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Comprehensive Review on Design of Low-Cost Portable Ventilator for Emergency Use in Resource-Limited Settings

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Abstract

Mechanical ventilation serves as a lifesaver in the rapidly evolving field of respiratory disease treatment. However, limitations of existing ventilators, such as high cost and limited portability, affect the accessibility and affordability of respiratory support in resource-limited emergency settings. The aim of this paper is to design a low-cost and portable ventilator machine that overcomes the limitations of ICU ventilators and other portable ventilators. This proposed solution focuses on affordability, portability, and versatility, making it suitable to provide lifesaving respiratory support in various settings. Prior to the design phase, a background study was conducted using the shadow approach, alongside a literature review to collect relevant data and insights. The proposed design consists of an ATmega2560 Arduino microcontroller as the main control board, along with a Honeywell AWM720P1 flow meter, Bosch BMP280 pressure sensor, SST OXY-LC oxygen sensor, and Max30100 pulse oximetry sensor. This system offers Assist Control (AC), Synchronized Intermittent Mandatory Ventilation (SIMV), and Cardiopulmonary Resuscitation (CPR) ventilator modes, as well as adjustable tidal volume, respiratory rate, positive end-expiratory pressure value, and a pressure control system with a user-friendly interface. This design includes a standalone feature, allowing the ventilator to operate in the absence of an external oxygen supply. It also has an alarm system to alert operators or caretakers about potential issues such as high pressure, insufficient oxygen levels, low pulse oximetry, power shortages, or abnormal heart rates.

Keywords: *Respiratory Disease treatment, Low-cost Respiratory support, Portable ventilator, Resource-limited emergency settings*