Internet of Life (IOL)

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Abstract

Internet of Life (IoL) is a project aimed at minimizing the complications faced in tracking the Vital Signs Statistics of In-Patients, Prioritization of Patients in an Emergency Room, During a Natural Disaster or Tracking a Patient in transit in an Ambulance to a Hospital. As we know that tracking the Vital Signs and keeping a log of it is crucial in attending Emergencies, at the time of Natural disaster it is very important to keep a constant watch on Vital Signs of each and every individual, which becomes impossible as the number of affected people is much more higher than the number of available healthcare professionals. Many a times there are human errors which causes loss of lives. IoL would track the Vitals of Every Patient through Internet connected network of Secure Wireless Sensors and alert the doctor through a Push Message about the weak Vitals of a specific patient. IoL also aims at tracking a Patient in transit in an Ambulance, rerouting to another Hospital in case of a traffic congestion while a Senior Doctor keeps an eye remotely on the patient.

1. Introduction

Internet of Life (IoL) is a project aimed at minimizing the complications faced and increasing the efficiency in tracking the Vital Signs Statistics of In-Patients, Prioritization of Patients in an Emergency Room, Natural Disaster or Tracking a Patient in transit in an Ambulance to a Hospital. All Patients whose vitals need to be monitored are connected to the provided sensors. In case the Patient is in transit (through an Ambulance) to a Hospital, senior Doctors can keep an eye on the Vitals along with the Location and if there is a delay in transit the Ambulance can be redirected to another nearby Hospital where Primary Treatment can be given to the Patient. In case there is any deviation in the Vitals of a Patient, the Ward In-charge, concerned doctor is informed by a Push Message on the phone and if the Doctor does not respond within the provided timeframe all other Doctors from the same Department are sent the same Push Message requesting urgent attention. In the Case of Emergency or Natural Disaster every Affected person can be provided and equipped with IoL. With hundreds of People in need of Medical Attention and with a limited number of Healthcare Professionals, prioritization is necessary in treating people who are in need of attention. If a person has to referred to a different Medical Facility, Doctors can keep track of the Vitals remotely via omnipresent GSM Mobile Network and also the Location via GPS, in case of delay alternative route can be taken or Medical Attention can be sought in a nearby Hospital.
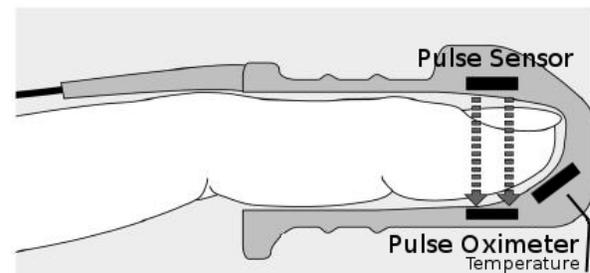
2. Sensors

There are many Biomedical Sensors available in the Market but developing sensors that are easy to use, low cost and also approved by FDA (Food and Drug Administration) is the basic focus. The design of Vital Signs Sensor (integrated Temperature, Pulse, Blood Pressure, Pulse

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Oximeter) and Respiratory Rate Sensor is very vital for the easy overall functioning of IoL. All sensors would form a High Speed Secure Wireless Network [1] and will connect to Internet.

2.1 Vital Signs Sensor

The Vital Sign Sensor consists of an Integrated Temperature, Pulse, Blood Pressure, Pulse Oximeter. It will be a small sensor that will attach to the Index finger via a clip and read all these Parameters with 1 Wire API Interface so more and more sensors can be attached to a single Microcontroller.

Pulse oximeter [2] uses light to work out Oxygen Saturation. Light is emitted from Light Sources which goes across the pulse oximeter probe and reaches the light detector. If a finger is placed in between the light sources and the light detector, the light will now have to pass through the finger to reach the detector. Part of the light will be absorbed by the finger and the part not absorbed reaches the light detector. The amount of light that is absorbed by the finger and the part not absorbed reaches the light detector. The amount of light that is absorbed by the depends on many physical properties and these properties are used by the pulse oximeter to calculate the Oxygen saturation.

