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Detecting Vital Signs of Chronic Patients with Wireless Sensors Using Bluetooth &Ethernet

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Abstract:

We have developed an Android based mobile data acquisition (DAQ) solution, which collects personalized health information of the end-user, store analyze and visualize it on the smart device and optionally sends it towards to the datacenter for further processing. The smart mobile device is capable to collect information from a largest of various wirelesses (Bluetooth, and Wi-Fi) and wired (USB) sensors. Embedded sensors of the mobile device provide additional useful status information (such as: user location, magnetic or noise level, acceleration, temperature, etc.). The user interface of our software solution is suitable for different skilled users, highly configurable and provides diary functionality to store information (about sleep problems, can act as a diet log, or even can be used as a pain diary). The software enables correlation analysis between the various sensor data sets. The developed system is tested successfully within our Living Lab facility. Sensor data acquisition on the personal mobile device enables both end-users and care givers to provide better and more effective health monitoring and facilitate prevention. The paper describes the internal architecture of the software solution and its main functionalities.

Keywords: **Microcontroller, Smart mobile device, Bluetooth, WI-FI, MEMS,Pulse Temperature and humidity sensor etc.**

I. Introduction

The aging population of industrialized countries grows and this increases also among other things the health care costs. Transparently embedded remote health care can become a new cost effective paradigm, which can solve most of the problems primarily centralized Health Care system's have. Currently, there is a large number of enabling technologies to measure the patient's physiological signals remotely. With handheld and PC devices used as data acquisition (DAQ) systems we are able to collect vital information about the (elderly and demented) patients remotely. Due to the different - in most cases proprietary and incompatible- sensor technologies and solutions, it is a hard task to create generic, user friendly DAQ systems. There are already remote patient monitoring solutions available such as the Android based MyFitnessCompanion, which is able to support the following therapy fields: Fitness, Diabetes, Asthma, Obesity, Hypertension, CHD, or the i-Care[which provides medical guidance, emergency alarm functionality and collects personal health information. Other example is the Microsoft Health Vault which supports care of elderly persons (e.g.: neurodegenerative diseases, stroke etc.), additionally it provides online web

interface to manage (process and share) health information. Biotech Lab at Ouida University is involved in AALAMSRK (a national R&D project), specialized both on Android based (we call this Mobile Hub) portable remote monitoring applications, and normal PC based (we call this Home Hub) remote monitoring solutions

II. The Hardware System

1. Micro controller:

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

2. Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

III. Design of Proposed Hardware System

The process of working of this project is explained as follows. The total equipment of this project is placed in hardware Kit . Here we have Bluetooth and wifi modules for sending and receving the data.

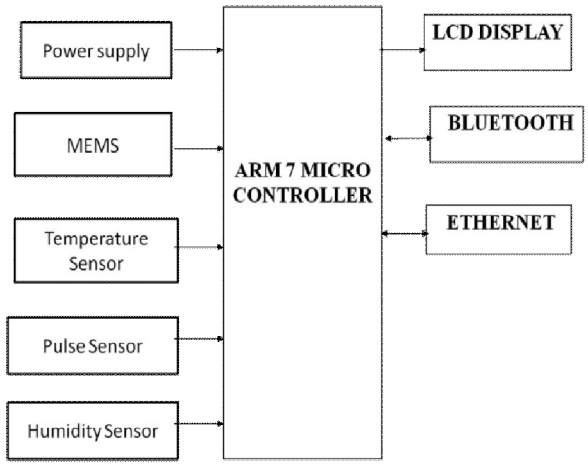


Fig.1.Block diagram

Values are displayed on the LCD (Liquid Crystal Display). In this project we have three sensors which are interfaced to the micro controller. Those are temperature sensor , pulse sensor and humidity sensors through which we can measure the temperature, pulse and amount of humidity can be collected and stored in micro controller. These values are displayed on LCD. Here ADC (Analog to Digital Converter) is used to convert the analog data from the sensors to digital form. Whenever these values exceed the threshold then the patient status is normal condition, else abnormal condition.

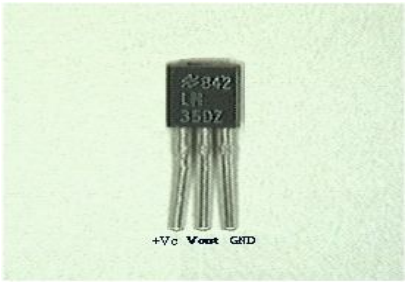
IV. Board Hardware Resources Features

1. Temperature Sensor:

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ^{o}C)

The LM35 - An Integrated Circuit Temperature Sensor 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 0.1 °C.

