SMART PULMONARY FUNCTION ANALYSER

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Introduction:
Asthma and Chronic obstructive pulmonary disease (COPD) are both respiratory conditions that are chronic and affect a person's breathing. With many shared similarities, the two can easily be misdiagnosed for one another and that is why testing is so important to determine the exact diagnosis. Chronic Obstructive Pulmonary Disease (COPD) is the third leading cause of death globally and presents a significant burden to patients, carers and health services worldwide. Untreated or poorly managed asthma can also cause scarring in the lungs, which can lead to COPD. When a person has asthma, the lining of the airways in the lungs swells and the muscles around the airways get tight. Spirometry helps diagnose and manage asthma. Children age five or older, and adults of any age, who have asthma-like symptoms should have a spirometry test. Large electronic spirometers used in the hospitals are massive, quite expensive, complex and therefore not installed in many locations mainly rural areas where the hospitals lack sophisticated equipment like Spirometer, thereby requiring for the patients to travel substantial distances to undergo the testing.

Objective:
The prevalence of respiratory illnesses such as Asthma and COPD has been growing rapidly across the world, with more than 900 million currently afflicted.

- The Main objective is to bring out the indigenous model for the Lung Function Evaluation.
- Aims at one-to-many communication and is platform adaptable.
- Device can be used in patient's home for routine respiratory health checks.
- Provides real-on-time analysis, and tale medicine opportunities in remote areas.

Methodology:
Whenever a person needs to check his conditions this device can be used. Since the proposed prototype is small in size this can be carried with the person who is suffering from those kind of diseases for routine check-ups. The device supports the person who needs a routine check-ups. The system consists of three parts: (i) the Spirometer shell, (ii) the pressure sensor and electronics, and (iii) the android application. The prototype consists of Hardware implementation of overall system consists Arduino controller board, high
resolution ADC, Bluetooth module, Pressure sensor. The mechanical part of the system consists of a 3D-printed Spirometer shell. The instantaneous flow rate during breathing is measured by a pressure sensor as air passes through a fine stainless steel wire mesh in the shell. Spirometer measures the air flow rate in litres/second by making the expelled air pass through a constriction which results in a change in its pressure. The pressure sensor output is monitored by a microcontroller, which transmits the information over a Bluetooth HC-05 Link. The measured data is received by an android app running on a smartphone or tablet, which analyses the data and displays the sensor values. The Spirometer is placed in the device and controlled the breathing patterns through the software application. The data received from the module is displayed in the form of sensor values on a smart device with the help of a self-assessment application. The self-assessment app mainly considers the age, height in inches, smoked years and if there is significant pollution in that area. The expected values are then compared with the actual values and the result is predicted.

**Block Diagram:**

![Block Diagram Image]

**Results and Conclusion:**

The COPD test analysis was conducted for both men and women of different age groups and height.

**COPD test analysis for men:**

The COPD Prediction is done for men by considering certain parameters. The main parameters considered for COPD Prediction are age and height respectively. The expected values for FVC (Force Vital Capacity) and FEV1 (Force Expired Volume during the first second) was calculated. The data obtained from the Bluetooth was used to calculate FEV1,FVC and their respective ratio to predict COPD range.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Age</th>
<th>Height (inches)</th>
<th>FVC</th>
<th>FEV1</th>
<th>COPD Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>69</td>
<td>Ex:3.78</td>
<td>Ex:3.31</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ac:3.72</td>
<td>Ac:2.50</td>
<td>Ratio:67.20%</td>
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<tr>
<td>2</td>
<td>40</td>
<td>68</td>
<td>Ex:3.78</td>
<td>Ex:3.31</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ratio:65%</td>
</tr>
</tbody>
</table>
Copd test analysis for women

The COPD Prediction is done for women by considering certain parameters. The main parameters considered for COPD Prediction are age and height respectively. The expected values for FVC (Force Vital Capacity) and FEV1 (Force Expired Volume during the first second) was calculated. The data obtained from the Bluetooth was used to calculate FEV1, FVC and their respective ratio, to predict the COPD range.

<table>
<thead>
<tr>
<th>Sl. No</th>
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<th>Ac:3.75</th>
<th>Ac:2.47</th>
<th>Ex: 3.78</th>
<th>Ac:3.75</th>
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</table>

Conclusion:

Smartphone users around the globe are expanding every year. For most of all purpose people are relying on smart devices. As it is handy now researches are linking module with smart application. For the benefits of patients many applications have been developed in healthcare domain but here concentrating only on the spirometry monitoring. With the increasing proliferation of Internet-Connected Smartphone's across the world, low-cost smartphone-based medical devices are now attractive alternate to traditional custom-made medical equipment, especially in developing countries. So this project encourages easy and reassuring use and is of low-cost and used for routine respiratory health checks at home. The spirometry equipment used in hospitals for pulmonary function testing costs thousands of
dollars, which is beyond the means of health care facilities in many countries. The Smart pulmonary function analyser designed in this project will be of low cost and encourages easy and reassuring use. It gives a fast detection of possibility of pulmonary restrictions and obstructions. It can be operated regardless of time and place. It can also be used to provide real-on-time analysis and tale medicine opportunities in remote areas. The device can be used in patient’s own home for routine respiratory health check.

**Future work:**

The Proposed project module is small in size, hence it can be further implemented as the Product. The developed product can be distributed in the remote locations, primary health care centres and can be used as the assistive device for the COPD prediction for the people all around the nation. Prototype can be used in the areas where the doctors cannot visit with all the precise equipments.