A Survey Of Electronic Heartbeat, Electronics Body Temperature And Blood Pressure Monitoring System

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***Abstract*— Over the years people have been monitoring some vital signs in human's health. Notably, in the physiological study of mankind, various methods and techniques are being used to track the heartbeat, body temperature, respiratory rate and arterial blood pressure. This quest was to ensure that humanity is in good condition at all time. Since health is wealth, the human's health becomes a crucial and vital to every medical professionals and scientists as well. Up till today, it is still in progress, and more ways of solving human's health problems keep on unfolding on daily bases. This work takes a critical survey of human health monitoring system, with focus on heart beat, body temperature and blood pressure monitoring devices and systems, how they evolved over the years, and what the human health monitoring system of today are capable of. It also noted some research gaps and sets some agenda for further research work. The ideas presented in this paper will open up more areas for further studies. It will enable researchers to further advance the methods and tools used in monitoring the identified vital signs in human health.**

***Keywords*— Health Monitoring System , Health Vital Sign, Heartbeat, Body Temperature, Respiratory Rate , Arterial Blood Pressure, Internet of Things**

I INTRODUCTION

Heart beat measurement, body temperature measurement and blood pressure measurement are essential indicators for human's health awareness. Heart beat can be measured in a variety of ways, such as an electric wrist, ECG devices and finger placement on the forearm. Body temperature can also be measured in a variety of ways such as oral, axillary, rectal, tympanic, or temporal. Also measuring blood pressure involve the use of sphygmomanometer. The three parameters mentioned are among the key vital signs in human's health monitor. This paper presents historical background and evolution of electronics heartbeat, body temperature and blood pressure monitoring system.

II HISTORICAL BACKGROUND AND EVOLUTION OF HEART BEAT MONITORING SYSTEM

The history of heartbeat monitoring system is a combination of progress in both bio-medical technique and obstetric. The technical developments ranges from the first generation which was the first obstetric stethoscope by a French doctor named Rene Theophile Hyacinthe Laennec (1781-1918) at the Necker-Enfants Malades Hospital in Paris in 1816 [1]. The second generation was the cardiotography by Willem Einthoven while the modern computer operated cardiotography evaluation system of today is the third generation of obstetric monitoring equipment or device.

A. FIRST GENERATION HEARTBEAT MONITORING SYSTEM

Since mankind first began to study human physiology, and the physical characteristics associated with various ailments, it has been obvious that the heart plays a crucial role in our body system. The sounding of the organs such as lungs can be very crucial indicators when examining a patient. The action of listening to these sounds called auscultation has been affined using even more powerful tools to aid physicians or medical personnel in this crucial examination. In the early 1800's and priorism to the development of the Stethoscope, physicians would often perform physical examinations using techniques such as percussion and immediate auscultation. In immediate auscultation , the physicians place their ear directly on the patient chest to observe internal sound. This technique suffered a lot of drawbacks, because of a physical contact between the patient and the physicians as well as proper positioning of ear.

In addition to this, the sounds observed by physician were not amplified in any way, this create the possibility of missing some key sound that might indicate potential illness. This act of performing immediate auscultation could be awkward for both the physicians and patient.

In order get rid of this limitations that are associated with immediate auscultation, a French doctor named Rene Theophile Hyacinthe Laennec (1781-1826) at the Necker-Enfants Malades Hospital in Paris , invented the first Stethoscope in 1816.This discovery later lead to the development of the first device specially for this purpose [2].The invention of this device also made it possible to listen more accurately to the heart beat.

B. THE SECOND GENERATION OF HEART BEAT MONITORING SYSTEM.

Although the invention of Rene Laennec made it possible to listen more accurately to heartbeat, however, it was not possible to create an accurate picture of the changes that occurs within the heart or to monitor the heart beat during exercise. Consequently, at the start of the 20th century, the Dutch physiologist Willem Einthoven developed the first Electrocardiograph (ECG). This invention won him a Nobel peace prize in physiology in 1924. With an Electrocardiograph (ECG), it is possible to make a graphic recording of the electric activity, which is present in the heart. The Electrocardiograph is composed of three sections which are, a p –wave, a QRS- wave and a T- wave [3]. These waves represent the depolarization of the atria, depolarization of the ventricles and repolarization of ventricle respectively. Soon after the invention of the ECG, the Holter Monitor was developed in 1962. The Holter monitor is a portable Electrocardiograph (ECG) capable of making a continuous tape recording of an individual's ECG for 24 hours [3].

