# Iot Enabled Health Monitoring Using WBAN Sensors In Non-Invasive Remote Environment

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## Abstract

The WBAN (Wireless Body Area Network) (inside and outside of the human body 1-2meters) is used to develop intelligent health care systems that predict unusual conditions Pre-Hand by sending alerts to caregivers / users who monitor information according to a doctor's prescription by prescribing prescribed medications, with non-invasive sensors (SP02, ECG, Heart-Rate, Temperature and Gluco meter) connected to Arduino. Data from the sensor is digitized and transmitted to a physician using Zigbee data analyst using the Raspberry Pias laptop computer and adapts to health conditions (using regular / unusual switches). Using Bluetooth sensor data is sent simultaneously from sender to user and received via built-in Bluetooth. Module on cell phones and is displayed in the APP. Procedures include hearing data, transferring it to a doctor and receiving data in the APP to which the doctor and patient are connected. Hardware modules focus on size, cost and non-abrasive non-invasive wearable. Python and Embedded C are pre-requisites for the Raspberry Pi system and Arduino boards.

## Keywords

IoT, WBAN Sensors, Arduino UNO, Non-Invasive Remote Environment, Prediction.

## 1. Introduction

Health is a very important factor and exercise and good health make us more susceptible to infections, which helps us to live healthier lives. The development of various technologies has greatly contributed to the growth of health-related Smart Technologies [1] to overcome the modern challenges of visiting a doctor for regular checkups. BAN (Body Area Network) is a special purpose network that is used internally and externally (1-2m) in the human body helping to provide real-time updates by transmitting information to the recipient [2].

WBAN (Wireless Body Area Network) Architecture is divided into three categories such as Intra-BAN, Inter-BAN and bridging Inter and beyond BAN communication. Intra-BAN connects body sensors to a personal network; Inter-BAN connects servers and multiple access points. Outside of the BAN closes the gap by transferring information available on the website and doctors can access it, without previous records in files. In remote monitoring time-saving and early diagnosis is made [3]. With the Android APP (popular mobile OS) user who sends data via Bluetooth, Physician interacts using the Raspberry Pi receiver as an APP interaction and the patient can be notified of any abnormalities or health conditions [4].

A study at Prevention Control recommends exercising or doing aerobic activities to maintain a healthy lifestyle. Figure 1 shows the HealthCare division where you include a real-time Mobile / PC monitor and wearable includes sensors as part of bloodless data collection. The ultimate goal of building a portable, painless and effective device for measuring Glucose is a matter of concern today.
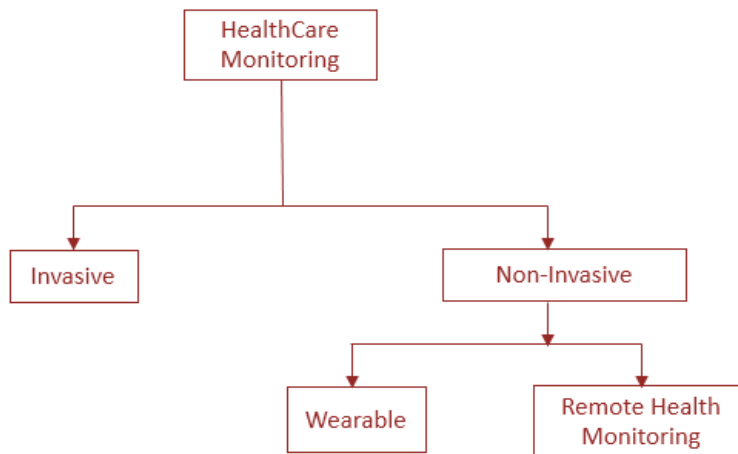


**Fig.1 Classification of HealthCare Monitoring Systems**

## 2. Literature Survey

A summary of various techniques using sensors, computer technology and intelligent information processing is used in BSN which is part of WSN. Non-invasive (i.e.) nerves are used without blood precision and reusable. Rarely recognized at advanced levels for information transfer and business monitoring [5][6]. The sensors communicate and send information in real time and in an emergency - emergency help is needed for health care managers. Models can be analyzed using FFT conversions and drawn with drawings. Wi-Fi, IoT is used as the central node for long-distance communication [7, 8]. Monitoring suffers from intensive care by collecting signals from the node.