2. Pulse Sensor

BP is the pressure exerted by circulating blood upon the walls of blood vessels. During each heartbeat, BP varies between a maximum (systolic) and a minimum (diastolic) level. In this segment of population, the abnormality of punctual values of BP and its variability in a short period are the main manifestations of cardiac instability. For these reasons, more measurements per day are suggested. The systolic and diastolic punctual values provided by the sensor are analyzed to find under or over threshold situations and the general trends of both parameters are verified looking for suspicious variability. The complexity in terms of memory and computation is linear with the number of values considered. An example of observation of BP, one month long, along with the safety thresholds. It is possible to observe an under threshold and an over threshold situation, respectively, for the diastolic and systolic parameters. Pulse Oximeter In its most common (transmissive) application mode, a sensor is placed on a thin part of the patient's body, usually a fingertip or earlobe, or in the case of an infant, across a foot. Light of two wavelengths is passed through the patient to a photo detector. The changing absorbance at each of the wavelengths is measured, allowing determination of the absorbance's due to the pulsing arterial blood alone, excluding venous blood, skin, bone, muscle, fat, and (in most cases) nail polish. Reflectance pulse oximetry may be used as an alternative to transmissive pulse oximetery described above. This method does not require a thin section of the patient's body and is therefore well suited to more universal application such as the feet, forehead and chest, but it also has some limitations. Vasodilatation and pooling of venous blood in the head due to compromised venous return to the heart, as occurs with congenital cyanotic heart disease patients, or in patients in the Trendelenburg position, can cause a combination of arterial and venous pulsations in the forehead region and lead to spurious SpO2 (Saturation of peripheral oxygen) results. VI.

Pulse Module BP is the pressure exerted by circulating blood upon the walls of blood vessels. During each heartbeat, BP varies between a maximum (systolic) and a minimum (diastolic) level. In this segment of population, the abnormality of punctual values of BP and its variability in a short period are the main manifestations of cardiac instability. For these reasons, more measurements per day are suggested. The systolic and diastolic punctual values provided by the sensor are analyzed to find under or over threshold situations and the general trends of both parameters are verified looking for suspicious variability. The complexity in terms of memory and computation is linear with the number of values considered. An example of observation of BP, one month long, along with the safety thresholds. It is possible to observe an under threshold and an over threshold situation, respectively, for the diastolic and systolic parameters. Pulse Ox meter In its most common (transmissive) application mode, a sensor is placed on a thin part of the patient's body, usually a fingertip or earlobe, or in the case of an infant, across a foot. Light of two wavelengths is passed through the patient to a photo detector. The changing absorbance at each of the wavelengths is measured, allowing determination of the absorbance's due to the pulsing arterial blood alone, excluding venous blood, skin, bone, muscle, fat, and (in most cases) nail polish. Reflectance pulse oximetry may be used as an alternative to transmissive pulse oximetery described above. This method does not require a thin section of the patient's body and is therefore well suited to more universal application such as the feet, forehead and chest, but it also has some limitations. Vasodilatation and pooling of venous blood in the head due to compromised venous return to the heart, as occurs with congenital cyanotic heart disease patients, or in patients in the Trendelenburg position, can cause a combination of arterial and venous pulsations in the forehead region and lead to spurious SpO2 (Saturation of peripheral oxygen) results.

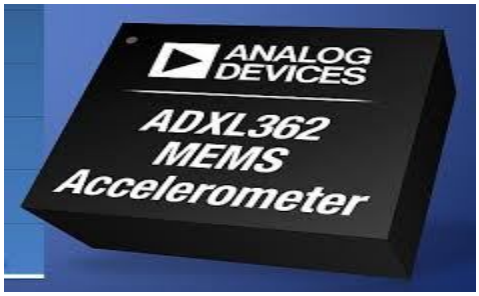
3.MEMS

Micro electro mechanical systems (MEMS) are small integrated devices or systems that combine electrical and mechanical components. Their size range from the sub micrometer (or sub micron) level to the millimeter level and there can be any number, from a few to millions, in a particular system. MEMS extend the fabrication techniques developed for the integrated circuit industry to add mechanical elements such as beams, gears, diaphragms, and springs to devices.

Examples of MEMS device applications include inkjet-printer cartridges, accelerometers, miniature robots, micro engines, locks, inertial sensors, micro transmissions, micro mirrors, micro actuators, optical scanners, fluid pumps, transducers and chemical, pressure and flow sensors. Many new applications are emerging as the existing technology is applied to the miniaturization and integration of conventional devices.

These systems can sense, control and activate mechanical processes on the micro scale and function individually or in arrays to generate effects on the macro scale. The micro fabrication technology enables fabrication of large arrays of devices, which individually perform simple tasks, but in combination can accomplish complicated functions.

