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HEART AND RESPIRATORY MEASUREMENT USING FIBER OPTIC SENSORS

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ABSTRACT-Generally heart rate monitoring and respiratory monitoring are the two basic phenomena measured for monitoring health status of a patient. These two parameters measurements should be safe and without any risk. In this case, fiber optic sensors are used for monitoring both the respiration and heart rate. Generally cables are preferred than the electrodes because the information can be transmitted in larger bandwidth. Only contact with patient is optical fiber cable hence we can assure that patient is isolated from electrical hazards. Fiber optic interface for heart rate monitoring system avoids harmonics, spikes, transience, EMI interferences which are in the electrical lines and enters to the medical instruments and spoils the quality of signal presentation. In the previous methods, electrodes have been used to monitor. The major disadvantage of this method is that the electrodes has to be penetrated in the human body to measure which is painful and becomes difficult when using large numbers of electrodes. We here present a fiber optic cable that can receive signals from the Heart rate sensors and can transfer to an embedded controller which is coupled with computer. The features of this method are Use of pc, High speed embedded for interface, Industrial grade fiber optic cable. The optic cables are preferred over theElectrodes because it eliminates the electric spark and also transfers information with greater bandwidth. Cost of cables is less compared with the electrodes.

Keywords: Respiration rate, patient safety, heart rate, sensors.

I.INTRODUCTION

The normal respiration rate for adults is 7-12 breaths per minute. When the respiration rate is below 7 the person will be in coma. By measuring the respiration rate, one can know the physiological function of the human body. The optic cables are preferred because it eliminates the electric sparks and also transfers information with greater bandwidth. Medical fields have developed new sensors to perform vital signal monitoring in hazardous environments. Fiber optic sensors can solve problems involving high temperature, electromagnetic interference, and humidity environments and provides electrical safety. Commonly used sensors for measuring heart beat is RTD PT 100. The main advantage of this sensor is side effect free sensor. Optic fiber transmits information through light which conserves Electricity. One of the major parts of the human Body which gets easily affected is lung. The commonly occurring disease is asthma and wheezing. Spirometry is a simple breathing test. It measures how much air you can blow out of your lungs and how fast you can blow it. This breathing test is used to determine the amount of airway obstruction. A methacholine challenge test may be performed to help establish a diagnosis of asthma. Asthma triggers are different from person to person and can include airborne allergens, such as pollen, animal dander, mold, cockroaches and dust mites, Respiratory infections, such as the common cold, Physical activity (exercise-induced asthma) Cold air, Air pollutants and irritants, such as smoke. Fiber optic fabric-based sensor system is ideally suited for long-term monitoring due to its enhanced comfort and versatility. The other advantages of optical fibres-based sensors compared to electrical or chemical devices are their insensitivity to electromagnetic fields, water and corrosion resistance, and their compact size combined with low small weight. The insensitivity to electromagnetic fields is of great importance in the hospital environment where a lot of such fields are present. This opens the door to the use of fiber optic fabrics during magnetic resonance imaging (MRI) and computed tomography (CT) examinations. Recently researchers successfully developed MRI compatible sensors, for instance by means of a Plexiglas springboard which converts patients' movements to strain, and the latter is then measured by a fiber Bragg grating system. Different approaches to measure the respiratory rate with optical fibers have been studied. [2]Zieba et al. recorded changes in the distance between the light waveguide end and a sensor's head, which were caused by the chest movements. Within the Seventh Framework Programmed "Ofseth", optical fibers-based optical time-domain reflectometry for distributed respiration measurement and optical fibres with long period gratings in micro structured POF were evaluated. They were incorporated into elastic fabrics to measure the breathing rate and the breathing volume. Similar principles have been reported and a summary presented in. Augousti et al. proposed a respiratory analysis by means of macro bending loss effects. Although most of the published work dealing with textile-based breathing monitoring systems show satisfactory sensing capabilities, their use in a medical environment is still limited by the poor usability of the sensors for the medical staff and the patient. Furthermore, the high costs and the incompatibility with current industrial textile processes have hindered market entrance. The brittleness and the weak mechanical strength of optical glass fibres is an additional challenge when it comes to the textile integration of these fibres using an