C. THE THIRD GENERATION OF ELECTRONICS HEART BEAT MONITORING SYSTEM.

The relatively large control box and the wires necessary to record the changes in the electric field created by the heart make the Holter monitor unsuitable for recording heart beat during exercise as well. This triggered the first wireless heart beat monitor development system in 1980's. The device consists of transmitter and receiver. The transmitter could be attached to the chest using either disposable electrode or an elastic electrode belt. The receiver was a watch-like monitor worn on the wrist [3].
The development of this relatively small wireless monitor resulted in an increased Utilization of Heart beat monitor by patient and athlete as well. It is worth to say that since the inception of heart beat monitoring system, there is a series of development in technology on a daily basis. The various research works showing chronological development of heart beat monitoring system are presented in table 1.0

Table 1.0

: The table below show the chronological development of heart beat monitoring system.

Scientists/manufacturers name	Year of invention	Description/ discovering
1. Sir John Floyer	1707	He was the first to give the
		scientific report on pulse rate [4]
		.
2. Theophile Hyacinthe	1816	
Laennc		He invented the first stethoscope
		[1]
	1851	
3. Author Leared		He improved on the stethoscope
		by making the device bi-aural [2]
	1852	
		He refined the invention of
4. George Cammann		Authur and commercialized it [2]
	1903	He developed the first
		electrocardiography(ECG) [3]
5. William Einthoven		
	1952	
		They invented cardiotachoscope
6. Himmelstein and		[5]
Scheiner		
	1954	
		Cambridge instrument company
		developed Cambridge operating
7. Cambridge instrument	1957	room cardioscope [6]
company		
		He invented Defib Monitor with
		non-invasive spacemaker [7]
8. Paul M Zoll	1962	
		He invented portable heart beat
	1972	monitor called holter monitor [8]
		He made CS-625 Memory
9. Norman Jefferis	1977	monitor [8]
	1978	The company invented the first

10.	**Burdick Electrodyne**		**wireless EKG or ECG [9]**
11.	**Polar Electro**	**1982**	**The company introduce the first retail product of wearable heart rate monitor [9]**
12.	**Polar Electro**		**The company introduce of chest belt [9]**
		1984	
13.	**Polar Electro**		
		2006	**Introduction of polar sport Tester [9]**
		2008	**Introduction of GPS Tracking [9]**
14.	**Polar Electro**		
		2010	**Introduction of performance and fitness wearable [9]**
15.	**Polar Electro**		
		2017	**Polar Electro introduce Germin wearable technology [9]**
16.	**Polar Electro**		
		2018	**Polar Electro introduce polar H10 heart rate monitor [9]**
17.	**Polar Electro**		
		2019	**Polar Electro introduce polar vantage m watch [9]**
18.	**Polar Electro**		**Polar Electro introduce polar OH1 heart rate monitor [9]**
19.	**Polar Electro**		
20.	**Polar Electro**		

III HISTORICAL BSCKGROUND OF ELECTRIC BODY

Out of the several equipment or instrument that is viewed as important tools to the clinical examination, none has had such versatile application as the clinical thermometer. In the early time of Hippocrates, the hand was only used to probing the cold or heat of the human body, even though fever and chills were identified as sign of pathological processes. In the time of Alexandrine medicine, the pulse was noticed as a sign of disease, replacing the raw assessment of temperature. However, four moods were assigned in the Middle Ages, this mood were qualities of hot, moist, dry and cold.

In 1592 Galileo designed a crude temperature measuring equipment that used water, but it had no measuring scale and no numerical reading was taken. The instrument were also been affected by the atmospheric pressure. A step forward was accomplished by the Italian physician Santoro Santoro. He was the first known individual to have put a measurable scale on the thermo-scope and wrote it in 1625, nevertheless he possibly invented one as early as 1612. Santoro models were impractical, bulky and took a fair amount of time to record accurate oral reading of the patient's temperature [10].

The two individuals which switched from water to alcohol thermometer were:

- Ferdinando II de' medici (1610 – 1670), a Grand Duke of Tuscany. He invented an enclosed thermometer that used alcohol in1684 [10]
- Daniel G. Fahrenheit (1686 – 1736), a Dutch Physicist, a glass blower and an engineer. He first made a vital contribution to thermometers and later made an alcohol thermometer in 1709. He further innovated the mercury thermometer in 1714. Daniel Gabriel Fahrenheit also found that mercury responded more swiftly to temperature changes than the formerly used water. He further designed the temperature scale which is named after him today, having recorded the system in 1724.

