A Systematic Design Approach to Monitor Bio-Vitals of Venerable and Specially abled: A Trail for Cost-Effective Clinical Grade Technology

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Abstract - *Vital sign measurements in elderly and specially abled patients take a long time and are prone to inaccuracies. The idea of combining assessing multiple vital measurements will result in a painless and uncomplicated cumulative medical record. This intelligent system can assess vital signs and improve real-time patient monitoring by minimizing measurement time, painful procedures, and incorrect medical record entries. As we live in the digital era, all representations of many disciplines are constantly updated and revised, hence, as an inspiration this electrical model is built. In addition to this initiative, this design focuses on high tolerant real-time clinical-grade measurements for the elderly and specially abled.*

Key Words: clinical grade, real-time analysis, vital analyser, ambulatory medical record, tele-health, advanced diagnosis

1.INTRODUCTION

The purpose of this research is to relieve the difficulties faced by elderly and differently abled individuals. They must exert serious effort and endure several physical problems for each medical examination. As a result, the individual undergoing medical examination will have the most difficulty. This technology will enable them to conduct measurements conveniently and safely. Vital sign parameters serve as the foundation for assessing a person's health. This prototype will provide several vital sign metrics, assisting the clinician in assessing the patient without putting undue emphasis on the patient's position. The measurements were made using a high-tolerance electrical model, which provides additional precision. (Ralph Bloch, 1980) Due to the gadget's usage of simple electrical circuits, this intelligent analyzing equipment is portable and straightforward to operate. Each critical measurement is combined into a single output that can be saved to an external device. This is a relatively inexpensive technology that considerably reduces diagnosis time when compared to standard analyzing instruments. Theoretically, efficiency appears to be relatively high, as it is equipped with various technologies for data collection, including glucose monitoring, MCT (mobile cardiac telemetry), and blood pressure monitoring for vital sign analysis. Sensor placements vary according to the patient's needs. The helpful devices can be positioned according to the clinician's diagnostic requirements. (Gheorghe AV, 1976)

2. TECHNOLOGY AND METHODS

The system features multiple distinct circuit configurations which integrate to form a single digital output. Each circuit operates and functions independently. Four different electrical circuits address glucose measurement, MCT (mobile cardiac telemetry), and pulse and blood pressure.

2.1 Blood Pressure

The oscillometric approach is used to control the blood pressure monitor. This technique makes use of pressure pulsations recorded during measurements. Pulsations increase in frequency until mean arterial pressure (MAP) is attained, at which point they cease to exist. (Md. Muntasir Islam, 2019) (Chu, et al., 2009). The pulsations obtained from the unit are utilized to assess the heartbeat rate. The output from the pressure sensor is sent into the MCU after the signal pre-amplification. The signal is converted into digital data through ADC and the main output is sent to the common output display.

2.2 Pulse Monitoring

The pulse monitor used is a wearable smart device that detects the heartbeat of the wearer. This intelligent gadget incorporates photoplethysmography (PPG) technology and two sensors unilaterally placed near the jugular vein beneath the jaws. It works by irradiating light through the skin with an LED and then measuring heartbeat and body movement changes. (Cao, 2020) (Andrea Tura, 2007) Monitoring heartbeats can be inaccurate depending on the physical body and intensity of the user's activity. It can be reduced when the individual is at stationery for a standard reading. It may be used during physical activity, exercise, rest, and other times to record other readings for comparison.

2.3 Mobile Cardiac Telemetry

MCT devices are compact, portable monitors that immediately transmit data when a cardiac abnormality is identified. MCT is a type of cardiac monitoring that utilizes a simple circuit to monitor a patient's heart activity (Cao, 2020). It monitors the patient's heart rate throughout the day to run errands, exercise, and rest. These are constructed using simple, flexible electrodes to lower the unit's overall weight and accommodate the individual examined or monitored. The storage and communication module are not integrated inside the device, which communicates through mobile to a neighboring station that records, stores, and transmits signals to the caregiver and physician. (Krittanawong, 2020)

This control system monitors heart rate and a simple cardiogram signal which will be transmitted for medical diagnosis. (Cesari, et al., 2017)

2.4 Temperature

Infrared (IR) temperature sensors provide the reliable monitoring of non-contact temperature in medical applications. The most common application for this sort of temperature sensor is to measure the ear, forehead, or skin temperature. Multiple thermocouples on a silicon chip are used to measure an object's infrared energy. The temperature measurement is obtained by preparing this sensor along with the glucose-measuring sensor. It also has two more sensing temperature sensing points for building accuracy. (Huang, et al., 2017)

