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Design and Development of Non-Invasive Kiosk for Self-Care Health Management

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Abstract

Health kiosks are interactive device designed for self-service check-in and collection of patient's health report. Kiosk interacts through touchscreen that does not require any expertise to navigate. It is a tool for providing patients health condition and monitors them between doctor visits. The independent, unassisted collection of information is clinically useful with a patient identifier. The health kiosk shall monitor and measures different physiological parameters of the body such as blood pressure, heart-rate, body-temperature and blood sugar level will be continuously transmitted through wireless technology. All the parameters are monitored using PC via WSN protocol and also updated in server (IoT). The patient can therefore approach with the results about his/her physiological parameters to the doctors and also with a suggestive prescription for necessary discussion. Welcoming this application for the improvement of advanced check-up procedure comforts the limitation to make use of regular device for experimenting telemedicine.

Keywords: Non-invasive method; health monitoring; IoT; Bio-medical; WSN protocol.

I. INTRODUCTION

To measure the physical parameters of Human using sensors that will not affect the body health kiosks is introduced. Touch screen with voice that navigates patients to record their own parameters without any hesitation is far better than wasting precious time by waiting for doctors. Health kiosk measures four physical parameters such as Blood Pressure (BP), Heart rate, Body Temperature and Blood Glucose. These parameters are recorded and stored in cloud. Wherever patients need their results which are updated on the server they can collect their reports [4]. As the technology changes the lifestyle also changes, people are more concern about health conditions and taking proper diet in spite of their hectic life. This helps the patient to have an eye on their health too.

The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies can be overcome [6]. These health kiosks can be used anywhere there are no limits of where these kiosks can be located. They can be placed anywhere from large hospital environments to smaller individual physician's home.It is a medical procedure of not involving the introduction of instruments into the body. This method will not harm the patient nor take blood samples to test. To prevent spreading of infectious disease, non-invasive method is the best.

II. BLOCK DIAGRAM

Here bio medical monitoring systems of patient's health are studied. By this device the user can able to monitor their electrical activity of pressure, glucose level, body temperature and heart beat will be continuously transmitted through wireless technology. The Figure 1 shown below is the block diagram of the proposed system.

Block diagram comprises of various sensors and microcontroller. The hardware block of the proposed system is operated using ATMEL microcontroller. There are 4 different inputs entering the system, each are from four various sensors. A constant 5V power supply initiates the process. Since AT89S52 supports only digital inputs, an external ADC0809 is used for Blood pressure sensor and Blood glucose sensor, which converts the analog input before entering the microcontroller. A LCD 16x2 is used to display the output values. The conversion time for the signal to be converted from analog to digital is 100 microseconds. The output depends on the user. The minimum value that the ADC can read is 19.2mV variation which is one step cycle. The baud rate of AT89S52 is 9600bps for serial communication.

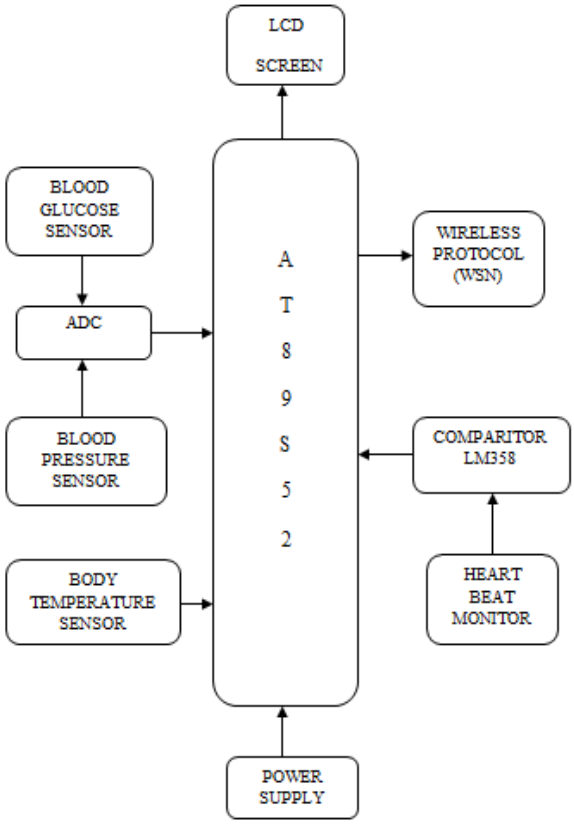

Figure 1: Block diagram

III. HEALTH PARAMETERS

The following health parameters are measured using different sensors which can be used in any location [10].