The scale is still in existence and is mainly use for everyday applications in U.S territories and its associated states which are all served by the United States National weather service (NWS) as well as the Bahamas, Cayman islands and Belize [11]. In 1665, a fore-standing Dutch Physicist, astronomer and mathematician named Christian Huygen made a clinical thermometer. He also added an early form centigrade scale to it by setting the scale to the freezing and boiling point of water [10]. In 1742, Andres Celsius a Swedish astronomer created the Celsius temperature scale that was the reversed of the modern scale. The temperature read: 0℃to boiling and 100 ℃ for freezing. However, the scale was earlier reversed by Carlous Linneus (1707 – 1778) who was the Swedish banist in 1744 [12]. A permanent secretary of Academic des sciences, bells – letter et art Lyon Jean Pierre Christin, a Lyonnais physicist, developed a similar scale in which 0 ℃ represent the freezing point while 100 ℃ represents boiling point of water. Jeanpierre also published the model of a mercury thermometer called the "Thermometer of Lyon". This thermometer was built by pierre casati craftman and it was used on May 1743 [13].

Hermann Boerhaave (1668 -1738) and his students Gerard Van Swieten (1700 -72) and Antonde Haen (1704 -76) as well as George Martine (1700 -1741) employed the medical thermometer built by Pierre De Haen also made a giant stride in medicine with thermometer by trying to figure out the correlation in the physical symptoms of the illness and patients changes in body temperature. In his conclusion, he stated that the patients temperature recorded could be used by the doctor or medical personnel to deduce the patients' health condition. However, his submission were not been accepted by his peers and the medical thermometer remained a barely used instrument in medicine [10]. Due to the nature and the position of some medical personnel, thermometer remained cumbrous in usage. However, Thomas Clifford Albutt(1836-1925) designed a medical thermometer that was much more portable, measuring only six inches and taking only five minutes to record of a patient's body temperature against what was applicable in the middle of 19th century where medical thermometer was about 30.28cm long and took no longer than twenty minutes to take an accurate temperature reading [11].

In 1868, Carl Reinhold August Wunderlich, a medical professor, a German physician and pioneer psychiatrist published his research studies on human body temperature. In his studies, he took over one million readings from twenty-five thousand patient's temperature in their underarm. With his findings, he concludes that human body temperatures fell within the range of 36.3 to 37.5^{0}c (97.34 to 99.5^{0}F) [11]. The ear thermometer was also invented in 1964 by Theodar H. Benzinger (1905-1999) [11]. Table 2.0 shows the various research works of chronological development of temperature monitoring system.

Table 2.0: Chronological development of temperature monitoring system

Scientists/manufacturers names	Year of invention	Description/discovering
1. Galileo Galilei	1592	He discovered water thermoscope thermometer without a scale [10] .
2. Santorio Santorio (1561-1636)	1625	He invented mouth thermometer and first to put measurable scale on water thermoscope thermometer [10]
	1654	
3. Ferdinando II de Medici (1610-1670)		He invented an enclosed thermometer that used alcohol [11]
	1665	
4. Christiaan Huygens		
	1709/1714	He made clinical thermometer and added centigrade scale on it [10]
5. Daniel Gabriel Fahrenheit (1686- 1736)	1731	He first invented alcohol thermometer and later innovated the mercury thermometer [11]
6. Rene Antonione Reamur(1683-1757)		
	1742	He proposed a thermometer scale on which the freezing point of water was 0 degrees and the boiling point of 80 degrees [11]
7. Andres Celsius (1701-1744)	1743	He reintroduces a centigrade scale called it Celsius temperature scale [12]
	1744	
8. Jean- Pierre Cristin (1683-1755)		He published the design of mercury thermometer [11]
9. Carolus Linnaeus (1707-1778)	1848	He reverses the modern scale from 0 to boiling and 100 to freezing [11]
	1866-1867	
10. Lord Kelvin		

		He invented the Kelvin scale [14]
11. **Sir Thomas Clifford Allbutt**	**1868**	**He designed a practical medical thermometer that was much more portable, measuring only six inches long and taking only five minutes to record a patient's temperature [11]**
12. **Carl Wunderlich**	**1964**	
	1970	**He gave the human's health temperature within the range of 36.3 to 37.5 degree Celsius (97.34 to 99.5 degree Fahrenheit [11]**
13. **Dr. Theodor H.Benzinger**	**1972**	**He invented the ear thermometer [11]**
14. **Billy martin and co**	**1980**	**They invented the digital prob thermometer [15]**
15. **Bob parker**	**1997**	**He invented forehead strip thermometer [16]**
16. **Terumo**	**2003**	**Terumo develop the first electronic thermometer which is safer alternative to mercury thermometer [17]**
17. **Allegro medical**	**2011**	**Allegro medical developed temple touch thermometer [18]**
	2019	**Allegro medical invented infrared scanning thermometer [18]**
18. **----------**	**2019**	**Pcmag developed Infrared gun thermometer [19]**
19. **PCMAG**		
20. **La cross Technology**		**La crosse Technology made indoor and outdoor thermometer with full colour screen [20]**
21. **Iproven medical**		**Iproven medical developed iproven medical ear thermometer that has forehead infrared sensor [20]**