Block Diagram

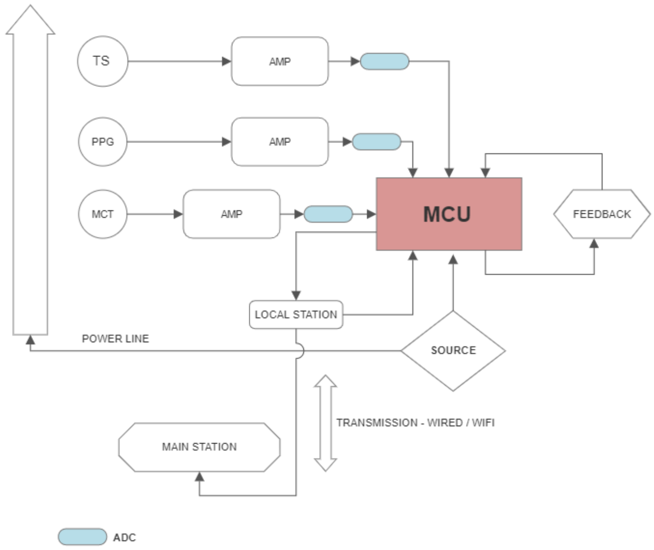

Figure 1 - Integrated Sensing Unit

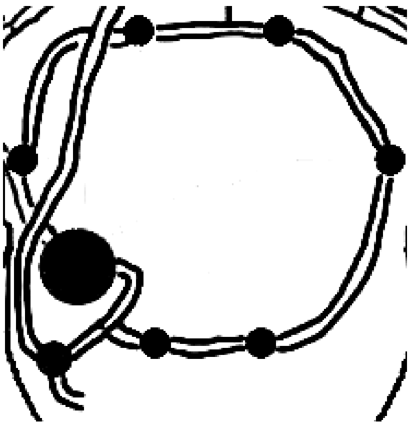

Figure 2 – Rough schematic sketch of sensors placed

3. INFERENCE

The diseases relating to cardiovascular systems and diabetes has been a considerable threat. Many nations are being affected by these diseases. On average, people aged 50 and above has mainly been affected. Noninvasive technology has been recently in development which serves excellent asset.

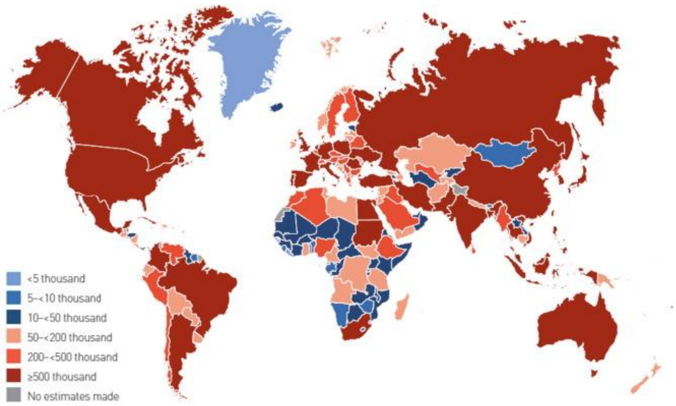

Figure 3 – Diabetes affected world map
Courtesy: Diabetes and global ageing among 65–99-year-old adults: Findings from the International Diabetes Federation Diabetes Atlas, 9th edition

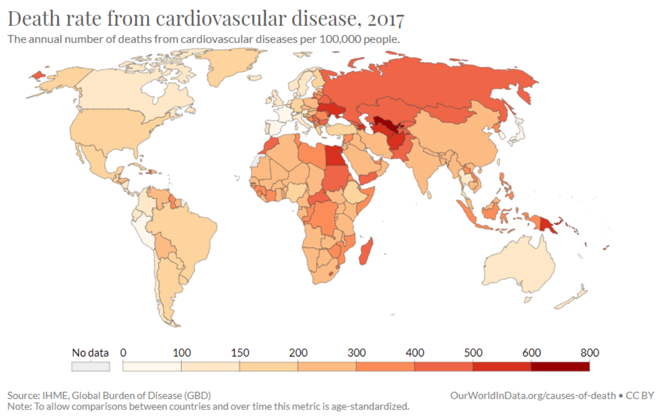

Figure 4 – Death rate – cardiovascular diseases
Courtesy: Our world in data | IHME, Global burden of diseases

Noninvasive technology remains the best asset for these disorders' diagnoses. The ambulatory measure gives near to precise measurements. The adaption of this technology in the design will provide the lesser difficulties for tests and give out results faster. It will reduce pain for the diagnosis, and it will help the individuals to be less strained. More data from national and regional sources is needed to better understand the prevalence of diabetes and cardiovascular diseases in older people. However, the current evidence indicates that diabetes and cardiovascular disease represent a significant worldwide chronic illness burden in ageing and specially abled societies.

