IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 7, July 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.542

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

|| Volume 9, Issue 7, July 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0907100 |

A Novel Methodology of Portable Ventilator Using IOT

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ABSTRACT: Human lungs use the reverse pressure generated by contraction motion of the diaphragm to suck in air for breathing. A contradictory motion is used by a ventilator to inflate the lungs by pumping type motion. A ventilator mechanism must be able to deliver in the range of 10-30 breaths per minute, with the ability to adjust rising increments in sets of 2. Along with this the ventilator must have the ability to adjust the air volume pushed into lungs in each breath. The last but now the least is the setting to adjust the time duration for inhalation to exhalation ratio. Apart from this the ventilator must be able to monitor the patient's blood oxygen level and exhaled lung pressure to avoid over/under air pressure simultaneously. The ventilator is designed and developed using MSP430 encompasses all these requirements to develop a reliable yet affordable ventilator to help in times of pandemic. A silicon ventilator bag coupled driven by servo motor with one side push mechanism to push the ventilator bag. The system makesuse of blood oxygen sensor along with sensitive heart Beat sensor, pulse sensor and respiratory sensor to monitor the necessary vitals of the patient and display on a webpage using IOT. To adjust the time duration of innovation the option comment given in the IOT application to set. The entire system is drivenby msp430 controller to achieve desired results and to assist patients in pandemic and other emergency situations.

KEYWORDS: Internet of Things(IoT).

1. INTRODUCTION

The coronavirus pandemic is a major health emergency, the World Health Organization (WHO) has reported over 1.3 Million of confirmed coronavirus cases all over the world. According to data provided by WHO, 80% of confirmed coronavirus cases will be able to recover without the need for hospitalization. However, 1 in 6 patients could have significant aggravated symptoms,causing damage to the lungs and therefore decreasing the levels of oxygen in the body. In this sense for patients with severe effects of the infection, an artificial ventilator may offer the best chance of survival. Since 1990, the interest in providing positive pressure ventilation (PPV) through a mask rather than through an endotracheal tube has increased. This method has been called non-invasive ventilation NIV, since the patient is not intubated, NIV has certain potential advantages compared with invasive ventilation methods. NIV is relatively easy to apply and can be used for short intervals because it can be started and stopped very easily and the major advantage of avoiding the complications associated with intubation and they are usually more comfortable for the patients reducing the need for anesthesia required for intubation .In recent works it is possible to find developments of artificial ventilators as full-professional devices, nonetheles, different efforts have been done in order to develop low-cost artificial ventilators and due to the COVID-19 pandemic, the efforts for developing a low-cost ventilator have increased significantly because of the lack of this devices within the public health institutions. One of the possible solutions for the development of an artificial ventilator is the conditioning of existing technology, such as the case of airway mask units (AMBU) , which are devices for manual artificial ventilation, that can be automated by using adequate mechanisms and control systems.Watch, fitness brands, smart headphones, smart clothing) are also expected to witness the growth in the future. IoT is really the secret that makes this whole system work.

II. LITERATURE SURVEY

Smart ventilation energy and indoor air quality performance in residential buildings.

Author name:GaelleGuyotabMax H.ShermancIain S.Walkerc. a)Cerema, Direction Centre-Est, 46, rue St Théobald, F-38080, L'Isle d'Abeau, France.

b. Univ.Grenoble Alpes,Univ.Savoie Mont Blanc, CNRS, LOCIE, 73000 Chambéry, France.

c. Lawrence Berkeley National Laboratory, 1Cyclotron Rd, Berkeley, CA 94720, United States.To better address energy and indoor air quality issues, ventilation needs to become smarter. A key smart ventilation concept is to use controls to ventilate more at times it provides either an energy or indoor air quality (IAQ) advantage (or both) and

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less when it provides a disadvantage. As a result, demand-controlled ventilation (DCV) systems are widely and easily available on the market, with more than 20 DCV systems approved and available in countries such as Belgium, France and the Netherlands. This paper provides a literature review on smart ventilation used in residential buildings, based on energy and indoor air quality performance. This meta-analysis includes 38 studies of various smart ventilation systems with control based on CO2, humidity, combined CO2 and total volatile organic compounds (TVOC), occupancy, or outdoor temperature. These studies show that ventilation energy savings up to 60% can be obtained without compromising IAQ, even sometimes improving it. However, the meta-analysis included some less than favorable results, with 26% energy overconsumption in some cases.

