moves away from the heart through arteries, has its greatest decrease in the small arteries and arterioles, and continues to decrease as the blood moves through the capillaries and back to the heart through veins. The term blood pressure usually refers to the pressure measured at a person's upper arm. It is measured on the inside of an elbow at the brachial artery, which is the upper arm's major blood vessel that carries blood away from the heart.



Circuit Diagram of Blood Pressure Sensor

A person's BP is usually expressed in terms of the systolic pressure and diastolic pressure, BP is sometimes measured in other places, for instance at an ankle. The ratio of the BP measured at the main artery of an ankle, to the BP measured at the brachial artery of an upper arm, gives the Ankle Brachial Pressure Index (ABPI). Arterial pressure is most commonly measured via a sphygmomanometer, which historically used the height of a column of mercury to reflect the circulating pressure. Today BP values are still reported in millimeters of mercury (mmHg), though aneroid and electronic devices do not use mercury. For each heartbeat, BP varies between systolic and diastolic pressures. The systolic pressure is the peak pressure in the arteries, which occurs near the end of the cardiac cycle when the ventricles are contracting. The diastolic pressure is the minimum pressure in the arteries, which occurs near the beginning of the cardiac cycle when the ventricles are filled with blood. An example of normal measured values for a resting, healthy adult human is 115 mmHg systolic and 75 mmHg diastolic (written as 115/75 mmHg, and spoken [in the US] as "one-fifteen over seventy-five"). The pulse pressure is the difference between systolic and diastolic pressures. Systolic and diastolic arterial BPs are not static, but undergo natural variations from one heartbeat to another and throughout the day (in a circadian rhythm). They also change in response to stress, nutritional factors, drugs, disease, exercise, and momentarily from standing up. Sometimes the variations are large. Hypertension refers to arterial pressure being abnormally high, as opposed to hypotension, when it is abnormally low. Along with body temperature, respiratory rate, and pulse rate, BP measurements are the most commonly measured physiological parameters.

Arterial pressures are usually measured non-invasively, without penetrating the skin or artery. Measuring pressure invasively, by penetrating the arterial wall to take the measurement, is much less common, and usually restricted to a hospital setting.

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Pulse sensor

Heartbeat is sensed by using a high intensity type LED and LDR. The finger is placed between the LED and LDR. As sensors, photo diode or a photo transistor can be used. The skin may be illuminated with visible (red) using transmitted or reflected light for detection. The very small changes in reflectivity or in transmittance caused by the varying blood content of human tissue are almost invisible. Various news sources may produce disturbance signals with amplitudes equal or even higher than the amplitude of the pulse signal. Valid pulse measurement therefore requires extensive pre-processing of the raw signal. The new signal processing approach presented here combines analog and digital signal processing in a way that both parts can be kept simple, but in combination are very effective in suppressing disturbance signals. The setup described here uses a red LED for transmitted light illumination and a LDR as a detector. With only slight changes in the preamplifier circuit the same hardware and software could be used with other illumination and detection concepts. The detectors, photo current (AC Part) is converted to a voltage and amplified by an operational amplifier (LM358). Output is given to other non-inverting input of the same LM358; here the second amplification is done. The value is present in the inverting input, the amplified value is compared with preset values, if any abnormal condition occurs it will generate an interrupt to the controller.

B. **BREATH SENSOR**

The sensors contain two in contact with an electrolyte. The electrodes are typically fabricated by fixing a high surface area precious metal onto the porous hydrophobic membrane. The working electrode contacts both the electrolyte and the ambient air to be monitored usually via a porous membrane. The electrolyte most commonly used is a mineral acid The electrodes and housing are usually in a plastic housing which contains a gas entry hole for the gas and electrical contacts.

