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Digital Health Suite

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Abstract: There has been an exponential increase in the costs of health care in the past few years. People have to make frequent visits to their physicians to get their vitals checked. This project specifically deals with the data acquisition. There are several devices that are available in the market today that allow patients to monitor their health on a regular basis. It was a custom to get these body vitals measured by consulting the physician. This method is advantageous for both patients and physicians. Patients can monitor their health regularly in their house at their comfort zone and adjust their diet and physical exercise accordingly to keep their vitals in balance. The main aim is to make a prototype device that acquires and processes the two parameters that is blood pressure and body temperature. This data is sent through Bluetooth to the mobile application and display the same.

Keywords: Blood pressure, Temperature, Non Invasive, Raspberry Pi, Bluetooth Modulation.

I. INTRODUCTION

It was a custom to get the vital signs measured during a visit to the doctor. With advances in medicine and technology, this concept has adapted. There are many devices available in the market today that allow patients to monitor their own health on a regular basis from the comfort of their home. These devices are having a huge impact on health care costs as they are reducing the time and resources of medical physicians and facilities required by patients. This is advantageous for both patients and physicians. Patients can monitor their health regularly and adjust their diet and physical exercise as needed to keep their vitals in balance. There are very few in-home monitoring devices in the market that are accurate, easy, and safe to use, while being of low cost to the customer. The objective of this project is to develop such a device.

II. THEORY AND FUNDAMENTALS

2.1 Blood Pressure

Blood pressure is pressure applied by blood flowing on the walls of arteries. "Blood pressure" ordinarily intends to the blood vessel pressure in the systemic circulation. It is generally measured at a man's upper arm. Blood pressure is normally read as far as the systolic (greatest) SBP pressure over diastolic (least) pressure DBP and is measured in millimeters of mercury (mm Hg) with reference to mercury. It is one of the essential body vital signs alongside respiratory rate, heart rate, spo2, and body temperature. Typical resting blood pressure in a grown-up is around 120/80 mm Hg. Blood pressure that is low from the ordinary level because of an condition is called hypotension, and pressure that is reliably high from the typical value is called hypertension. Both have numerous causes which can extend from gentle to serious.

Types of measurement

Blood pressure is most normally measured by means of a sphygmomanometer which is the conventional strategy, which truly utilized the tallness of a section of mercury to mirror the circling pressure.

i) Noninvasive

The noninvasive auscultator and oscillometric estimations are less difficult and speedier than obtrusive estimations, require less ability, have for all intents and purposes no difficulties, are less disagreeable and less pain full for the patient. Be that as it may, noninvasive techniques may yield to some degree lower exactness and little precise contrasts in numerical results. Noninvasive estimation techniques are all the more ordinarily utilized for routine examinations and checking.

a) Palpation

A base systolic worth can be generally assessed by palpation, regularly utilized as a part of crisis circumstances, however ought to be utilized with caution. It has been evaluated that, utilizing half percentiles, carotid, femoral and outspread heartbeats are available in patients with a systolic blood pressure > 70 mm Hg, carotid and femoral heartbeats alone in patients with systolic blood pressure of > 50 mm Hg, and just a carotid heartbeat in patients with a systolic pulse of > 40 mm Hg.
A more exact estimation of systolic blood pressure can be acquired with a sphygmomanometer and palpating the outspread pulse. The diastolic blood pressure can't be assessed by this strategy. The American Heart Affiliation prescribes that palpation be utilized to get an evaluation before utilizing the auscultator strategy.

b) Auscultator

The auscultator strategy (from the Latin word for "tuning in") requires a stethoscope and a sphygmomanometer. This involves an inflatable (Riva-Rocci) sleeve put around the upper arm at generally the same vertical height as the heart, joined to a mercury or aneroid manometer. The mercury manometer, considered the highest quality level,

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measures the height of a section of mercury, giving a flat out result without requirement for adjustment and, subsequently, not subject to the blunders and float of alignment which influence different techniques.[7]

2) Invasive

Blood pressure (BP) is most precisely measured invasively through a blood vessel line. Invasive blood pressure estimation with intravascular cannulae includes direct estimation of blood pressure by putting a cannula needle in a artery (normally outspread, femoral, dorsalis pedis or brachial).

The cannula must be associated with a clean, liquid filled framework, which is associated with an electronic pressure transducer. The benefit of this technique is that pressure is always observed beat-by-beat, and a waveform (a diagram of weight against time) can be shown. This invasive method is consistently utilized in human and veterinary intensive care medication, anesthesiology, and for examination purposes.

Cannulation for invasive vascular pressure checking is rarely connected with complications, for example, thrombosis, contamination, and dying. Patients with invasive blood vessel observing require close supervision, as there is a threat of bleeding if the line gets disengaged. It is generally for the patients where rapid variations in blood pressure are expected.