a) Blood Pressure

Blood pressure should be normal for all ages and genders. It is a silent killer which cannot be identified easily unless it is measured. Blood pressure is due to hypertension or mentally stressed or depression. They are measured by high and low values. Some of the other symptoms of blood pressure are headache, dizziness, blurred vision, nausea and vomiting, chest pain and shortness of breath. It should range below 120 and 80 for normal conditions. Measurement Between 120-139 or between 80-89 will fall under hypertension category. Measurementbetween140-159 or between 90-99 will fall under stage 1 hypertension. Measurement between 160 or higher or 100 or higher will fall under stage 2 hypertension. Measuring process of blood pressures is as follows. The pressure cuff is placed on the upper arm barely on the body above the elbow bend for the patient. Put the cuff so tightly around the

patient's arm. Then close the pressure control valve and start squeezing the bulb rapidly until the gauge reads 30 points. Release the valve slowly and let out the air, then stop squeezing. The value of the blood pressure will be displayed on the LCD screen. Figure 2 shows the blood pressure measurement.

Figure 2: Blood pressure measurement

b) Body Temperature

Temperature measurements are necessary in many fields of such as industry, science, medical care and other basic human needs. Many processes in industry are temperature controlled or strongly affected by temperature. Therefore, accurate temperature measurements are required to carry them out properly. Mostly Mercury thermometers are used for measuring the temperature of the human body orally, in the rectal oraxilla. However, in spite of the fact that such measurements are in themselves accurate, they often poorly reflect the inner temperature of the human body, since there is a substantial difference between said temperature and that of the sensed area [9]. Oral and rectal measurements are inconvenient for the patient, and in some cases it may even cause pain. Another drawback of the mercury thermometer is its fragility. In addition, it should be sterilized after each use. So non-invasive methods estimation is the best, even under intense of physical activity. Body temperature can change at any time of the day. It can measure normal, high or low readings. Human body temperature will be measured in Fahrenheit or Celsius. Temperature may be abnormal due to fever i.e. high temperature or hypothermia i.e. low temperature. Temperature above 38°C indicates fever which is caused by infection or illness. The normal body temperature varies from 36.5°C to 37.5°C. [5] Body temperature can be classified as Hypothermia which measures less than 35.0°C, Normal between 36.5°C to 37.5°C, Fever/Hyperthermia ranges greater than 37.5 or 38.3°C and Hyperpyrexia ranges greater than 40.0 or 41.5°C. Measuring of temperature is shown in Figure 3.

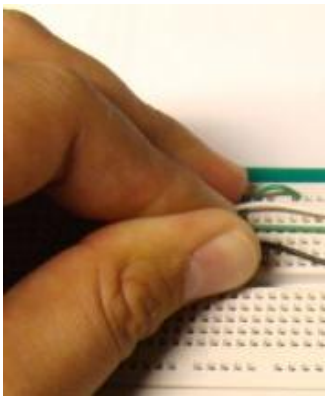

Figure 3: Body temperature measurement

To sense the body temperature LM35 sensor is used which is a precision IC temperature sensor. It measures the output proportional to the temperature in °C which is easy for the user as there is no need for subtracting large constants for calibrating in °Kelvin.The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies, as it draws only 60 μA from its supply. It can be measured using fingertip [3].

c) Heart rate

Heart rate is determined by the speed of the heart beat per minute. The heart rate can vary with each person according to need of the physical body, amount of oxygen or excretion of carbon dioxide. For adults a normal heart beat ranges between 60 to 100 bpm depending upon the person's physical condition and age. For children the heart beat ranges between 70 to 100 bpm. Pulse oximeter sensor is designed to give digital output of heart beat when a finger is placed on it. LED flashes in harmony with each heartbeat indicating its working condition. Beats Per Minute (BPM) of the heartbeat is measured using this digital output. The detector detects the blood flow at each pulse which is shown in light modulation of LED when a finger is placed. The sensor consists of bright red LED and light detector. The LED will pass light through the finger and the detector detects the reflection of light. As the heart pumps, the finger becomes opaque and minimum amount of light will be detected. The signal varies for every single heart beat and this variation will be converted into an electrical pulse [8]. Figure 4 shows the heart rate measurement.