C. THEORY OF OPERATION

The gas diffuses into the sensor, through the back of the porous membrane to the working electrode where it is oxidized or reduced. This electrochemical reaction results in an electric current that passes through the external circuit. In addition to measuring, amplifying and performing other signal processing functions, the external circuit maintains the voltage across the sensor between the working and counter electrodes for a two electrode sensor or between the working and reference electrodes for a three electrode cell. At the counter electrode an equal and opposite reaction occurs, such that if the working electrode is an oxidation, then the counter electrode is a reduction.

Specification:
Power supply Voltage: 5 volts
Output voltage Range: 0-0.9 Volts.
Gain in %: 3 %

D. GLUCOSE SENSOR

An enzymatic-electrochemical sensor was developed for continuous glucose monitoring based on a novel miniaturized planar sensor flow-through cell arrangement. The sensor, which was manufactured using polymer thick film technology, features four electrodes serving as the barometric detection unit and for measuring conductivity. The enzyme is immobilized by a hydro gel matrix forming a self-adhesive layer at the surface of the working electrode. The electrode surfaces and the enzyme immobilization are protected against interfering bio-compounds from the body fluid by a biocompatible selective diffusion barrier (molecular weight 160 kDa). The polymer coating improved the linear range of the glucose sensor to 20 mm and the drift during long-term glucose measurements in serum solution were limited to +0.23 % per hour. The response time of the sensor is about 3 min and the running-in period is less than 10 minutes. A plastic foil was micro-structured by hot embossing and glued to the sensor to create a disposable flow-through cell. The patented inner geometry of the flow-through cell, featuring a gap close to the indicator window and surrounded by channels for the sample flow, prevents air bubbles from forming or entering the sensitive area of the sensor. This arrangement provides a continuous flow of small volumes of sample to the sensitive area by capillary forces and convection. The volume of the measuring chamber is about 0.3 µl.
Successful in-vivo measurements were carried out using this arrangement in several workshops with healthy volunteers,

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diabetic patients and critically ill patients after major cardiothoracic surgery.

E. TEMPERATURE SENSOR - THE LM35

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature. The LM35 - An Integrated Circuit Temperature Sensor. Why Use LM35s to Measure Temperature you can measure temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

It has an output voltage that is proportional to the Celsius temperature.

The scale factor is.01V/C

The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 C at room temperature and +/- 0.8 C over a range of 0 C to +100 C.

Another important characteristic of the LM35DZ is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The sensor self-heating causes less than 0.1C temperature rise in still air.

The LM35 comes in many different packages, including the following.

·TO-92 plastic transistor-like package,

·T0-46 metal can transistor-like package

·8-lead surface mount SO-8 small outline package

Here is a commonly used circuit. For connections, refer to the picture above.

F. BLUETOOTH

Bluetooth is a defacto standard and specification for small-form factor, low-cost, short range radio links between mobile PCs, mobile phones and other portable devices. The technology allows users to form wireless connections between various communication devices, in order to transmit real-time voice and data communications. The Bluetooth radio is built into a small microchip and operates in the 2.4GHz band, a globally available frequency band ensuring communication compatibility worldwide. It uses frequency hopping spread spectrum, which changes its signal 1600 times per second, which helps to avoid interception by unauthorized parties. In addition, software controls and identity coding built into each microchip ensures that only those units preset by their owners can communicate.

The specification has two power levels defined; a lower power level that covers the shorter personal area within a room, and a higher power level that can cover a medium range, such as within a home. It supports both point-to-point and point-to-multipoint connections and provides up to 720 Kbps data transfer within a range of 10 meters (up to 100 meters with a power boost). The technology uses omnidirectional radio waves that can transmit through walls and other non-metal barriers. If there is interference from other devices, the transmission speed decreases, but does not stop.

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IV. RESULTS

Android smartphone interface snapshots for m-health systems to monitor COPD exacerbation or pregnancy complications.
(a) Both systems use an alert module to prompt patients to perform core tasks. (b) Questionnaire for the COPD system, which is relatively simple to accommodate COPD patients, who are typically older. Pregnant patients, in contrast, are usually younger and are comfortable with more elaborate displays, such as (c) clinical data, (d) measurement data, (e) current status and advice, (f) a prognostic chart, and (g) measurement analysis. Tailoring the interface to patient preferences is critical to the patient's acceptance of the mobile agent.