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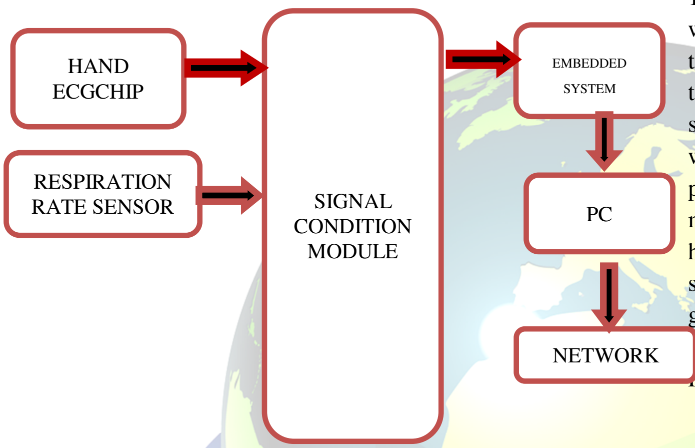
industrial process. Yolo et al. also showed respiratory rate measurementssystems, but their systems, even if capable of being integrated into textiles, would be of very low haptic response. They used commercial optical fibers with additional springs and mirrors.

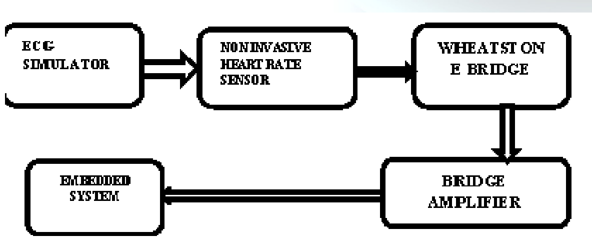
II.BLOCK DIAGRAM:

The hardware and software of the entire system is presented below. The operation of each block is explained.



The sensor senses the respiration and heart rate signal which is given to the signal conditioning module. In signal conditioning module the signal for sensor is collect and converted in form of light. This converted signal is transmitted through optical cable. The information is given to the personal computer using RS232.

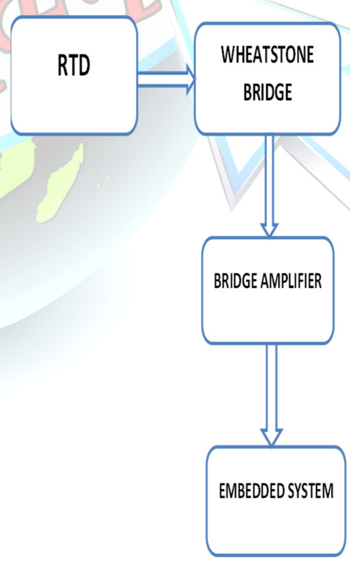
HEART RATE BLOCK:



The heart rate value can be measured by placing the sensor in the right hand fore finger. The trigger is given for measuring is from ECG simulator. The sensed value is given as unknown resistance to the Wheatstone bridge. The output of Wheatstone bridge is given to bridge rectifier circuits which amplifies the obtained signal. This amplified signal is then given to embedded system pic microcontroller. The information is transmitted to personal computer through RS232.

III.RESPIRATION BLOCK:

The sensor used for measuring the respiration rate is RTD PT 100(Resistance Temperature Detector Platinum 100).This sensor is preferred for measuring shorter pulse. A wide temperature range (-50 to 500°C for thin-film and -200 to 850°C for wire-wound). Good accuracy (better than thermocouples), Good interchangeability, Long-term stability. Only when excitation source is constant, the RTD will work properly. Hence Wheatstone bridge is used for proper excitation.[1]Instrumentation amplifier is used for maintaining the gain of the obtained signal. Each resistance has its own tolerance which the affects overall gain of the signal. To avoid this, variable resistance is used to obtain gain of 30db.To control the measurement of the radiation along with the heart rate, zero adjustment is used. PIC16F877A microcontroller is used.



