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Design and Development of IoT enabled Oxygen Saturation and Heart Rate based Wearable Remote Health Monitoring System

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***Abstract*—Now a days, the development of an intelligent health care system is a emerging field of research on the Internet Thing (IoT). Most people living in provincial areas are unable to access medical care due to a lack of specialists, emergency clinics and private clinics. Likewise, with the exception of minor medical issues, people are more likely to seek professional advice because of travel, costs, and time. The heart is the most important organ in the human body, and the heart rate is an important part of the human body. Pulse oximetry is a non-miraculous measurement of oxygen filling (SpO2) in the heart. However, most heart rate measurement tools are expensive and only available in hospitals, and accurate measurement of SpO2 in rural areas may not be possible immediately to measure oxygen levels in the human body. In the proposed system, Beer Act used to use the Heart Beat Rate, and the SpO2 detector used to measure SpO2, heart rate. Two different light wavelengths (Red Led and Infrared Led) are used to measure the actual difference in absorption spectra between HbO2 and Hb. The SpO2 probe is placed on a person's finger and on the other side with a small control to calculate the number of pulses and the amount of SpO2 present in their body. Spo2 rating, Heart Beat Rate are viewed over web application and the same is viewed by a doctor on the other side of the cloud. In this paper we are preposing IoT based remote health monitoring system.**

***Key Words* – IoT, SpO_2, Heart Rate, Remote Health Monitoring .**

I. INTRODUCTION

A public pulse oximeter connected to the Internet of Things (IoT) system empowers a relative to screen a patient distantly. It is basic to give a genuine time ready system equipped for alert a patient when they are at threat. The unit utilizes a pulse oximeter module, a WLAN switch to connect the gadget to the cloud worker, which is fit for showing information on the website. Gear fo the patient is fueled by a generator. Battery power is observed, as well. The pulse's most minimal perusing precision was 96.9 percent contrasted with the fingertip heartbeat oximeter's deliberate effectiveness. Controller information transmission speed relies upon Internet access limit.

The Internet of Things (IoT) and its applications are developing at the same time. These applications need new savvy gadgets along heterogeneous systems administration. Which makes them exorbitant to carry out in fact. Stages and open gadgets intended for open-source equipment are potential arrangements. This examination was led under an IoT plan, execution, and evaluation model for the distant checking of heartbeat oximetry by means of oxygen fractional immersion (SpO2) and pulse (HR) with low-energy utilization.

II. Block Diagram

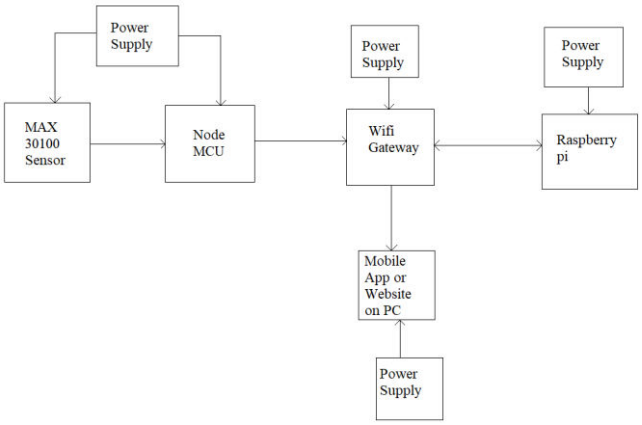

Fig. 1. System Block Diagram

III. BASIC OPERATION OF THE SYSTEM

MAX30100is connected to Node MCU. MAX30100 is used measure SpO_2 and Heart Rate. Raspberry pi is made as server to get SpO_2 and Heart Rate of the patient. Decision tree algorithm is attached to the LAMP server on raspberry pi for

analysis of the SpO_2 and Heart Rate reading coming from node mcu to server and display the result on web site. OLED is used to monitor SpO_2 and Heart Rate locally. Server is used for analysis of the received SpO_2 and Heart Rate from Node MCU to display the health condition with reading of SpO_2 and Heart Rate on web site. For data analysis on raspberry pi local host decision tree algorithm is developed. Decision tree algorithm is well know for classification.

