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Design and Development of a Smart Seat for Relieving from Pressure Ulcers

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Abstract: ***The long-term effects of sitting in a wheelchair/chair can be painful. People who use wheelchairs/chair can get muscle deformities and even serious injuries. Wheelchair/chair injuries and pains, such as pressure ulcers, normally hit people who spend a significant amount of time in wheelchairs. Bad posture is another major challenge for people who use wheelchairs/chair because they are not able to change their sitting position.***
Keywords: Pressure ulcers, cushion, load cell, body weight, air pressure, spinal cord injury

I. INTRODUCTION

A pressure ulcer is an area of skin that breaks down when something keeps pressing or rubbing against the skin. It is a localized injury to the skin and its underlying tissue, usually over a bony prominence. Older people are at high risk of developing pressure ulcers due to their decreased physical and functional health conditions, which lead to decreased mobility and confinement to chair or bed. Over 50% of pressure ulcers are around the sitting areas near to the buttocks. In the early stage, the formation of pressure ulcers can be avoided by the application of appropriate treatment and preventive measures such as special pressure relieving seat cushions.
Sitting for prolonged periods of time is thought to increase the risk of developing pressure ulcers. Sitting forces the weight of an individual against the supporting seat surface which compresses the soft tissues around the buttock area between the chair and the bony ischial tuberosities. This pressure causes an obstruction of blood flow that when combined with limited movement, poor sensation, malnutrition, and increased age can eventually lead to ulceration. These severe, yet usually preventable wounds are relatively common, spanning acute, rehabilitation, and community settings, as such, the treatment of pressure ulcers is considered to outweigh the social and financial costs associated with prevention.
One of the most effective preventative methods in terms of cost and pressure relief is regular repositioning. Within rehabilitation, individuals at risk of developing pressure ulcers are taught and encouraged to perform regular repositioning movements in order to redistribute the build-up of pressure around the ischial tuberosity and sacral regions. These repositioning movements include vertical pushups, lateral and forward leans. Occupational therapists being responsible for seating and postural care are ideally placed to educate the individual and their carers on good skin health and the importance of relieving pressure at the seating interface regularly.

II. OBJECTIVES

The objective of this project is design and development of a smart seat to provide a relief from the pressure ulcers to the patient and Relief the pressure of hip bones of the person on seating continuously for work.

III. METHODOLOGY

The work is discussed in four parts.

A. Measure Weight Using Load Cell And Pass To The Controller
B. Connect the air pump to fill air into cushion
C. Connect solenoid to realising pressure
D. Test on adjusting surface pressure using switches

The first part is concerned with the construction of a state of-the-art pressure sensor, as well as a color LCD screen displaying the pressure distribution with the use of an Arduino Nano microcontroller.
Next, fill air into cushion according to weight , Various sitting postures and seat materials are used to test their impact on the sitting pressure distribution. Sitting postures include normal position and leaning forward.
The third part is on the connection on solenoid valve opens up to release the air.

The forth part is connect the switches for add pressure and release the air manually.