Invasive vascular pressure tests are pressure checking techniques intended to procure pressure data for showcase and processing. There is an variety of intrusive vascular pressure monitors for injury. [7]

2.2 Temperature:

The typical body temperature is a narrow temperature band which indicates ideal health and thermoregulation of a person and it changes depending upon gender, recent activity, health, food, the area in the body at which measurement is made and also depending on the time when measured. Typical body temperature varies from 96 degrees F to 99 degrees F for a healthy adult. The body temperature of a healthy person varies during the day by around 0.5 °C (0.9 °F) with lower temperatures in the morning and higher temperatures in the late evening and night, as the body's needs and activities change. Temperature sensing is possible either through direct contact with the heating source, or remotely. There are wide range of temperature sensors available in the market today which includes Thermocouples, Resistance Temperature Detectors (RTDs), Thermostats, Infrared sensors, and Semiconductor(IC) Sensors.

III.PROCEDURE

Raspberry Pi is a series of credit card sized Linux computer fabricated and designed in the United Kingdom by the Raspberry Pi establishment with the goal of showing fundamental computer learning to students and each other individual inspired by PC equipment, programming. The Raspberry Pi 3 has a Broadcom BCM2837 system on a chip (SoC), which replaced the Raspberry Pi 2 Model B in February 2016.The upgrades in the 3rd generation model are:

A 1.2GHz 64-bit quad-core ARMv8 CPU.The Raspberry pi 3 looks identical to the previous Pi 2 models with similar features like 1GB RAM,4 USB ports,40 GPIO pins, full HDMI port, Ethernet port, combined 3.5mm audio jack and composite video, camera interface (CSI), display interface (DSI),micro SD card slot (now push-pull rather than push-push). A system on a chip is an integrated circuit (IC) that coordinates all parts of a computer or other electronic systems into a single chip. It might contain digital, analog, mixed signals, and radio-frequency on a single chip. SoCs are extremely normal in the portable hardware market on account of their low power utilization. An average application is in the area of embedded systems. [2]

Interfacing an SPI ADC (MCP3008) chip to the Raspberry Pi

MCP3008 is an SPI-based analog to digital converter (ADC) is interfaced with Raspberry Pi. This enables the Raspberry Pi to interpret analog voltages that are in turn emitted by analog based sensors to reflect a measure of physical characteristics such as acceleration, light intensity or temperature.

IV.METHODOLOGY

4.1 Methodology for blood pressure

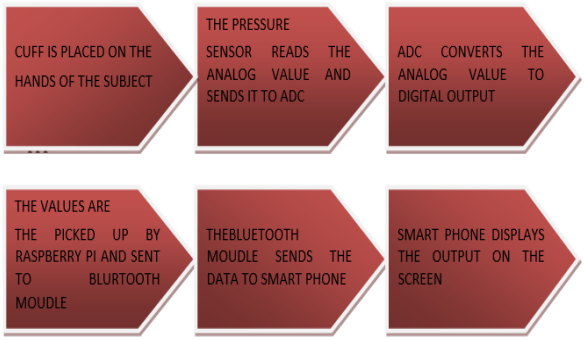

Fig 1 Method of acquiring blood pressure

The MPS-2000 is a silicon pressure sensors in 6-pin double in-line bundles. All parts in this arrangement are uncompensated high performance die mounted on a substrate with a plastic top. Pins are intended for through-board get together. The MPS-2000 is perfect for applications requiring low hysteresis, high quality and stability. With consistent voltage excitation, the MPS-2000 produces a voltage yield that is proportional to input pressure. The MPS-2000 is good with most noncorrosive gasses and dry air.

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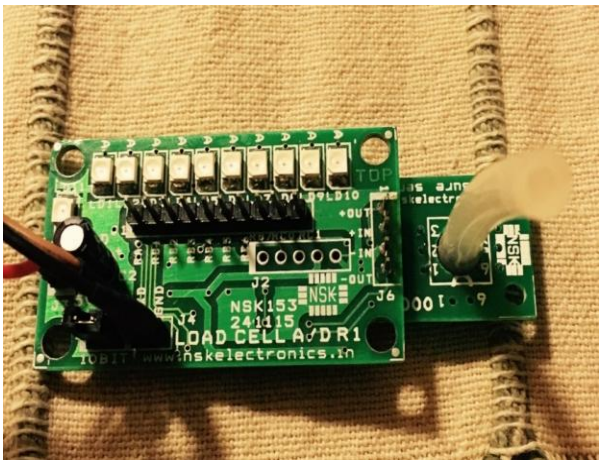

Fig 2 MPS-2000 pressure sensors

4.2 Methodology for temperature sensing

For temperature sensing LM35 temperature sensor is used. The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the temperature in centigrade. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±0.25°C at room temperature and ±0.75°C over a full −40°C to 120°C temperature range.[8]