NRF24L01 + connects between Arduino boards and displays signals in Lab VIEW. Upon receipt of the data, the user may receive approval. With the use of the HTTP protocol a physician can also view data on his or her computer, each patient having his or her own data pipeline, with a unique id [9]. Focuses on low power consumption, long battery life, power harvester (RF) are used to charge the battery during standby but protection against overload is required [10].

The non-invasive glucose level uses a Near Infra-Red vision system where the selected NIR light absorbs glucose and fat than other body fluids. It is based on the PPG method that determines the amount of sugar in the blood by the intensity of light passing through the skin by getting a reduced light passing through the finger [11][12]. Diabetic blood sugar levels are converted to voltage and signal condition is created to remove noise and improve signal quality. At 940nm the intensity of the IR wavelength is present and glucose absorption is high [13]. Living cells and body fluids shine at a wavelength 700-1100nm. The NIR helps absorb glucose without body fluids, reducing interference [14] .The tissue viewing window is used to determine blood sugar levels. The glucoses molecule $C_6H_{12}O_6$ has bonds of C-O, O-H and C = O. Other infra-red methods Raman Spectroscopy, Photo-Acoustic Spectroscopy, Polarization and Light Scattering include less common techniques [15].

## 3. Methodologies

### 3.1 Invasive Methods in Hospitals

The existing invasive methods in hospitals to measure health limits are difficult to use and make them larger while others require analog values. Electrodes with gel pads (12 lead) use ECG waveforms and the doctor performs analyzes on measurement and rhythm. Adhesive tracts are attached to the body area of the limbs or chest and the other part has cords to connect to the monitor.

To measure oxygenated blood or periphery capillary oxygenated saturated blood adhesive is placed near the patient's nose and the amount of respiration and oxygen can be measured. For example Nasal Alar was approved as a nose ring worn by patients. Heartbeat no machine used.

Place your index and middle fingers in your coronal artery near the neck and count the number of beats for 10 seconds and multiply by 6 to get your heart rate / heart rate up. Temperature measurement is performed with an invasive digital thermometer as it needs to be placed in the mouth or armpit to measure body temperature or temperature and is measured in a centigrade of Fahrenheit. The arithmetic formula is calculated by ($\circ$C × 5/9) +32 = 32$\circ$F.Metal may igle. Normally measuring glucose or blood sugar levels takes extra time to inject into a vein and take a few liters of blood and then report on post-parent blood sugar levels and fasting which may take 1 day to provide updated reports.

### 3.2 Non – Invasive Methods for Monitoring Healthcare

Sensors are also called detectors as a tool that measures the measuring attribute and converts it to a signal read by an observer. Different types of sensors are classified as active (require external power supply such as Photovoltaic cell) and passive (no need for power supply such as radiometer). Sensors should show accuracy, repetition, low cost and should be within measurable limits. With PPG technology, between the Infra-Red LED Transmitter and the Photodiode receiver finger is placed and the receiver absorbs bright light, both operating at 5v. Selection of sensors is very important and should be kept away from moisture, otherwise even a small error can cause an error.

The ECG uses the PPG Technique and is measured by BPM and varies between 60-100.A clip containing IR LED and Photodiode with control. circuit based on LM358. Transmission or light sensor can be used when in the first part the light source and the detector are placed facing each other while at the end they are placed close together. The other ECG includes a 8232 module but has an invasive pad so it is avoided. Heart palpitations are two types of rapid heartbeat that occur when the heart fails, Palpitations. Bradycardia called neutral pacemaker occurs when oxygen-rich blood is transfused into the body. The SP02 sensor provides the level of periphery capillary oxygen saturated in the blood. Concentration and Absorption have a direct relationship. Oxygen in the blood depends on the state of health, the respiratory rate of oxygen.

For example if a person has 98% of SP02 each RBC each has about 98% oxygen-rich blood and 2% oxygen-free blood. For insufficient oxygen is less than 85% and for the average adult 95%. Temperature consists of a sensory element enclosed in a plastic or metal housing and the sensor indicates a change in natural temperatures. In the normal human body it is 98.4$\circ$F and fever status> 98.4$\circ$F.Hib body temperature is controlled by thermoregulation which helps to maintain a normal body temperature.