A. IV CLASSIFICATION OF BODY TEMPERATURE INSTRUMENT (THERMOMETER) ACCORDING TO LOCATION

The body temperature can be obtained in different locations or points in the body which preserve a proper temperature, such locations are oral, rectal, auxiliary tympanic or temporal etc. It is worth nothing that the normal temperature of the body varies marginally with the location. For example, an oral reading of 37^0c may not correspond to rectal and temporal readings of the same value. It is important to note that when temperature is cited the locations must also be specified. If a temperature is quoted without specification, it is usually assumed to be sub-lingual. The differences between the main temperature and measurements at different points, known as clinical bias, is discussed in the article on normal human body temperature [21] measurements of body temperature are subject to both site-dependent clinical bias and variability between the standard deviations of their differences. For example, one study has recorded that the clinical bias of rectal temperature was greater than that of the ear temperature, this was measured by a selection of thermometers under test but variability was less [21].

A. ORAL TEMPERATURE

The oral temperature may only be used by the patient who has the capacity to hold the thermometer firmly under the tongue. In this situation, children normally exclude as well as those people who are unconscious or overcome by coughing, vomiting or weakness. However, it is less problem with fast reacting digital thermometers, but often be an issue in mercury thermometers, which take a long duration to stabilize the reading. When the patient drunk cold or hot liquid beforehand, time must be given for mouth temperature to return to its normal state or value. The typical range of a sub-lingual thermometer use in humans is about 35^0C – 42^0C or 90^0 F-110^0F [22].

B. ARMPIT TEMPERATURE

Armpit or axilla temperature is measured by holding the thermometer firmly under the armpit. One is requiring to hold the thermometer for some minutes to get an accurate measurement. The armpit temperature plus 1 °C is a very good guide to the rectal temperature in patients that is older than one month. The accuracy from the axilla may be inferior to the rectal temperature.

C. RECTAL TEMPERATURE

In rectal thermometer, temperature taking, especially if it is performed by a person other than the patient, should be foster with the use of a water-based personal lubricant. Although rectal temperature seems to be the most accurate, this method may be considered unpleasant, or embarrassing in some countries or cultures, especially when used on patients older than young children; also, if not taken the correct way, rectal temperature taking can be sometime uncomfortable and in some cases painful for the patient. Rectal temperature taking is considered the method of choice for infants [23].

D. EAR TEMPERATURE

The ear thermometer was invented by Benzinger in 1964.At the time, Benzinger was seeking a way to get a reading which is possibly close to the brain's temperature .However, since the hypothalamus at the brain's base regulates the main body temperature. He accomplished this by using the ear canal's ear drum's blood vessels, which are shared with the hypothalamus. Before the invention of ear thermometer, simple temperature readings could only be taken from the mouth, rectum, and underarm. Before now, when doctors wanted to record an accurate brain temperature, electrodes required to be attached to the patient's hypothalamus [12].

The tympanic thermometer has a focus (protected by a one-time hygienic sheath) that contains the infrared probe; the focus is gently placed in the ear canal and a button pressed; the temperature is reading and displayed within a second. These thermometers are usually used at home and in the hospital.

There are factors that make readings of this thermometer to some extent unreliable, for instant, faulty placement in the external ear canal by the operator, and wax blocking the canal. Such error producing factors usually cause readings to be below the standard value, so that a fever can fail to be detected.

E. FOREHEAD TEMPERATURE

Temporal artery thermometers make use of the infrared principle to report temperature, it has becoming increasingly in clinical practice because of their ease of using minimal invasiveness. Due to the variability of technique and environmental considerations, measurements by temporal artery thermometers may have issues of precision, and to a lesser degree accuracy. Temporal thermometers also been found to have a low sensitivity of around 60–70%, but a very high specificity of 97–100% for detecting fever and hypothermia. Because of this, it is suggested that they should not be used in acute care settings like the ICU, or in patients with a high suspicion of temperature imbalance. Evidence supports higher accuracy and precision amongst pediatric patients [24]

V. CLASSIFICATION OF BODY TEMPERATURE DEVICES ACCORDING TO TECHNOLOGY (THERMOMETER)

A. LIQUID-FILLED THERMOMETER

It has been established that, traditional thermometer is a glass tube with a bulb at one end containing a liquid which expands in a uniform manner with temperature. The tube itself is narrow (capillary) and has calibration markings alongside with it. The liquid is often mercury, but alcohol thermometers use a colored alcohol. Medically, a maximum thermometer is often used. The maximum temperature reached even after it is removed from the body. To use the thermometer, the bulb is placed in the location where the temperature is to be measured and left long enough to be certain to reach thermal equilibrium ,typically three minutes. Maximum reading is achieved by means of a constriction in the neck close to the bulb. As the temperature of the bulb rises, the liquid expands up the tube through the constriction. When the temperature falls, the column of liquid breaks at the constriction and cannot return to the bulb, thus remaining stationary in the tube. After reading the value, the thermometer must be reset by repeatedly swinging it sharply to shake the liquid back through the constriction.