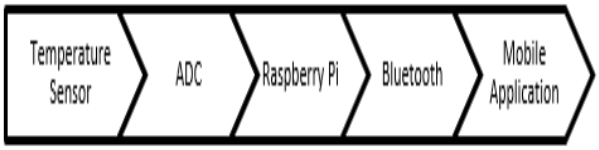

Fig. 3 Methodology

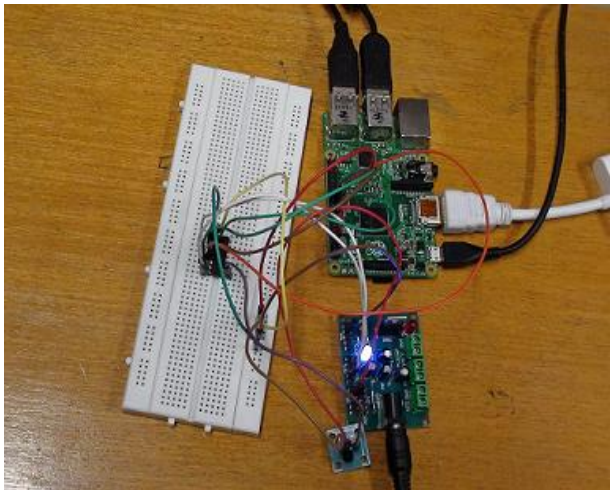

Fig. 4 Circuit connections

The Temperature sensor is placed using a strap on the wrist of the subject who's temperature is being measured and the temperature is sensed and the output of the sensor is in volts this output voltage is sent to ADC where the digital output in the form of temperature is obtained now this is sent to mobile application through Bluetooth.

V. IMPLEMNTAION

The cuff is placed on the subjects upper arm (left arm) generally same vertical height as the heart And temperature sensor is strapped on to the wrist of the subject using a Velcro. The temperature sensor senses the temperature and then the output of the sensor is in terms of the volts, this output voltage is sent to ADC. Similarly, pressure is applied using the pump till the first led glows which indicates the maximum, now the sensor detects the pressure points the systolic and diastolic points are detected using algorithm code the output of the sensor is in terms of voltage which is sent to ADC the logic for detection of SBP and DPB is the maximum pressure is detected. From the maximum when the pressure reduces to 50% is the SBP point and when it reduces to 70% is the DBP point.

The voltage values at this point is sent to adc and the digital values of both temperature and pressure sensor is sent to mobile application through the Bluetooth which is interfaced with raspberry pi.

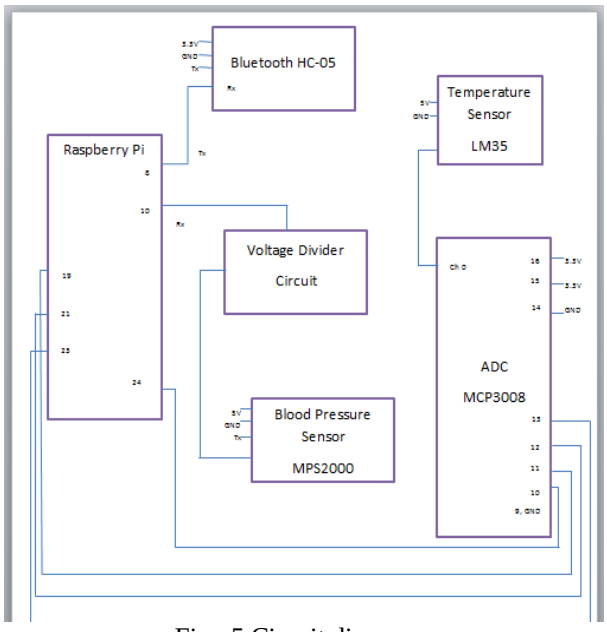

Fig. 5 Circuit diagram

VI. RESULTS

The below figure shows the result obtained from the built prototype, the temperature measured was in the range 93-98 deg F with accuracy of +/- 0.75 / deg C and in the case of blood pressure sensor range acquired was 70/123 with accuracy of +/- 2.5% (as per data sheets).

The test was carried out for people of different age groups and the results obtained are mentioned in the test results. The results acquired were different for different age groups this is due to various reasons like age, posture of the subject and various factors.

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Fig. 6 Result in mobile

VII. SCOPE OF THE PROJECT

This project can be improved and expanded by adding the other body vital signs such as respiratory rate, heart rate, oxygen saturation levels in the blood. Adding these parameters would make this prototype device a complete Digital Health Suite.

VIII. CONCLUSION

The objective of this project was to build a low power affordable nonintrusive and noninvasive prototype device which monitors the body vital signs that is blood pressure and temperature.
A vital sign monitoring system targeted towards which is user friendly so that people can use at their comfort zone and be able to obtain the data in smart phones.

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