Fig: 1.   Integrated Vital Signs Sensor

- Concentration of the light absorbing substance.
- Length of light path in the absorbing substance.

- Oxyhemoglobin and deoxyhemoglobin absorbs red and infrared light differently.
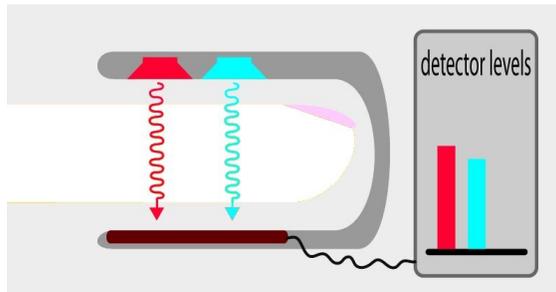

Fig: 2. Pulse Oximeter

The LM35 temperature sensor is proposed in this work for measuring the human body temperature. It is a precision integrated circuit Temperature Sensor which is small and can be laced anywhere on the body. The LM35 output voltage is linearly scalable to the measured temperature, which is 10 mV per 1 degree Celsius. So if Vout = 0.37V then the measured temperature is 37°C. It does not require external calibration and maintains an accuracy of 0.4°C at room temperature and ±0.8°C over a range of 0°C to +100°C [3],[4]
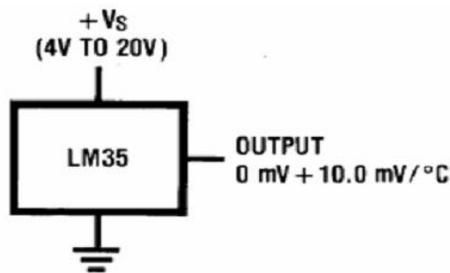

Fig: 3. LM35 Temperature Sensor

2.2 Respiratory Rate Sensor

Respiratory Rate is one of the most important Parameter in Vital Signs, still there are no advanced devices for monitoring it. Many a times doctors have to place their fingers near the nostrils and manually count the number of Respiration Cycles. The Respiratory Rate Sensor is used to measure the breathing rate in a patient in need of respiratory help or person. This device consists of a flexible thread which fits behind the ears, and a set of two prongs which are placed in the nostrils. Breathing is measured by these prongs. The specifically designed cannula / holder allows the thermocouple sensor to be placed in the optimal position to accurately sense the oral/nasal thermal airflow changes as well as the nasal temperature air. Comfortable adjustable and easy to install. Single channel oral or nasal reusable Airflow

Sensor. Stay-put prongs position sensor precisely in airflow path.

3. Controller

IoL uses basically two types of controllers, one is Scout Controller which is an Arduino and the other is the Lead controller, a Raspberry-Pi.

3.1 Scout Controller

The Scout Controller located near the patient is assigned a Unique ID and is connected to the Biomedical Sensors. The major advantage of Arduino being scalability. Scalability of an Arduino Ranges from small ATTiny85 to mighty ARM Cortex-A8. Various Platforms of Microcontrollers and Microprocessors have started supporting Arduino platform keeping the portability of Programs simple, with little or no change at all. All scout controllers form a Secure Mesh Network via nRF24L01 [5],[1] connecting to the Internet Connected Lead Controller. All Scout Controllers connect to pre-defined Lead Controller forming a mesh. If required the Lead Controller can be changed by the System Administrator.

3.2 Lead Controller

Lead Controller is connected to the Internet and runs a program to sends all the data to the Hospital Server which is either on-site or off-site in accordance to the Policies of that Hospital. In case the Lead Controller is placed in a moving Vehicle or an Ambulance it can be connected to Internet via GSM modem (via USB).

3.3 Topology in case of Wi-Fi availability

If there is a already deployed Wi-Fi network all the Scout Controller can be fitted with ESP8266 which can directly broadcast to the Server via a Wi-Fi network which eliminates the requirement of a Lead Controller and a Mesh Network. The Controllers have been developed keeping ease and scalability in mind.