Residential smart ventilation.

Author name: Gaëlle Guyot 1 Max Sherman Iain Walker Jordan D Clark.
a. LOCIE - Laboratoire Optimisation de la Conception et Ingénierie de l'Environnement.Air ventilation is one of the top energy users in residential buildings. Smart ventilation equipment and controls help to reduce the amount of energy use attributable to ventilation in homes while maintaining high indoor air quality. Ventilation can also be used as a resource for utility grid demand response if done intelligently. A key component of the smart ventilation concept is the use of controls to ventilate more when doing so provides an energy or air quality advantage and/or a resource to the power grid, and less when it provides a disadvantage. Results of the review of smart ventilation in residential buildings is used to: Determine and discuss performance of smart ventilation in terms of energy and indoor air quality Gather data on occupant behavior Assess the suitability of automatically controlled ventilation systems Assess the applicability of a multi- zone approach for ventilation. This meta-analysis of 38 studies of various smart ventilation systems with controls (on either CO2, humidity, combined CO2 and TVOC, occupancy, or outdoor temperature) shows that ventilation energy savings of up to60%canbe obtained without compromisingIAQ—andsometimes even improving it. In some cases, the smart ventilation strategies did not reduce energy use(showing an increase in energy use of up to 26%)..Finally, this report summarizes ongoing developments in smart ventilation strategies and applications.Performance based approaches in standards and regulations for smart ventilation in residential building.

Author name: Gaëlle Guyot,Iain S. Walker &Max H. Sherman.Received 27 Mar 2017, Accepted 26 Jan 2018, Published online: 13 Mar 2018.
As ventilation systems become more sophisticated (or ‘smart’) standards and regulations are changing to accommodate their use. A key smart ventilation concept is to use controls to ventilate more at times it provides either an energy or IAQ advantage (or both) and less when it provides a disadvantage. This paper discusses the favorable contexts that exist in many countries, with regulations and standards proposing ‘performance-based approaches’ that both enable and reward smart ventilation. The paper gives an overview of such approaches from five countries. The common thread in all these methods is the use of metrics for the exposure to an indoor generated parameter (usually CO2), and condensation risk. As the result, demand-control ventilation strategies (DCV) are widely and easily available on the market, with more than 20-30 systems available in some countries.

A literature survey of the robotic technologies during the COVID-19 pandemic

Author name: panelXi VincentWangLihuiWang.Since the late 2019, the COVID-19 pandemic has been spread all around the world. The pandemic is a critical challenge to the health and safety of the general public, the medical staff and the medical systems worldwide. It has been globally proposed to utilise robots during the pandemic, to improve the treatment of patients and leverage the load of the medical system. However, there is still a lack of detailed and systematic review of the robotic research for the pandemic, from the technologies’ perspective. Thus a thorough literature survey is conducted in this research and more than 280 publications have been reviewed, with the focus on robotics during the pandemic. The main contribution of this literature survey is to answer two research questions, i.e. 1) what the main research contributions are to combat the pandemic from the robotic technologies’ perspective, and 2) what the promising supporting technologies are needed during and after the pandemic to help and guide future robotics research. The current achievements of robotic technologies are reviewed and discussed in different categories, followed by the identification of the representative work’s technology readinesslevel. The future research trends and essential technologies are then highlighted, including artificial intelligence, 5 G, big data, wireless sensor network, and human-robot collaboration.

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Towards sustainable, energy-efficient and healthy ventilation strategies in buildings.