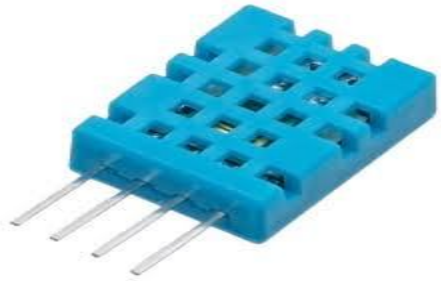
MEMS are not about any one application or device, or they are not defined by a single fabrication process or limited to a few materials. They are a fabrication approach that conveys the advantages of miniaturization, multiple components and microelectronics to the design and construction of integrated electromechanical systems. MEMS are not only about miniaturization of mechanical systems but they are also a new pattern for designing mechanical devices and systems.



4.HUMIDITY SENSOR

Humidity is the amount of water vapor in the air. In daily language the term "humidity" is normally taken to mean relative humidity. Relative humidity is defined as the ratio of the partial pressure of water vapor in a parcel of air to the saturated vapor pressure of water vapor at a prescribed temperature. Humidity may also be expressed as absolute humidity and specific humidity. Relative humidity is an important metric used in forecasting weather. Humidity indicates the likelihood of precipitation, dew, or fog. High humidity makes people feel hotter outside in the summer because it reduces the effectiveness of sweating to cool the body by preventing the evaporation of perspiration from the skin. Absolute humidity is the quantity of water in a particular volume of air. The most common units are grams per cubic meter, although any mass unit and any volume unit could be used. Relative humidity is defined as the ratio of the partial pressure of water vapor in a gaseous mixture of air and water vapor to the saturated vapor pressure of water at a given temperature. Relative humidity is expressed as a percentage. Specific humidity is the ratio of water vapor to air (including water vapor and dry air) in a particular volume. Measuring and regulating humidity. There are various devices used to measure and regulate humidity. A device used to measure humidity is called a psychomotor or hygrometer. A humidistat is used to regulate the humidity of a building with a de-humidifier. These can be analogous to a

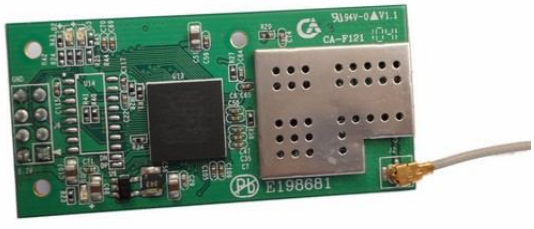
thermometer and thermostat for temperature control.



5.Bluetooth:

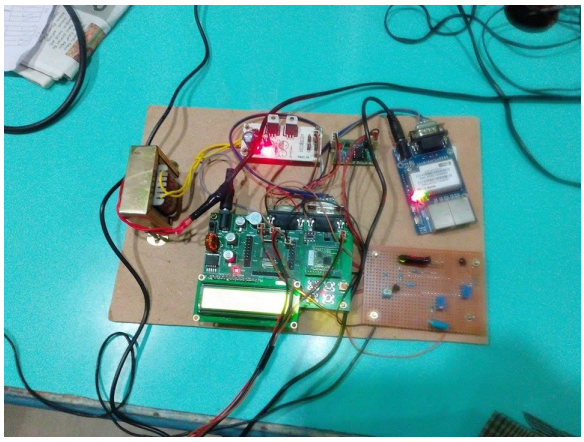
AUBTM-22 is a Bluetooth v1.2 module with SPP profiles. The module is intended to be integrated into another HOST system which requires Bluetooth functions. The HOST system could send commands to AUBTM-22 through a UART. AUBTM-22 will parse the commands and execute proper functions, e.g. set the maximum transmit power, change the name of the module. And next the module can transmit the data receive from the UART with SPP profiles

6.Wi-Fi



VSD03 is the new third-generation embedded UART WI FI modules studied by VSDTECH. UART-WI FI is an embedded module based on the UART serial, according with the Wi-Fi wireless WLAN standards, it accords with IEEE802.11 protocol stack and TCP / IP protocol stack and it enables the data conversion between the user serial and the wireless network module. through the Uart-Wifi module, the traditional serial devices can easily access to the wireless network.VSD03 does a comprehensive hardware and software upgrades based on the products of the first two generations ,now it's more functional and more Convenient to use.

RESULT



Hence the vital signs of chronic patients has collected and values are displayed in LCD Display, we are sending data to Health monitoring control through blue tooth and Wi-Fi modules and finally we observe the status of patient whether his condition is normal (or) abnormal .

CONCLUSION

During our almost 4 years long development period both the fixed and portable solutions have been

rigorously tested in the Living Lab environment. Beside patient monitoring we had to monitor remotely not only the patient's status, but also some mobile hardware and software specific parameters (such as: battery level of sensors), and we had also to redesigned the whole user interface of the handheld device to support elderly persons with low IT skills. According to the received result both our PC and Android based DAQ solutions are capable to provide seamless remote monitoring of elderly persons not only at home, but with Mobile Hub also abroad. The developed solutions provide important feedbacks about health status to the patient and to the medical experts.

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