A. **PERSONALIZED INTERACTION**

Personalized interaction enables the patient to rely on a mobile device agent that knows the patient's preferences and can adjust its behavior accordingly. The more personalized the patient-agent interaction becomes, the more motivated patients will be in integrating the agents into their daily lives. Interaction must account for the patient's preferences in mobile technology as well as the interface's adaptability. Patient preferences Different patient groups can have vastly different needs and preferences for mobile self-management, which underlines the importance of a tailored interaction approach. A user who often interacts with smartphone applications would probably not mind being interrupted by phone mobile agent instead of turning it off, which could result in missed measurements or medications. Adaptive interface alerts, such as the one in Figure 3a, but another patient might dislike that intrusion. In Figure 3b, the interface for a questionnaire displays only one question at a time, which accommodates most patient preferences. The questionnaire module in the figure is part of the COPD- monitoring my-health system, but with different questions, it could easily work in other m-health systems. Setting preferred days and times for reminders about taking measurements or medications or filling out questionnaires will give the patient more flexibility and encourage the patient to persevere in using the The patient must be able to easily and intuitively interact with the mobile agent, so the complexity and form of displayed information should depend on the patient's education level, age, and interests. Interface adaptation ranges from a simple setting adjustment-for example, to raise the volume for elderly users-to tailoring the entire interface for a particular age group. COPD patients tend to prefer simple, easily understood feedback and uncluttered screens, so a visual depiction of their health status works better. Our experiments with the COPD-monitoring system confirmed these preferences. Younger patients, on the other hand, tend to be more familiar with modern technology and thus can tolerate a more complex interface and more functions.

B. APPROPRIATE TRAINING ENHANCES THE WILLINGNESS OF CLINICIANS TO ADAPT THEIR PRACTICES TO MOBILE DECISIONSUPPORT TECHNOLOGIES.

Pregnancy system the option of displaying a prognostic chart for disease development until the end of the pregnancy, which is based on the probabilities from the embedded Bayesian network model as well as detailed measurement

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analysis. Figures 3e through 3g show the respective interfaces. Overall, the interfaces in Figure 3 are based on generic display elements tailored to accommodate the preferences of a particular patient group. With different tailoring, the displays would be equally effective for M-health systems with other target patient groups. The data-acquisition rate is also adjustable, depending on the risk to the patient. Low-risk patients can need fewer check-in times, so they can reduce the rate. If the patient's risk increases, the system will automatically increase the check-in rate so that it can detect any health deterioration also personalized patient decision support and disease-management advice. It is now much easier to run large models on mobile devices, but healthcare is complex and requires solutions that move beyond the technical. Decision support must be clinically valid as well, since patients using a m-health system are often outside a controlled clinical environment. Appropriate training programs can enhance the willingness of health professionals to adapt their clinical practices to mobile decision- support technologies. This nexus of technical, clinical, and psychological elements underlines the importance of multidisciplinary cooperation among clinicians, computer scientists, engineers, and patients early in system development.

V. CONCLUSION

This project and design with complete solutions of hardware, software achieved the real-time transmission of patient self-tested blood pressure data to doctors. This data is able to provide evidence to the doctor's diagnosis and treatment. We report an exploration of utilizing the latest technique to monitor the Blood Pressure, glucose, pulse, breathes and temperature of a person and using Blood Pressure sensor which is interfaced with the Microcontroller. The status will display on the LCD. And also the status of the sensor's which placed in the person's body will transmit the value to the user's mobile through Bluetooth module. The Bluetooth in the monitoring section is equipped with Blue Term Application, then monitoring and updating the data in the particular patient's database.

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