Instrumentation amplifier is used for maintaining the gain of the obtained signal. Each resistance has its own tolerance which the affects overall Gain of the signal. To avoid this, variable resistance is used to obtain gain of 30db. Noise is

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generated during the process. To remove the noise integrated filter is used. Small amount of non-linearity is created in the circuit. To avoid this capacitor is placed at the output terminal. The basic offset of the instrumentation amplifier is nullified by placing resistance. To control the measurement of the radiation along with the heart rate, zero adjustment is used. PIC16F877A microcontroller is used.

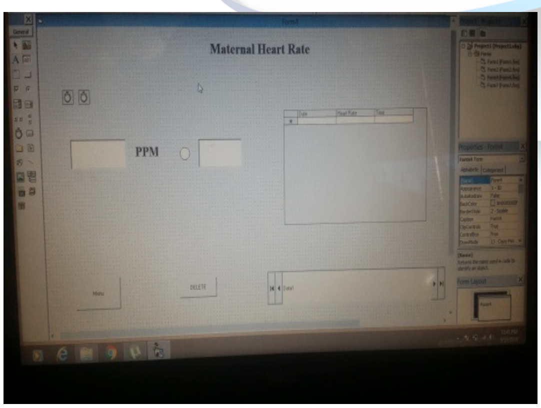
IV.CONCLUSION

The quality of imaging will not be affected by using the sensors as in the case of MRI measurements. The information is transmitted using optic cable hence there are minimal possibilities of losing the signal due to electromagnetic wave interference. Using IOT the patient health can be monitored wherever possible. These data can be access instantly. The all monitored information's are stored in personal computer as well as in IOT. The application of sensors allows a large number of developments in monitoring physiological signal even during harsh environments. Some examples of sensors based monitoring applications are MRI, aquatic rehabilitation. For the best comfort of patient and electrical isolation, the fiber cable can be preferred. The cable that is to be used should be properly tested and used.Pre-testing was performed with the purpose of checking the response of the sensor and assessing the viability of the system as a respiratory rate.

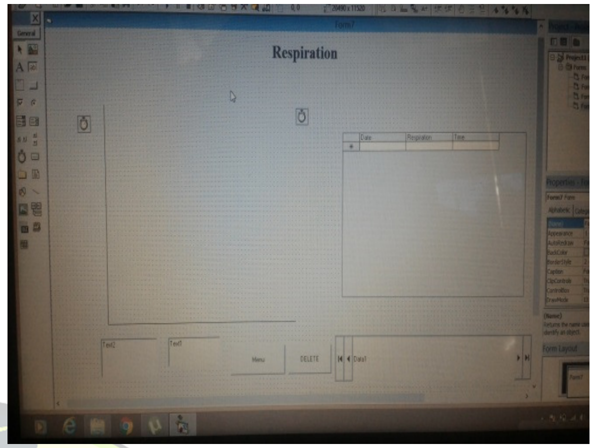
V.RESULTS

Pre-testing was performed with the purpose of checking the response of the sensor and assessing the viability of the system as a respiratory and heart beat rate .

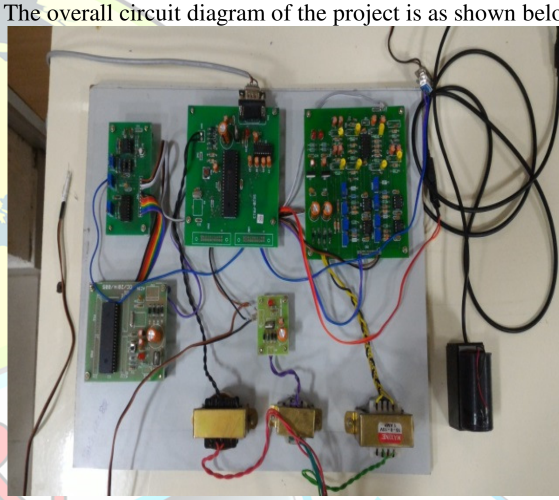
CODING FOR DISPLAYING MATERNAL HEART RATE



CODING FOR DISPLAYING RESPIRATION



The overall circuit diagram of the project is as shown below



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