IV. TRAINING THE DATASET

A. *Building and Labelling Image Dataset*

A data set is a collection of information in form of table or a data set compares to the contents database table, where each segment of the table speaks to a specific variable, and each column relates to a given individual from data set being referred to. In our system, Data set for training is needed where it is used to train the model for varies actions. The Training dataset is the actual dataset used in a decision tree model. Table for classification of health parameter is as follow

Health conditions	Labels	Conditions	Samples
Some how reduced	1	SpO_2 : 92 to 95	1000
Bradycardia and middle SpO_2	2	HR : <60 SpO_2 : 92 to 95	1000
Tachycardia and middle SpO_2	3	HR : >100 SpO_2 : 92 to 95	1000
COPD	4	SpO_2 : 88 to 91	1000
Critical Condition	5	HR : <60 and >100 SpO_2 : <91	1000
Bradycardia	6	HR : <60	1000
Tachycardia	7	HR : >100	1000
SpO_2 Critical	8	SpO_2: < 87	1000
Normal	9	HR : 60 to 100 SpO_2 : 96 to 100	1000

Table 1

Training our ML model heavily depends upon dataset. Consider we have 1000 sample for each classes (i.e. COPD,Normal,SpO_2 Critical etc.). On this 1000 sample health parameter, we are using 0.75% as training data and 0.25% as testing data. Whereas, While testing with an input data. The models are fitted into parameters. This process is called Adjusting weights. These sample images is being saved on directory as testing and training for each class.

B. *Training and Testing Model*

The sklearn library on python is used to handle health parameter dataset on resizing and to make simple classification techniques. On Actual dataset of 9000 sample under each class. Training and testing data splitting is must. The train dataset that we use to prepare the model (weights and bias on account of decision tree). The model sees and gains learning from this information. The sample in data used to give an unbiased assessment of a model fit on the testing dataset while tuning model hyperparameters. The assessment more biased as detailing on validation dataset into model configuration. The sample of information used to give an unbiased assessment of a last model fit on training dataset is called test data. It is just utilized once a model is totally trained using the train and validation datasets). The test set is utilized to assess competing models.The Train-Test Split is used to split the ratio for training and testing dataset. Using sklearn Learn capabilities test dataset splits with 25% test holdout.

V.Respberry pi as localhost

A. *Introduction on Raspberry pi as localhost using LAMP*

Originally popularized from the phrase "Linux, Apache, MySQL, and PHP", the acronym "LAMP" now refers to a generic software stack model. The modularity of a LAMP stack may vary, but this particular software combination has become popular because it is sufficient to host a wide variety of website frameworks, such as Joomla, WordPress and Drupal. The components of the LAMP stack are present in the software repositories of most Linux distributions.

The LAMP bundle can be combined with many other free and open-source software packages, such as the following:

1. netsniff-ng for security testing and hardening
2. Snort, an intrusion detection (IDS) and intrusion prevention (IPS) system
3. RRDtool for diagrams
4. Nagios, Collectd or Cacti, for monitoring.

As another example, the software which Wikipedia and other Wikimedia Foundation projects use for their underlying infrastructure is a customized LAMP stack with additions such as Linux Virtual Server (LVS) for load balancing and Ceph and Swift for distributed object storages.

B. *Decision Tree on raspberry pi LAMP server*

Decision trees was presented in SQL Worker 2000 alongside Microsoft's bunching procedure. For example, how about we look at the vTargetMail view in the AdventureWorksDW2012. Subsequent to making the SSAS project, AdventureWorksDW2012 was made as the information source and vTargetMail was added to Information Source Perspectives.

VI. RESULTS AND DISCUSSION

The health parameter reding is done using MAX30100 sent the data to raspberry pi based LAMP server having decision tree algorithm is running for analysis and result got on web page of having classification of health parameter is as follow

Hi, **Sumedh**. Welcome to our site.

Reset Your Password | Sign Out of Your Account

Health Parameters

ID	SpO2	Heart_Rate	Health_condition	Time_Stamp
1	98	80	Normal	12.3.2110:20.21
1	98	77	Normal	12.3.2110:21.22
3	99	72	Normal	12.3.2110:22.23

VII. CONCLUSION AND FUTURE SCOPE

The Internet of Things is viewed as now as one of the attainable answers for any far off esteem following particularly in the field of wellbeing observing. It encourages that the individual thriving boundary information is gotten inside the cloud, stays in the clinic are decreased for traditional routine assessments and most significant that the wellbeing can be checked and sickness analyzed by any specialist at any distance. In this thesis, an IoT based health monitoring system was created. The system checked heart rate and SpO2 utilizing sensors, which are additionally shown on a LCD. These sensor esteems are then shipped off a clinical worker utilizing remote correspondence. These information are then gotten in an approved personals advanced cell with IoT stage. With the values got the specialist at that point analyze the infection and the condition of strength of the patient

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