Author name: panelBehrang ChenariJoãoDias CarrilhoManuelGameiro da Silva Energy demand has been increasing worldwide and the building sector represents a large percentage of global energy consumption. Therefore, promoting energy efficiency in buildings is essential. Among all building services, Heating, Ventilation and Air Conditioning (HVAC) systems are significantly responsible for building energy use. In HVAC, ventilation is the key issue for providing suitable Indoor Air Quality (IAQ), while it is also responsible for energy consumption in buildings. Thus, improving ventilation systems plays an important role not only in fostering energy efficiency in buildings, but also in providing better indoor climate for the occupants and decreasing the possibility of health issues in consequence. In the last decades, many energy-efficient ventilation methods are developed by researchers to mitigate energy consumption in buildings. This paper reviews scientific research and reports, as well as building regulations and standards, which evaluated,investigated and reported the development of energy-efficient methods for ventilation in buildings. Besides energy-efficient methods such as natural and hybrid ventilation strategies, occupants' behaviours regarding ventilation, can also affect the energy demand in buildings. considered.The review showed that ventilation is interrelated with many factors such as indoor and outdoor conditions, building characteristics, building application as well as users' behaviour. Thus, it is concluded that many factors must be taken into account for designing energy-efficient and healthy ventilation systems. Moreover, it should be mentioned that utilizing hybrid ventilation in buildings integrated with suitable control strategies, to adjust between mechanical and natural ventilation, leads to considerable energy savings while an appropriate IAQ is maintained.

IoT Based Low Cost Smart Ambu-Bag Compressing Machine for Low Cost Ventilators

Author name:MS Khan, MF Rahman, MY Khan, S Pasha Mohammed Shuaib Khan, Mohammed Faraaz ur Rahman, Mohammed Yousuf Khan, Shahba pasha Ventilators are one of the most important devices to keep COVID-19 patients in the most critical condition alive. As the global demand for ventilators is increasing and there is shortage of ventilators in our country as well, also managing patients during this time is a big task, so we have designed portable rechargeable battery operated Ambu bag compressing machine, which sends real time cloud messages to the doctors and other medical authorities about the patient. We have made the prototype and we are improving it's performance by adding extra new features. It can be used for emergency purposes, in hospitals, Corona virus quarantine coaches, isolation wards and rural areas as well. The shortage of ventilators can be met effectively by developing this project. This project is a low cost yet effective ventilating system for the people affected with COVID-19.

Design and Implementation of Ventilator for Breathing Apparatus

Author name:Hidayat, J Saiful, S Iman, Suprapto, I Aidil and S Eddy.This paper present the design and implementation of a ventilator for a breathing apparatus.The ventilators that developed are the positive pressure ventilation type,the cycled volume mode and the controlled mechanical ventilation method(CMV). The technology that used is the ambu bag. The design and manufacture includes an automatic ambu bag pressing mechanical system and a control system using the arduino microcontroller. The mechanical design that is compact, lightweight, energy saving, low cost, meets aesthetics and is friendly makes this tool attractive so it is not scary for patients. BPM (beepperminute),IER (inspiratory expiratory ratio) and TV (tidal volume)parameter can be controlled via a touch screen or remotely using a mobile phone via 4 buttons remotely to facilitate and avoid transmissionofCovid-19tomedicalpersonnel. BPM can be set from 5-20 BPM, IER from 1:1 to 1: 4 and TV from 40-100%. The results of ventilator testing that have been done show a good response.

Ventilation and "building sickness"

Author name: Liddament MW.Air Infiltration Review, Vol 11, No 3, June 1990, As the thermal performance of buildings continues to improve, air exchange will eventually become the dominant mechanism for building heat loss. Although, therefore, an essential parameter of the energy equation, ventilation is nevertheless vital forthe dilution and removal of pollution generated within buildings. An inadequate supply of fresh air or poor air distribution will result in high levels of indoor contaminants, discomfort and a poor living environment, it could also result in more serious health related problems. As a consequence, reduced air change as a means to minimise energy demand hasbecome inextricably linked to the problems associated with unhealthy buildings. The purpose of this note is to summarise some of the International Energy Agency related and other activities in this field and to introduce the AIVC's Literature List on "Sick Buildings".