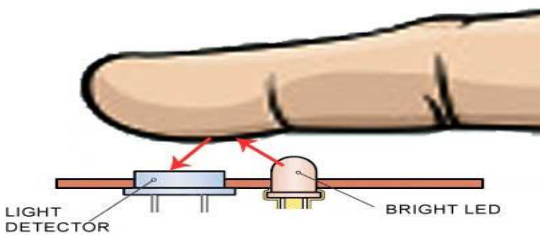

Figure 4: Heart rate measurement

d) Blood glucose

Blood glucose monitors are used to measure the amount of glucose present in blood, especially of patients with symptoms or a history of abnormally high or low blood glucose levels. In the morning glucose level will be low, and one or two hours after meals it will rise by a few millimolars. Sugar level between 0-70 mg/dl indicates low blood sugar referred to as Hypoglycemia. Normal blood sugar level ranges between 70-135 mg/dl. Sugar level between 135-450 mg/dl indicates high blood sugar referred to as Hyperglycemia. Blood level is measured in milligram per decilitre. The sugar level should be monitored very often as it is a deadly disease. Invasive methods are time consuming, causing more pain and there is risk of spreading infectious diseases. Non-invasive method provides results without any pain by the use of sensors [2]. It gives reliable, instantaneous results, cost effective and comfortable for the patients. Taking test at home saves time and gives healthy life for continuous monitoring of glucose levels for patients. Among several optical methods Near Infrared radiation (NIR) gives high accuracy, with greater penetration depths and has high energy. Hence NIR is chosen for Non-invasive glucose measurement.

1) Near infrared measurement of sugar level

The Near infrared region of electromagnetic spectrum in the range of 700nm-2500nm is a spectroscopic method called near infrared spectroscopy. To measure glucose across the finger Near Infrared transmittance spectroscopy is used. A light source and a light detector are placed on either side of the finger inside the clip. The amount of near infrared light passing through the finger depends on the amount of blood glucose in that region of that finger. The working of the Near Infrared is by applying NIR light onto one side of the finger, while the attenuated light is received on the other side. Then this attenuated signal is sampled and processed. LED 1550E is used as the light source. InGaAs is used as a photodiode with a high response around a wavelength of 1550nm is used. The blood glucose level is determined by the NIR light transmittance which depends on the blood amount in that light path. Lower transmittance will be the result of large amount of blood while larger transmittance will be the result of less amount of blood for the same glucose level in both

transmittances. At the measuring time the blood present in the finger determines the amount of glucose at that point. By calculating oxygen levels in the blood, the blood level can be determined. With the help of Pulse Oximetry blood oxygen level is determined [7]. Measuring of blood glucose level is shown in Figure 5

Figure 5: Measuring blood sugar level

IV. RESULT AND FUTURE SCOPE

All the four parameters are measured independently and the results are displayed on the LCD screen. These parameters can be calculated any number of times at the patients residence also. There is no need of waiting and booking appointments to meet the doctors [1]. Non-invasive testing brings the patient close to the technology and helps in recovering quickly. In future, developing the front end using touch screen helps the patient to navigate easily and follow the instructions to use the sensors. By transferring the reports of the patient to the server connecting through cloud, the registered patient can view the results anytime. Their previous results can be reviewed for their verification and follow up their health condition regularly.

V. CONCLUSION

Patient can monitor their electrical activity of pressure, glucose level, body temperature and heart bear will be completely monitored by this system. Computer-based touch-screen health information kiosk is a viable tool for providing health information to patients visiting hospital with reliable health information available. This method of dissemination of health content was found to be relatively cost-effective, useful and appropriate as seen from the study. A consumer wants more convenience and control over their health. Today these health kiosks are further technologically ahead. To reduce input error, healthcare organizations are using health kiosks to make their patients practice more efficiently and effectively. Kiosk data can be sent directly to the patient's electronic health record for the physician or other care provider to access and verify during the office visit. By utilizing a kiosk for taking blood pressure and performing other activities means the physician can spend more time talking with the patient. Patient satisfaction becomes an outgrowth of a well-functioning process. The Health Kiosk helps senior citizens to track their health and

wellness through the monitoring of various functions or in carrying out prescriptive practices and sending the results of compliance electronically to clinicians. Every individual are provided with more immediate feedback regarding their current state of health and are able to save on the costs and inconvenience associated with frequent visits to a doctor, lab, physical therapist, or hospital.

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