The LM75 is also designed to work only with Raspberry on the transmitter but we use Arduino on the transmitter so to use it we need ADC and Raspberry which makes it bulky. Heart rate / Heartbeat is used as a plug and plays with audio cancellation and has 3 PINs (Input, Output and ground). The value shown to the receiver is measured in terms of

electricity and using linear regression analysis the mathematical equation can be used to convert the current into electrical energy and by the absorption and wavelength we can set the graph which means if glucose is high energy. It is usually measured in mg / dl. It is also helpful as the fingers are chosen as a test area that makes them easy to access.
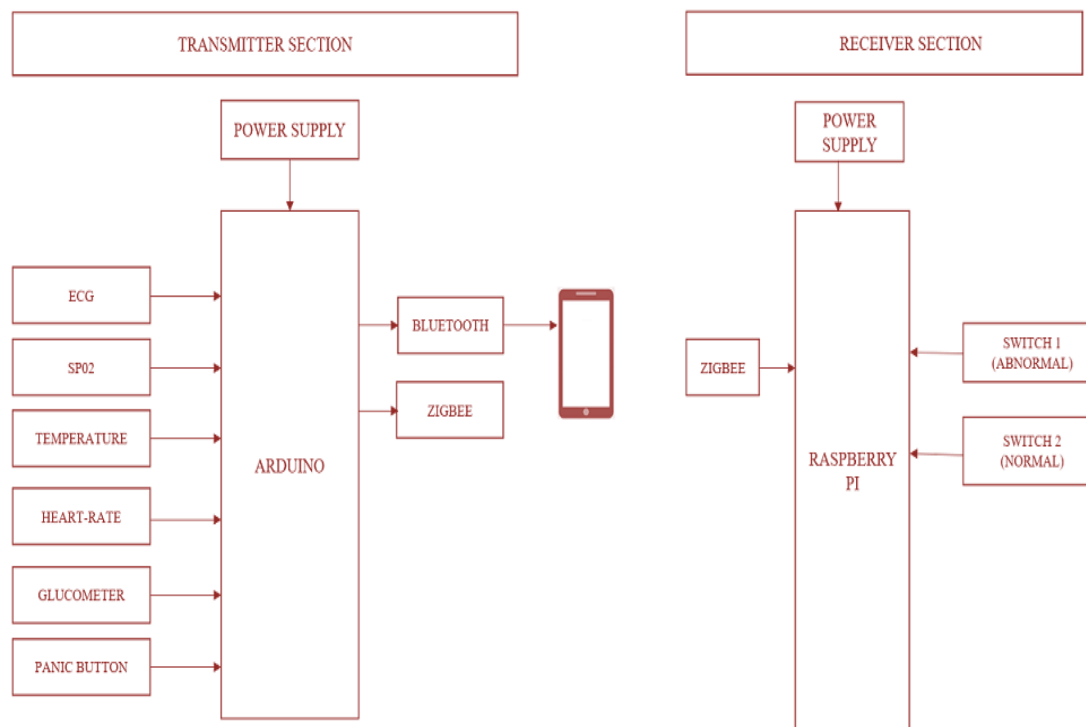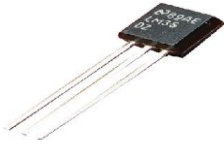


**Fig.2 Transmitter and Receiver Section**

The sections in Figure 2 of the analog are converted to digital signals ADC built-in data is transmitted via Bluetooth (<10 mts and 8 nodes per network) and Zigbee (75-100 mts with a limit of 255 nodes per network) simultaneously. In Phase 2 the physician analyzes and monitors the patient using the Raspberry Pi as a laptop (OS - 1GB RAM) and in rare / Normal cases sent via APP so that patients can see their results and take appropriate safety measures.

In an emergency, the alarm button that when pressed GPS location on the phone is sent to the doctor via APP to be sent to the patient's ambulance is taken in time.As monitoring and distance to the imaginary Wi-Fi or IoT can be used for long distance transmission. The app can be built using the Android studio and sold through Google Play. When the Android OS upgrade is updated to have new features and feasibility. It is an open source that allows you to build and test and has a drag and drop theme that makes it easy to integrate into the cloud with APP Engine. Due to the easy aging and small size these modules are selected. Arduino is used when a recurring action is required and converts the ADC signal into electricity. Open source also has GPIO PINs that use a minimum power of 40mA.