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Integration of Energy-Efficient Ventilation Systems in Historic Buildings

Author name:Marc Kastrup,Benjamin Tittmann,Tanja Sawatzki, Martin Gersch,Charlotte Vogt,Max Rosenthal,Simone Rosseauand Claudia Spies The current demographic development of our society results in an increasing number of elderly patients with chronicdiseases being treated in the intensive care unit. A possible long- term consequence of such a treatment is that patients remain dependent on certain invasive organ support systems, such as long- term ventilator dependency. The main goal of this project is to define the transition process between in-hospital and out of hospital (ambulatory)ventilator support. A further goal is to identify evidence- based quality indicators to help define and describe this process.This project describes an ideal sequence of processes (process chain), based on the current evidence from the literature. Besides the process chain, key data and quality indicators were described in detail.Dueto the limited project timeline, these indicators were not tested in the clinical environment.The results of this project may serve as a solid basis for proof of feasibility and proof of concept investigations, optimize the transition process of ventilator-dependent patients from a clinical to an ambulatory setting, as well as reduce the rate of emergency re-admissions.

Updated Ventilation On Demand

Author name:

a. Enrique I. Acuna, School of Mines, Faculty of Engineering, Universidad del Desarrollo, Chileb)Roberto A. Alvarez, Chuquicamata Underground Mine Project, Vice presidencia de Proyectos, Codelco, Chilec)Juan Pablo Hurtado, School of Mines, Faculty of Engineering, Universidad de Santiago de Chile,Within the past years, the Ventilation On Demand concept has been implemented in several mines worldwide and seems to be spreading significantly as a result of the energy savings that it is achieving for the operations. More mines and projects are considering its implementation as a result of the limited access to energy and its cost, but also because of the potential to increase health and safety and the number of faces available at any given time with the same airflow volume boundary. Although the concept is simple— bringing the right quantity and quality of airflow where it is needed at the right time—the different components of the system and the implementation process necessitate additional work and increased maintenance compared to conventional systems. This paper presents the study developed, as an updated review of the Ventilation On Demand concept and implementation in different mines, the system components, software packages, level of implementation, strategies in place and energy savings achieved. The comparison is made in terms of the strategy implemented and the energy savings achieved. A discussion is also presented of the results obtained,and the implementation level according to each mine's requirements and reality.

III. METHODOLOGY

The proposed artificial ventilator mechatronic design has the following practical
The structure of the paper is as follows:
Section I- It describes the mechatronic design of the mechanical ventilator.
Section II- It describes the nonlinear robust control based on super twisting sliding modes that will be used for the proposed application. Section III- Experimental results are presented.
Section IV- Presents the conclusions about this work

ADVANTAGE

a) A non-invasive mechanical ventilator, reducing the risk derived for the use of anesthesia during invasive intubation.
b) Low-cost design based on rapid prototyping technologies such as 3D printing.