Integrating these two diagnoses measurements and measuring bio vitals will give additional strength and serve the purpose of the device build.

4. OBSERVATION

The data is being saved on hardware and will be transmitted to the cloud for consultation by remote physicians. The full analyses will be displayed in the relevant software, such as LAB view or MATLAB, or they can be performed in a self-contained application that can be constructed or collaborated on. This ideology is primarily concerned with minimizing and optimizing the comfort and precision of the data produced.

Advantages

- Easy to interpret, operate and access.
- Can be constructed low-cost material.
- It can be built as free-standing device, or it can be collaborated with any existing objects for the specially abled.
- Portable
- Maintenance is easy and problems can be easily identified as it has individual check test circuits.

As people age, most senior persons have age-related illnesses. Wearable and non-invasive sensor advancements enable routine, comfortable, and continuous monitoring of vital human signs. These sensors can be worn on or near the body and can monitor a range of vital signs. This device is helpful in various ways, including long and short-term diagnosis, 24-hour ambulatory reading, casual critical sign analysis, ICU, and limited usage for particular and unique demands. The concept of merging the vital signs aids in reducing diagnosis time, ensuring accurate readings, and avoiding medical errors. (Carson E.R., 1985)

5. EFFECTS

The confidence in vital signs analysis is critical to rely on the data's correctness, which begins with the patient monitor. The reliability of the medical equipment is taken extremely seriously in this research, and extensive field testing of this revolutionary technology is planned at some of the world's busiest, most prestigious medical institutes before it is made available to the public. This product research aims to reach many people with low cost who suffer from significant disorders and diseases. The system produces an efficient output irrespective of time. This research gave an illustration of how fabrics could be integrated with medical diagnostic procedures. All the materials, which are well-equipped with these biosystems integrated, will provide specially-abled and older adults with a safe and healthy environment in which to live. As a result, the medical industry will be updated to accommodate these people with special needs and the elderly.

6. CONCLUSIONS

As we live in a digital world, everything and everyone is constantly being updated. As a result, for people with disabilities, this research can be a step toward keeping their health measures and diagnostic procedures up to date, this aids in reducing the time required for laboratory tests and the reduction of costs. This prototype can be portable, easy to handle, and transportable; this product can be taken anywhere and used at any time. The device can be highly beneficial in the medical industry because it can perform its tasks better and more efficiently with multiple diagnoses. However, detailed analysis will necessitate additional time investment; however, this research will continue to enhance its features for developing this prototype into a helpful medical device.

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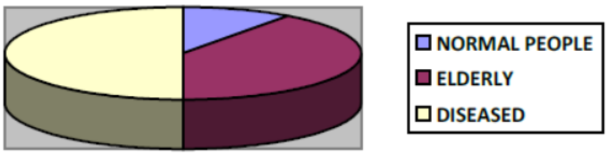
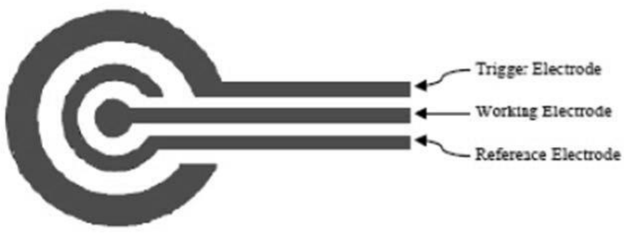
Appendix

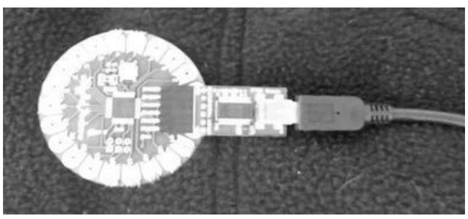
- The use of the device is mostly for the older adults, specially abled and for diseased. The chart illustrated below shows the usage for the device to be made:



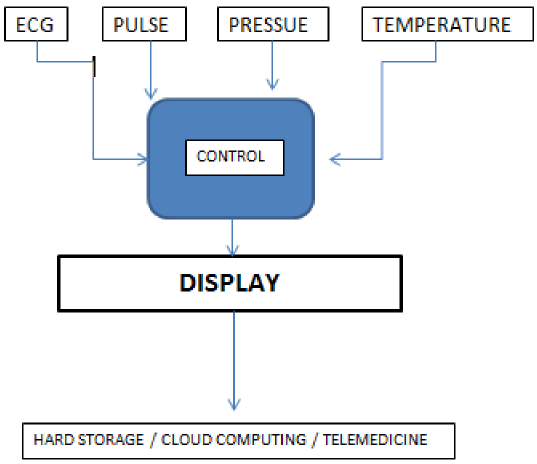
- **Glucose sensor**



- **Temperature sensor**



- **Control Flow Chart**



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