B. MERCURY THERMOMETER

Mercury-in-glass thermometers have been considered the most accurate liquid-filled types. However, mercury is a toxic heavy metal, and it has only been used in clinical thermometers when protected from breakage of the tube.
The tube must be narrow to minimize the amount of mercury in it , since the temperature of the tube is not controlled, so it must contain very much less mercury than the bulb to minimize the effect of the temperature of the tube—and this makes the reading rather difficult as the narrow mercury column is not very visible. Visibility is less of a problem with a coloured liquid.
In the 1990s it was decided that mercury-based thermometers were too risky to handle; the vigorous swinging needed to "reset" a mercury maximum thermometer makes it easy to accidentally break it and spill the moderately poisonous mercury. Mercury thermometers have largely been replaced by electronic digital thermometers, or, more rarely, thermometers based on liquids other than mercury (such as galinstan, coloured alcohols and heat-sensitive liquid crystals).

C PHASE-CHANGE (DOT MATRIX) THERMOMETERS

Phase-change thermometers use samples of inert chemicals which melt at progressively higher temperatures from 35.5 °C to 40.5 °C in steps of 0.1 °C. They are mounted as small dots in a matrix on a thin plastic spatula with a protective transparent cover. This is placed under the patient's tongue. After a short time, the spatula is removed and it can be seen which dots have melted and which have not: the temperature is taken as the melting temperature of the last dot to melt. These are cheap disposable devices and avoid the need for sterilizing for re-use [25]

D LIQUID CRYSTAL THERMOMETER

A liquid crystal thermometer contains heat-sensitive (thermochromic) liquid crystals in a plastic strip that change color to indicate different temperatures.
Since compact and inexpensive methods of measuring and displaying temperature became available, electronic thermometers (often called *digital*, because they display numeric values) have been used. Many display readings to great precision (0.1 °C or 0.2 °F, sometimes half that), but this should not be taken as a guarantee of accuracy: specified accuracy must be checked in documentation and maintained by periodical recalibration. A typical inexpensive electronic ear thermometer for home use has a displayed resolution of 0.1 °C, but a stated accuracy within ±0.2 °C (±0.35 °F) when new [25]. The first electronic clinical thermometer, invented in 1954, used a flexible probe that contained a Carboloy thermistor [25].

VI. TYPES OF DIGITAL THERMOMETER

A. bRESISTANCE TEMPERATURE DETECTORS (RTDS)

Resistance temperature detectors are wire windings or other thin film serpentines that exhibit changes in resistance with changes in temperature. Resistance temperature detectors measure temperature using the positive temperature coefficient of electrical resistance of metals. The hotter RTDs become, the higher the value of their electrical resistance. Platinum is the most commonly used material because it is nearly linear over a wide range of temperatures, is very accurate, and has a fast response time. Resistance temperature detectors can also be made of nickel or copper. The advantages of Resistance temperature detectors include their stable output for long periods of time. RTDs are also simple to calibrate and provide very accurate readings. The disadvantages include a smaller overall temperature range, higher initial cost, and a less rugged design

B. THERMOCOUPLES

Thermocouples are very accurate and highly sensitive to a little change in temperature , and quickly respond to changes to the environment. Thermocouple consist of a pair of different metal wires and joined at one end. The metal pair produces a net thermoelectric voltage between their opening and according to the size of the temperature ranges between the ends. The advantages of thermocouples include high accuracy and reliable operation over an extremely wide range of temperatures. Thermocouples are also well suited for making automated measurements both durable and inexpensive. The disadvantages include errors caused when using it over an extended period of time, and that two temperatures are needed to make measurements. Thermocouple materials are abrupt to corrosion, which can affect the thermoelectric voltage

C. THERMISTOR

The thermistor elements are one of the most sensitive temperature sensors available today. It is a semiconductor device with an electrical resistance that is proportional to temperature. The two types of products are, negative temperature coefficient (NTC) devices which are used in temperature sensing and are the most common type of thermistor. Negative temperature coefficients have temperatures that vary inversely with the resistance, such that when the resistance decreases, the temperature increases and vice versa. Negative temperature coefficients have temperatures are constructed from oxides of materials such as copper, iron and nickel. Another type of thermistor product is positive temperature coefficient (PTC). It is devices that are used in electric current control. The function of PTC is in an opposite manner than NTC such that as the temperature increases, resistance increases also increases as well. Positive temperature coefficient is coated from thermally sensitive polycrystalline or silicons ceramic materials. There are a lot of advantages and disadvantages of using a negative temperature coefficient thermistor thermometer. The advantages include high degree of stability and size. Negative temperature coefficients are also long lasting and very accurate. The disadvantages include unsuitability for use in extreme temperatures and non-linearity

D. OTHER PARAMETERS USED TO CLASSIFY ELECTRONICS THERMOMETER

Contact

The electronic thermometers may sometimes work by contact, in order to ease the electronic sensor that is placed in the location where temperature is to be measured, and stayed long while to reach the equilibrium. They always reach the equilibrium faster than mercury thermometers; the thermometer may honk when equilibrium has been attained, or the time may be specified in the manufacturer's record.