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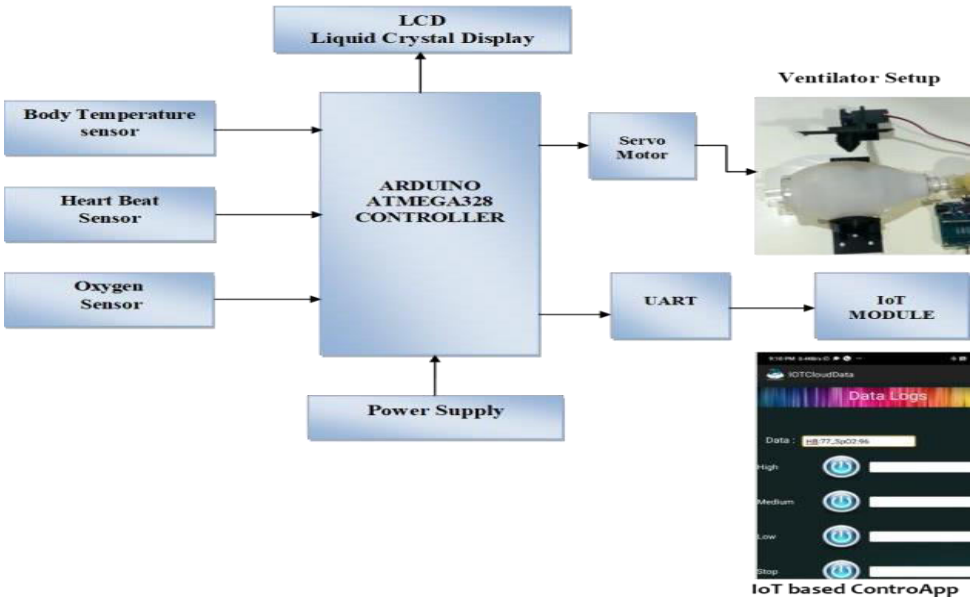
BLOCK DIAGRAM



LCD

LCD is used to display the results of the system operation such as sensed values, motor status etc…. A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. The LCD standard requires 3 control lines and 8 I/O lines for the data bus. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. In this tutorial, we will discuss about character based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff and tricks you can do with these simple looking LCDs which can give a new look to your application.

MSP430LAUNCHPAD

MSP430 Launchpad is a hardware development tool for MSP430 Value Line series of microcontrollers and is popular among hobbyist for its low cost and features. It is an easy way to start developing on the MSP430 MCUs, with on-board emulation for programming and debugging as well as buttons and LEDs for a simple user interface.

MSP-EXP430G2 LAUNCHPAD

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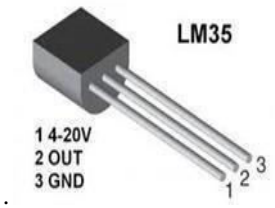
TEMPERATURE SENSOR

The LM-35 collection are precision integrated-circuit temperature gadgets with an output voltage linearly proportional to the Centigrade temperature. The LM35 gadget has an benefit over linear temperature sensors calibratedin Kelvin, as the person is no longer required to subtract a massive steady voltage from the output to reap handy Centigrade scaling.



OXYGEN SENSOR

An Oxygen sensor or lambda sensor it refers to air-fuel equilence ratio usually lambda .It is the electronic device that measures the propotion of oxygen in the gas .It is also used in hypoxic air-fuel prevention system to continuously monitor the oxygen concentration inside the protected volumes.

HEARTBEAT SENSOR

Heart beat sensor is designed to provide digital ouput of warmness beat when a finger is positioned on it. When the coronary heart beat detector is working, the beat LED flashes in unison with every coronary heart beat. This digital output can be linked to microcontroller at once to measure the Beats Per Minute (BPM) rate.

SERVO MOTOR

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor.

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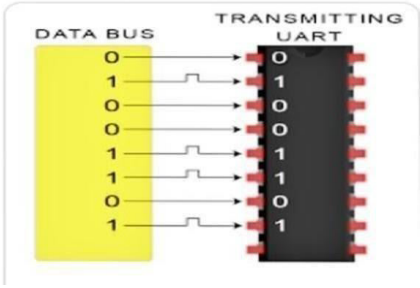
UART

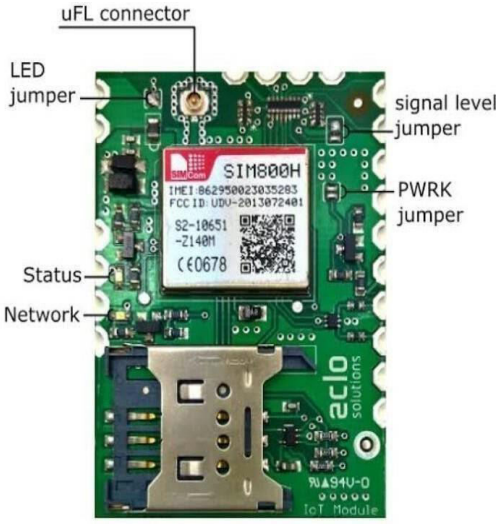
A Univeral asynchronous receiver-transmitter is a computer hardware device for asynchronous serial communication in which the data format and transmission speeds are configurable

.It sends data bits one by one, from the least significant to the most significant,framed by start and stop bits so that precise timing is handled by the communication channel



IOT MODULE

An IOT module is a small electronic device,machines and things connected to wireless networks and sends and receives data.