4. Server

Server is the most crucial part of this Project. Server is responsible for maintaining the Logs of all the data that has been collected by Sensors and tracks if any Vital Signs go weak. In case of a warning from the Controller Server initiates a Push Message sequence to the Ward In Charge's Phone and also to the Concerned Doctor.

The Server will run Microsoft Windows Server 2012 and will host a Hospital Information and Management System (HIMS) ASP.NET MVC Application responsible for maintaining all the data of every Patient. Connecting the Unique ID of every Scout Controller to a specific Patient. HIMS will maintain link between Patient and Doctor. By opening the details of any Patient all Sensor Logs can be viewed along with all the information like Blood Report, Drugs Administration etc. This record can be accessed from anywhere in the world by Authorized Personnel. Operation of the Application would be as easy as Logging in to an Email account, reading and sending an email.

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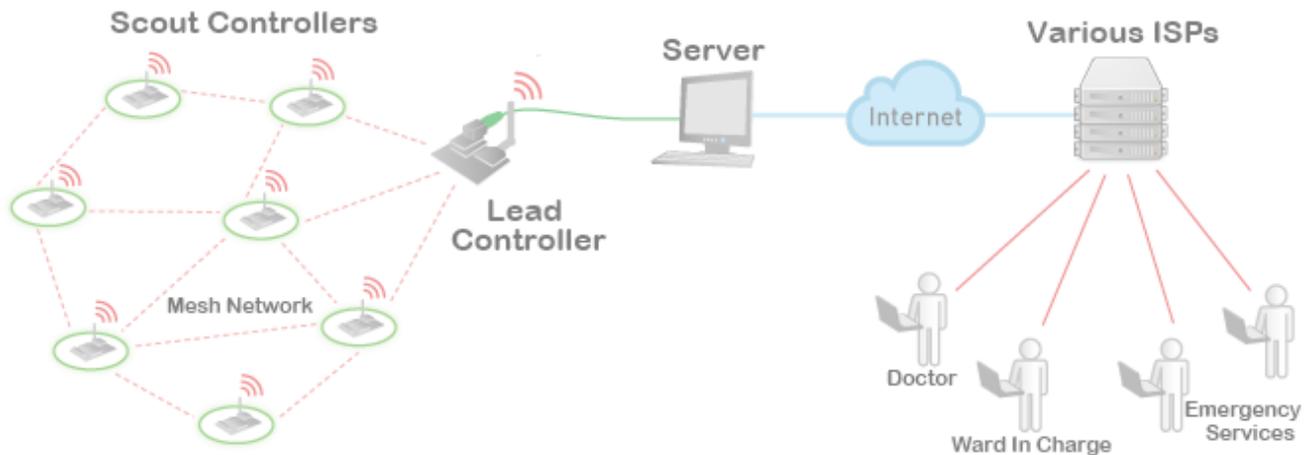
5. Conclusion

Internet of Life (IoL) is a Project Under Development when implemented would save lives and make the Patient's data available to the Doctors at every point of time. IoL would minimize the pressure on the Current Healthcare system by taking the task of Monitoring Patients, which despite of being crucial is also time and resource consuming. Any error can prove to be life threatening. By automating monitoring process Doctors and Healthcare Professions can pay attention to people who are in need of medical attention the most and hence saving crucial lives. When there is a Natural Disaster hundreds and thousands of people are affected, by providing people with IoL healthcare professionals can keep an eye on the Vitals of each and every individual and hence being more efficient in treating people who need attention the most, prioritization can be done in treating the worst affected people and many lives can be saved.

Currently, there are many features that need to be added in this system and there are many aspects that need to be analyzed and put to action. Further research is needed to make the system more efficient and cost effective so that IoL can reach to every person and it can make a difference at places where it is needed the most. The estimated cost per unit of IoL is Rs. 30,000.00 which is expected to exponentially come down with further Research and Mass Production Techniques. Research and support from every department is needed to make IoL a reality and succeed in saving more innocent lives.

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