Remote

Some electronic thermometers work by remote sensing, an infrared sensor responds to the radiation spectrum emitted from the location. Even though these are not in direct contact with the area being measured, it may be still contact one part of the body. For instance, a thermometer which senses the temperature of the eardrum without touching it is inserted into the ear canal. In such case, to eliminate the risk of patient cross infection, the available probe covers and single-use clinical thermometers of all types are used in hospitals and clinics.

Accuracy

In 2001,the research as shown that, electronic thermometers on the market are significantly underestimated with higher temperatures and overestimated lower temperatures. The researchers conclude that "the current productions of electronics and digital clinical thermometers, may not be sufficiently accurate or reliable to replace the traditional glass/mercury thermometers [25].

VII HISTORICAL BACKGROUND OF BLOOD PRESSURE MONITORING SYSTEM

The history of medical sphygmomanoometry and it evolution has been well recorded in recent years. However, step has been made which buttress various scientist whose contributions and ideas has form part of the success story of blood pressure measurement.
The first scientist to proposed the existence of a circulatory system in human body was Galen of an ancient Greece. Hippocrates however, build on this idea which was developed by Galen because when the arteries stopped bleeding, the death will surely have occurred. Galen also believed that such circulatory system was made up of an interconnected set of arteries that is filled with life giving force called 'pneuma' or air. Galen further maintained that human body system composed of three systems which are the brain and nerves, the heart, and the liver. The brain and nerves are responsible for thought and sensation, the heart is the life giving energy to the body while the liver provided growth and nourishment to the body.
As the research keep progressing, William Harvey in 1616 question the assertion of Galen who proposed that the heart produced blood constantly like a reservoir. Harvey further proposed that the blood has a finite amount which circulated to the body only in one direction. However, Harvey's position was earlier faced with a lot of disbelief and resistance. Off- course, this assertion was as the result of blood been constantly produced in the body and this raised some doubt for a popular medical practitioner at that time because of the benefit of bloodletting, having known as a matter of routine, bloodletting was also employed as a remedy to every symptom of disease that is known to man by then.

A. FIRST BLOOD PRESSURE MEASUREMENT

Reverend Stephen Hales in 1711 happened to be the first scientist to recorded blood pressure measurement. Hales recorded the blood pressure measurement by inserting a glass tube into an artery of a horse which he observed the rise and fall of blood in the glass tube. Hales concluded that the fall and rise of blood is due to fluctuating pressure in the arteries of the horse. However, hales methods was not quite suitable for testing with humans, as it was very intrusive and unfit for medical use. This technique make the horse died every time.

B. HUMAN BLOOD PRESSURE MEASUREMENT

For the first time in the history during a limb amputation, Faivre in 1856 recorded the human blood pressure. Faivre in his measurement employed Carl Ludwig's invented kymograph with catheters that inserted directly into an artery. The Ludwigs's kymograph consisted of a U-shape manometer tube that is connected to a brass pipe canula that is plugged directly into the artery. The ivory of manometer tube float onto a rod with a quill attached to it. The quill was not sketch onto a rotating drum.
However, at this period, blood pressure could only be measured by intrusive means. The research gap was to devised a suitable way to measured blood pressure in non-invasive manner. Has the year gone by, precisely in 1855, Karl Vierordt make an assertion that when there is an enough pressure the arterial pulse could be obliterated. Vierordt in his discovering introduced sphygmograph in line with the principle of obliteration.
Vierordt employed blown up cuff around the arm to narrow the artery. However, Vierordt's equipment was quite huge and unwieldy of 168cm tall that produced a very uneven results [26].

C. THESPHYMOGRAPH

In 1860, a Freench physician Eienne Jules Marey also known as a cinematographer and a father of modern photography developed a further ideas 'sphygmograph'. His sphygmography device could precisely measure a pulse rate even though it was somehow unreliable in determining the blood pressure. However, his design actually was the first to employed clinically which recorded some step of success. It was on this basis that makes Robert Ellis Dudgeon in 1882 to simplified and re-refined the Marey's sphygmograph which was very portable and easier to use.This huge success by Dudgeon's device make U.S Navy to adapt the equipment as a standard equipment [27].