**Table 1. Comparison Table of Existing and other Non-Invasive sensor Technologies**

| Invasive Methods Disadvantages | Sensors (Non-Invasive) Figures | Sensor features and advantages |
|---|---|---|
| Holter ECG Monitor AD8232 Invasive gel pads with patches with single lead may slip if sweat is formed and patches with electrodes need refrigeration CG machines need to be carried along to check the waveforms. | ECG (clip usually paired with LM385 control circuit). | Compact Size, 5v,-40°C Operating Temperature, DIP Package..3v, LM385 has a temperature of 0-70°C. |
| Per fused index if lowered is monitored using disposable nose adhesives but alternatively a stethoscope is needed if sufferer has cold. | SPO2 (XANEOXYM3444) | 5v, inbuilt amplification and circuit for noise elimination. Sensors such as clips for adults and wrap sensor for infants are used. |
| Thermometer, Thermocouple, RTD and Thermistor<br>1. Non-Linear<br>2. Limited stability<br>3. Sensitive<br>4. Self-heating | Temperature(LM35) | 60uA, No extra calibration, Tolerates -55 to 150°C, Temperature is calibrated in Fahrenheit or Celsius coating prevents heating. |
| Self-analysis wrist Pulse and beats can be found in 15 seconds. | Heart-Rate (XD -58C) | 1. 5v,4mA,inbuilt amplification circuit<br>2. Noise suppression circuit<br>3. Readily available sensor |

The Raspberry Pi Model 3B + is a small-sized computer used for high-performance 1GB data storage OS for SD card, 1.4GHz clock and 0-50∘C temperature and CSI port for connecting and A VGA doctor can call patients on video for regular check-ups in the future. Each patient has his or her unique ID stored on a website that eliminates the need for instructions.

**Table 2. Optical/Non-Optical Non-Invasive Glucometers Technology**

| Invasive Methodologies and its Disadvantages | Sensor (Non-Invasive) Features and its Advantages | Disadvantages of the Other Optical Technologies |
|---|---|---|
| Accu-check meter or disposable syringes like micro needle techniques painful, Causes anemia and pricking damages skin. Longer time for analysis. Blood samples have to be measured either intermittently or continuous period. Minimally Invasive Implantable sensors like laser induced micro pores, Sonophoresis, Reverse Iontophoresis | Optical Methodology – NIR Spectroscopy (940nm) NIR based glucometer operating at 5v, with faster and painless detection. 1. PPG technique uses Near Infra-Red penetrating more than 95% than other optical technologies without affecting pigmentation and has greater sensitivity and offers accuracy. 2. Signal conditioning circuit is used to eliminate noise and errors caused by slight movements. 3. Direct proportionality can be obtained, as voltage increases glucose concentration also increases.  | on-Invasive Optical Technologies **a.** Olarimetry Eye's retina is used as a measurement site but direct light when focused may cause eye irritation, infections and sensitive to changes with a lag time of 30 minutes. **b.** Aman Spectroscopy Needs longer stabilization time, spectrum deviates owing to unstable laser wavelength and velocity, low SNR. **c.** Reverse Iontophoresis Minimally invasive, inconsistent, causing irritation and skin ruptures (tattoo-like device) and may slip off easily due to moisture. **d.** OCT (Optical Coherence Tomography) Sensitive to motion and temperature changes, tissue in homogeneity. **e.** Illumination/Fluoresc ence technology Short lifespan, permits pH to change and auto fluorescence, toxicity increases when foreign |

|  |  | material enters biological media. |
|  |  | **f.** NIR Goes into only a few micrometers, strong water absorption, reflects more because of poor penetration. Non-Optical Techniques |
|  |  | **g.** ioimpedance and Metabolic Heat Confirmation Techniques Longer calibration times, sensitive to motion, sweat and temperature and are bulkier. |

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Sensors are used by general caregivers and physicians so that you can hear from a distance. Modern technology sensors make rapid and easy advances in data transfer easily. Table 1 of the comparison shows the comparison of existing sensory technology with non-insane ones. Table 2 shows glucomers using a variety of methods. Sites most targeted for fingers due to congestion of thin hair and nerves and clips.

## 4. Conclusion

The aim is to monitor glucose levels using NIR Spectroscopy which is a non-invasive method to measure blood sugar levels. NIR spectroscopy is effective and accurate compared to other technologies. The Assembly probe is covered with closed tape to block outdoor light; the cost ratio is relatively low compared to today's invasive equipment on the market. It is advantageous compared to traditional methods such as the absence of metals, self-help and a friendly environment without the disposal of waste and the slightest error compensation for accuracy. Compatible sensors such as the accelerometer sensor, blood pressure and BMI sensor can be added if precision can be reached making it more functional and dressed as you wish. Helping yourself with the panic button reduces wasted time to find space and ambulances are organized using GSM.

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