IoT Based Monitoring and Alert System for Patients with Chronic Obstructive Diseases

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Abstract. Information and telecommunications infrastructure is based upon to play an essential part in the changes that must be made to health centres to cope with chronic conditions. This article discusses telemedicine’s perspective in residential treatment for chronic patients with chronic obstructive pulmonary disease (COPD) & an advanced framework developed to do so. The chronic care telemedicine method to assess the effect on wellbeing. The paper proposed a method to this unaddressed requirement by modelling & structurally constructing a mobile device that constantly monitors the airflow rate, respiratory rate, physical exercise, nap quality, the likelihood of respiratory problems, & the degree of distress & exhaustion in a protected central server that can be accessed from a mobile globally.

Keywords: COPD patients, Remote monitoring, Micro-controller, RTOS, Sensor networks.

1. Introduction
Chronic obstructive pulmonary disease (COPD) is a serious illness leading to progressive airflow blocking, followed by airway damage that is irreversibly diagnosable [1]. As per the World Health Organisation (WHO), COPD is a big source of global death & mortality rates & is the 3rd-ranked cause of death today & a significantly high mortality rate worldwide. COPD induces 23k deaths a year in the UK; nearly a person dies every ten minutes from the disorder [2-3].

The prognosis is based on the principle of the Global Action plan for Respiratory Diseases obtained from the calculation of various lung function after complete motivation from a forced expiration manoeuvring using spirometry [4]. A proportion of lower than 0.72 within the quantity of air expires within (FEV1) & the complete quantity elapsed at the end of the expiry (FVC) is known as COPD [5].

This paper presents an acquisition concept on the following sections: Literature Review followed by Section 3 Proposed system, Section 4 Hardware & Software tools, Section 5 Results & Discussions and Finally Section 6 Conclusions.
2. Literature Review

The number of patients affected by chronic illnesses is growing & the cost of their treatment is also increasing. These facts raise huge problems for traditional healthcare programs, which are largely designed to cope with acute episodes & are thus not suited to the type of treatment needed for chronic diseases [6-7]. A main area of study has been treating chronic conditions & it is increasingly understood to ensure protection & cost control changes are needed in the way care is provided.

Patients with COPD are heavily reliant on treatments to maintain pulmonary function & prolonging the interval among clinical exacerbations. However, hospitalizations are increasingly frequent; 115,000 ambulance acceptances a year are triggered by COPD & 16,000 fatalities within ninety days of entry [7-8]. Depression & anxiety are very common & raise the amount & duration of hospital visits while active, raising the risk of mortality.

In recent times, numerous experiments have been carried out to introduce advanced & assistant categorizing, essential applications & methods for disease diagnosis. A few of these methods is the use of Artificial Neural Networks (ANN) [9]. These systems, which may be beneficial for diagnostic & have advantages such as shortening the diagnosis cycle, gaining time & increasing performance, add a great deal to medical R&D. In this review, the Artificial Neural Networks diagnosis of (COPD) is opposed. The data collection used in the analysis contains 15 factors, four stages of COPD disease (Mild, Moderate, Extreme, Very Severe) & 507 patient data [10]. In the study; the process of 5 layer cross-validation is used. MSE & (MAE) are obtained from the lab tests & the details are summarized with a mean of 5 layer errors. In summary, the values of the MSE & MAE are 0.00996 & 0.02478, accordingly. It is found that accuracy ratings are 99%. Inevitably, proven findings indicate that with 15 parameters, very high accuracy rates are obtained. Subsequently, the use of ANN in COPD classification seems to be effective, making it easier to detect a device that will benefit the doctor [11].

There are several no early signs or non-specific causative lung cancer agents, which people often ignore. If a patient is diagnosed patients with respiratory cancer, it is often necessary to see a doctor. In quick healing, accurate diagnosis aids [12].