D. THESPHYGMOMANOMETER

The sphygmomanometer is a device that is consisted of a water or mercury filled with rubber ball and joined to a manometer. This wonderful invention was made by Samuel Siegfried Karl Ritter von Basch in 1881. The rubber ball of this device always press against the radial artery until the pulse was obliterated. At this point, blood pressure can be estimated using the manometer and palpation to trace or determine when the arterial pulse disappear. However, von Basch's invention seem not to have the success it deserved because many physicians in his days were skeptical about the new technology. They claimed that the invention was meant to be a replacement for the palpation-based orthodox diagnosis approach. The main problem was that, most doctors interrogated some of the medical usefulness of blood pressure. However, this action did not stop some of them to keep on attempting to produced more reliable device, such as the sphygmometer by Bloch, which was significantly a spring- loaded and a tire- gage that was used in an artery to see how much pressure was relevance to obliterate the pulse.
Potain in 1889, also make a giant strive by improving on all the compressed device and replacing water and mercury with air as well as improving their accuracy. From this time, air sphygmometer became the compression medium of destination [27] .

Scipione Riva- Rocci in 1896 marked another decisive year in blood pressure history through the development of the first mercury sphygmomanometer. His design was tending to be the forerunner of the modern mercury sphygmomanometer. In the mercury sphygmomanometer, an inflatable cuff was placed above the upper arm to narrow the brachial artery. This cuff was attached to a glass manometer which was filled with mercury to measure the pressure exerted on the arm. From all effort put by Riva-Rocci's sphygmomanometer, the device was still spotted out by American neurosurgeon Harvey Cushingwhile he was traveling to Italy. He seen the potential benefit of Riva-Rocci's sphygmomanometer, and went back to U.S with the design in 1901 and redesign and modified to be more adapted for clinical use. With this development the sphygmomanometer became commonplace which marks the year of a new beginning of modern sphygmomanometry. It is important to remember sphygmomanometer which was only used to determine the systolic blood pressure, however, the diastolic pressure was yet to be clearly defined at this time. This lapses give birth to a young Russsian surgeon, known as Nikolia Korotkoff in 1905 who observed the sounds made when narrowing the artery using stethoscope. Korotkoff in his observation found that there were some characteristic sounds at a certain location in the deflation and inflation of cuff. The Korotkoff sounds were assumed to be caused by the passage of blood through the artery which is corresponding to the systolic and diastolic blood pressure. This buttress the present technique to measure systolic and diastolic blood pressure. The simple demarcation in Korotkoff technique was the use of a stethoscope to listen to sounds of blood flowing via the artery. Also, this ausculatory technique was proved tobe more reliable than the previous palpation technique and hence, it became the standard practice [28].

E. MODERN BLOOD PRESSURE

It was threshold in 1974, when Panasonic released the first digital oscillometric device. These sphygmomanometers measure the blood pressure which were imparted onto the cuff by the blood, pushing through the constricted artery over a range of cuff pressures. The data collected were used to estimate the systolic and diastolic blood pressures. Home monitoring of human blood pressure becomes popular in the early 1980's. The chronological development of the blood pressure measurement and monitoring devices/system are given in table 3.0.

Table 3.0: Chronological development of blood pressure

Scientists name	Year of invention	Descriptions/discovering
1. **Galen Pergamon**	**129AD**	**Propose the theory circulatory system [29] .**
	1000AD	**Detect in inaccuracies in Galen's**
2. **Avicenna**		**theory [29].**
	1500	
		Draw a heart with only two
3. **Leonarddo Da vincin**	**1543**	**chambers [29].** **He published that showed that**
4. **Andreas Vesalius**		**heart has four chamber [29].**
	1628	**He published the blood circulation by starting that the heart acts as a pump [27].**
5. **William Harvey**	**1733**	
		He used manometer to measure the blood pressure in the arteries of various animals [27].
6. **Stephen Hale**	**1828**	

		He is the first to measure blood pressure with mercury manometer [27].
	1854	
7. Jean Poiseulle		He invented sphygmograph.The device that estimate blood pressure externally in a non-intrusive way [27].
	1881	
8. Karl von Vierodt		He simplified and refined sphygmograph [28].
	1896	
9. Robert Ellis Dudges	1905	He introduced the first blood pressure monitor called sphygmomanometer [28].
10. Scipione Riva-Rocci	1974	He measure the diastolic blood using his improved version of the sphygmomanometer [28].
	1993	Panasonic released the first digital device [29].
11. Nikolai Korotkov		
	2010	Panasonic released a compact and automatic wrist cuff to measure blood pressure [29].
12. Japanese company (Panasonic)		Withings released smart blood pressure monitor, which can plugged directly into an iphone, ipad or ipod touch [30].
------	2014	
13. French company (Withings)	2019	Wireless blood pressure monitor was launched by Withings [30].
-------		Wifi smart blood pressure monitor lunched [30].