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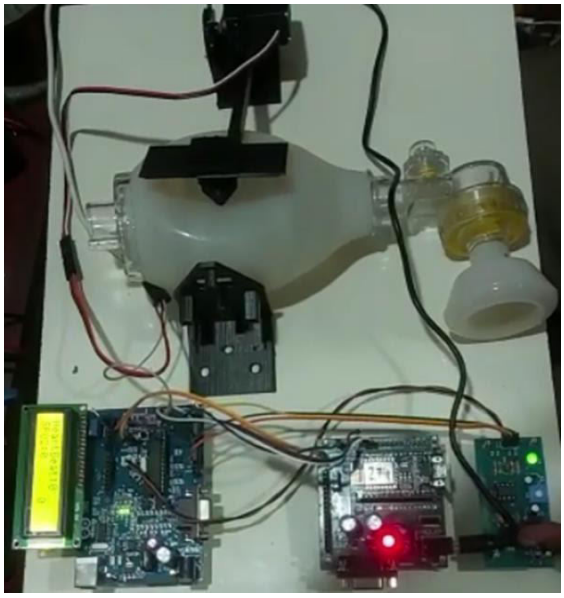
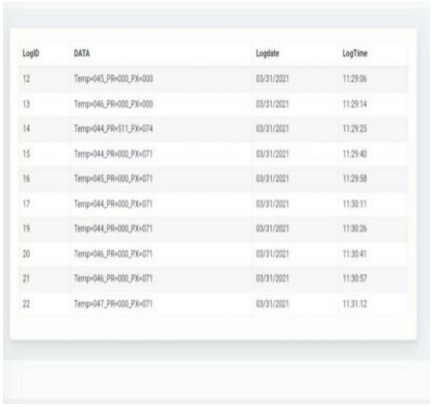
IV. RESULT AND DISCUSSION



HARDWARE SETUP

The Hardware Connection Which is Used For the Work is given .This Consists of MSP430 Board Which is Connected to the Iot Module.

SIMULATION OUTPUT:



LogID	DATA	Logdate	LogTime
12	Temp=045_PR=000_PX=000	03/31/2021	11:29:06
13	Temp=046_PR=000_PX=000	03/31/2021	11:29:14
14	Temp=044_PR=511_PX=074	03/31/2021	11:29:25
15	Temp=044_PR=000_PX=071	03/31/2021	11:29:40
16	Temp=045_PR=000_PX=071	03/31/2021	11:29:58
17	Temp=044_PR=000_PX=071	03/31/2021	11:30:11
19	Temp=044_PR=000_PX=071	03/31/2021	11:30:26
20	Temp=046_PR=000_PX=071	03/31/2021	11:30:41
21	Temp=046_PR=000_PX=071	03/31/2021	11:30:57
22	Temp=047_PR=000_PX=071	03/31/2021	11:31:12

V. CONCLUSION

This work proposes the design of a low-cost artificial ventilator in which mechatronic design strategies and manufacturing techniques based on rapid prototyping were implemented.

To guarantee the robustness and effectiveness of the proposed design, a robust control scheme based on a sliding mode super-twisting controller is used which allows the proper trajectory tracking control and enables to follow the required respiratory profiles.

Simulation and experimental results validate the effectiveness of the proposed controller and mechatronic design.

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FUTURE ENHANCEMENT

As future development, it is proposed to work toward the grant of the certification of this prototype in order to be used in the medical sector.

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INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 7.542

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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