The ultrasonic sensor on the top of the dustbin senses the proposed device's waste volume by causing a high pulsation or transmitting a ping from the sensor's TRIG pin [13-15]. The internally available clock begins ticking when the pin TRIG is high followed by the pin LOW (for a span of 10μs). 40 kHz of audio is dispatched from the transmitter for eight cycles. Moreover, the time taken to hit the pulse will start to be counted. The echo will be received on the ECHO pin, which is achieved by recording the time spent and determining the distance of the object as the distance = (speed of the sound in the air x time spent) /2, where the air sound speed is 340m/s or 29 cm/μs. The Arduino UNO board uses GSM, GPS and Wi-Fi module to power the sensor.

By using the ESP8266 Wi-Fi module, we can transfer sensor data processed by Arduino permanently via a hotspot to a cloud server. Data are sent to the Thingspeak Cloud server every 15 seconds, which helps to track the dustbin status online continuously. The global GPS module with a receiver antenna effectively determines its location based on the GPS satellites it receives. The GPS module sends data on Arduino's microcontroller's latitude and length values in real-time tracking location. There are also Dustbins with LED signs to let people know how far the bins are filled. If more than 70% of the green space is open, it is ON. A yellow light will glow in half-full containers (say 25 to 70% of the space), and a red light will glow when the threshold level is reached.

The microcontroller sends control to the GSM Module, the time that the waste level exceeds a threshold, which sends a text message to alert the mobile customer to the dustbin. The SMS also provides a link that guides the user to Google Maps, where he can reliably see the position of the GPS module dustbin and take the fastest navigation path from his current location into the dustbin. The specific steps involved in tracking garbage and gaining access to the dustbin position are seen in Fig.1.
3. Proposed System

Figure 2 illustrates the proposed block diagram of the system. It constitutes Microcontroller, Heart Beat Sensor, Temperature Sensor, Respiratory sensor, User mobile these are the hardware devices and modules used in the proposed system.

   a. **Heartbeat sensor**
   The pulse rate sensor is built when a finger is placed to offer digital heat beat output. The Rhythm LED flashes in sync with each cardiac cycle while the heartbeat detector is running.

   b. **Temperature sensor**
   The voltage around the terminals of diodes. The heat also changes as the applied voltage, accompanied by a voltage drop between both the base & emitter transistor terminals in a diode.

   c. **Respiratory sensor**
   The respiration sensor is stretch-sensitive. It can transform the rib cages or abdomen section's deformation, when wrapped around the upper abdomen of a user, to an increase & fall of the monitor's signals.
4. Results and Discussions
The results of the definition are discussed in this section of the article.

Creation & Prototype of the Device. The device consists of a temperature controller probe sensor and to detect the motion of the person’s proximity is used, which can be served to the mobile. All data can be pushed to the server concerning time so that there is no lag in viewing the data.

![Prototype of the implemented device](image)

**Figure 3.** The prototype of the Implemented device

Figure 4 illustrates a preview of physiological monitoring readings showcased in the accessible clinical app from a mobile. A list of activities and patient’s statistics can be shown, readily accessible for the doctors.

![Physiological monitoring reading](image)

**Figure 4.** Information accessed from the mobile for physiological monitoring

Figure 5 has a set of questionnaires to measure the person’s health and typical psychological situation. The doctors or therapist can finally view this.

![Questionnaires](image)
Figure 5. A version of the questionnaire on exacerbation severity & the measure of depression & anxiety obtained from the mobile is shown.

Injections of oxygen in COPD were shown to reduce hospitalization, reduce the number of patients' exacerbations that enhance the quality of living, increase the potential for effort, strengthen conformity with prescription boosting survival & improving pulmonary stability neurocognitive efficiency & hemodynamics. This procedure's advantages are better because it is provided to the correct patient & properly used; however, several aspects can decrease its efficacy.

5. Conclusion
The suggested framework takes advantage of creative technologies to offer an effective overview of the given treatment and automated messages & warnings on the affliction's intensity estimate or potential vital health episodes. The Decision Maker uses both the classification algorithm & the norm system to minimize the error of a judgment, improve the precision of the system & to explain the incidents found by supplying clinicians with a rule or important parameter. Given that many profiles have been developed, defining the patient's health state with specificity, & used as a feedback to the knowledgeable part of the method, customization of the decision is much more feasible with the scheme.

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