VIII. SYNCHRONIZATION OF THE MONITORING SYSTEM

The positive impact of the health monitoring system cannot be overemphasized. This impart lead to current logical step in patient's health monitoring system, which was to devise a system that allowed medical professionals to monitor all the vital signs such as, respiratory rate, body temperature, blood pressure and heart beat at once, and over an indefinite period of time. With the invention of Himmelstein and Scheiner's " cardiotachoscope" in 1952, and advancement of physiological monitoring system technologies by electronics companies in the early 1960's, it is noted that patient monitoring systems were improving almost on the yearly bases.

While measuring and monitoring a patient vital signs during medical attention has long been performed, it was only with advancement in digital electronics technology that medical scientists were to see vital sign representations on the screens of early patient monitors. One of this monitor was the CS-625 Memory Monitor by Burdick. This featured a small black screen with a single waveform and red numerals displaying the heart beats per minute.

In early 1980s, patient monitoring system evolved to include bedside arrhythmia analysis and larger colour screens that allowed for more waveforms to be displayed at once.

It is of note that the modern heart beat monitoring system make use of electrical and optical methods to record the heart beat signal.

The advancement in technologies that triple in 1990s and early 2000s,were touch screen patient monitor systems was visualized ,which make the device both easier to use and to be transporting data.. This work reveals how technology has improved the efficiency of medical professionals and scientists across the globe.

Also ,It has come to stay that, nurses and doctors or any other medical personnel are now able to monitor and report on patient vital signs effortlessly without difficulty with the portable monitoring systems one can only imagine where patient monitoring systems are destined to venture into because of the great advancement in holographic technology and microchip capabilities of recent years.As life continue, the recent development in modern concept of patient health has oversees wireless device by the internet of things(IoT).This is a big improvement in the field of medicine. Today, doctor can monitor the patient health without physical interact. This has also eliminated the numbers of traffic of patients in the hospital.

IX. THE GENERAL TREND AND DIRECTION FOR FURTHER RESEARCH IN THE MEASUREMENT AND MONITORING OF HEATH VITAL SIGNS

Nowadays, the general trend in the measurement and monitoring of heath vital signs is towards the development of wearable and internet of things-based devices which enable continues monitoring of an individual's vital signs and also real-time communication of the data to requisite database for further actions. In this wise, the health monitoring devices are increasingly becoming part of the big data framework which enable collective and system approach in the analysis of health challenges in an ear or region. For instance, the data collected from individuals in a area can be used along with environmental data collected through internet of this to assess how specific climatic condition can affect the health condition of the people in the given region.

Furthermore, there are some factors that can affect the instantaneous temperature, blood pressure and the heartbeat rate of an individual. For instance, after engaging in some exercises or embarking on some tasks, the blood pressure and heartbeat rate of the individual will be affected. So, taking the blood pressure and heartbeat rate measurement after any of such activities will give values that are different from what they would have been if the readings were taken just immediately after the person wakes up from sleep. Consequently, while the electronic measurement and monitoring devices can capture the instantaneous values for the temperature, blood pressure and the heartbeat rate, there is need to also capture information about other obvious factors that can easily affect the instantaneous values. This will assist in addressing the likelihood of considering some heath vital signs data items as outliers without regard to the possible factors that can lead to such suspicious instantaneous values from the measuring instruments. In essence, further work is required to include some ways to capture the data on the vital signs along with data about some relevant factors that can affect the instantaneous values. Such expanded data collection will require careful study of the key factors to be considered, how to quantify the factors, how to measure or express them for meaningful application in the interpretation of the instantaneous values of the health vital signs data.

X . CONCLUSION

The evolution of the development of heartbeat, body temperature and blood pressure measurement and monitoring system has been outline to identify the research gaps that will require further research works. There has been numerous breakthroughs in the electronic and communication industries which have facilitated the development of portable smart devices, as well as wearable devices with internet communication capabilities. These devices now fit in to the evolving Internet of Thing (IoT) framework which feeds the big data systems whereby , data from divers sources can be analyzed together to assess the correlations and the level of impact of one set of data on another. In this wise, the present day IoT-ready smart and wearable devices for monitoring the heartbeat, body temperature and blood pressure are pointers to a more sophisticated system which does not only the vital signs but also simultaneously reads other factors that can affect the specific vital sign of interest. This forms the research agenda for future works. In particular, identifying the factors that can significantly affect the instantaneous value of each vital sign and how to quantify and measure or record those factors forms the key future research focus. In addition, how to interpret the instantaneous value of each of the vital signs in respect to the data on the additional factors is also another focus in the future research agenda. In all, the future researches tends towards big data analytics that depends on continues data stream from IoT frameworks.

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