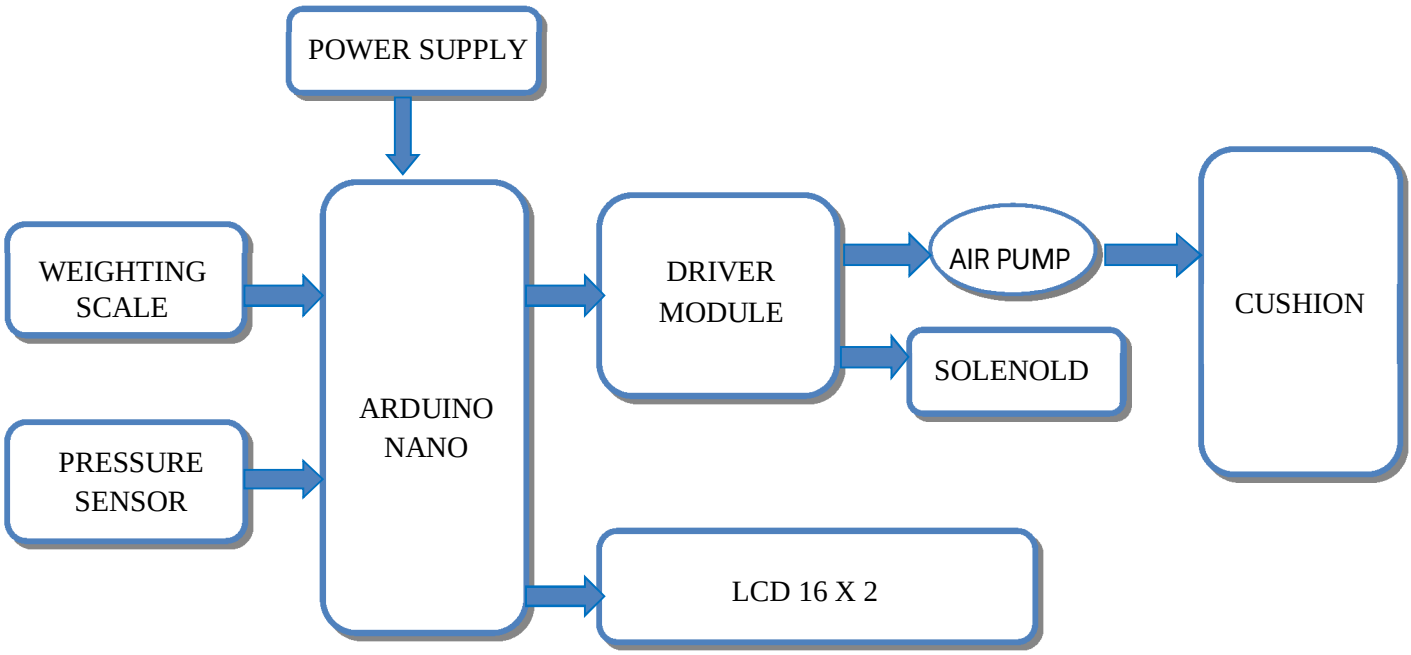

Fig1. Block Diagram A Smart Seat For Reliefing From Pressure Ulcers

IV. SCHEMATIC ARRANGEMENT

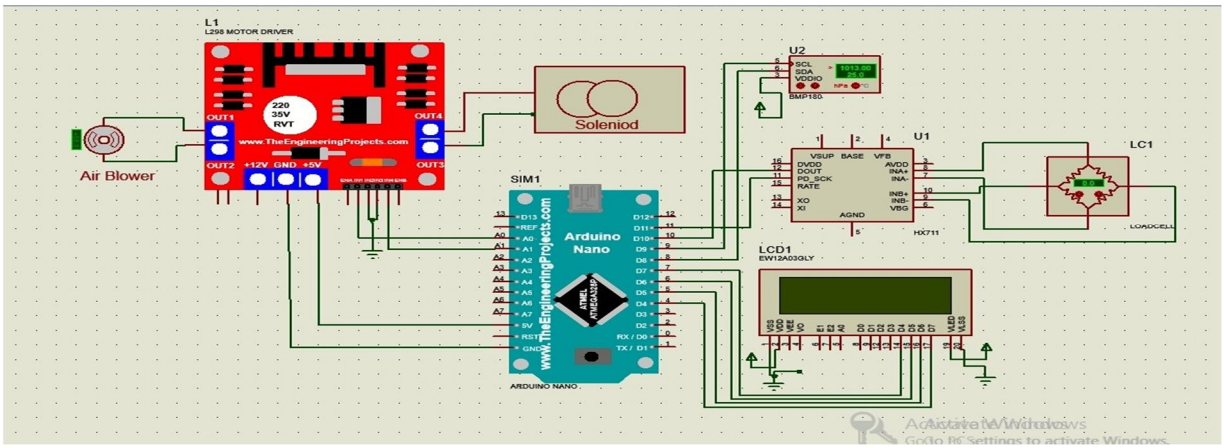

Fig2. Schematic Diagram

V. WORKING OF PROJECT

We are designing a system which will improve sitting arrangement for peoples. It is weight based cushion air pressure controlling system.

We will fill the air pressure in cushion according to weight of user.

Proposed system has arduino as a microcontroller board which used to control all the peripheral devices. A pressure sensor to measure air presser in air cushion. An air pump to fill air in cushion, a solenoid valve to release the air pressure.

To measure weight of a person we have weighing scale and lcd to show weight and pressure.

We used driver module L298 to drive air pump and solenoid.

12Volt 2Amp power supply is used for the project. On powering up the supply, Controller will initialize all sensors and actuators along with lcd display. After this controller will wait for the person to measure the weight.

After getting weight controller decide the air pressure to be filled in cushion. As soon as the weight is measure air realising solenoid valve opens up to release the air. It will be opened for 3 sec. as it is sufficient to release the pressure.
Once release, air pump started filling air with showing current pressure on LCD. Air pressure sensor reads the air pressure inside the cushion. Once the air pressure reaches the calculated pressure air pump stops the air flow. This is how we automate the process the blowing air inside cushion according to the weight.
We also have option to increase or decrease air pressure using manual push buttons.

VI. HARDWARE IMPLEMENTATION

A. Components Required To Smart Seat, The Required Components Are Listed Below

1) Air Pump
2) L298 Motor driver module
3) Solenoid Valve
4) Power supply
5) Arduino Nano
6) Cushion
7) Load Cell
8) LCD Display
9) Connectors and Cables

B. Mechanical Body Description

1) Mount All The Component on the wood board and connect air pump , solenoid valve and LCD display through L298 Motor Driver to arduino nano

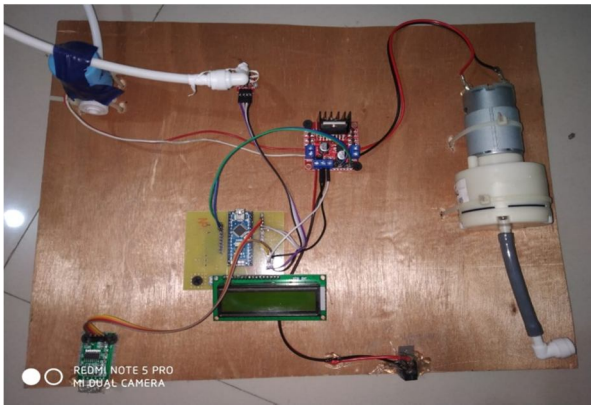

Fig3. Mount Component On Wood Board

2) Connect Air Pump to cushion for fill air through pipe

Fig4. Connect Air Pump

3) Connect Solenoid Valve to cushion for realising air through pipe

Fig5. Connect Solenoid Valve

4) Show Weight And Pressure in LCD Display

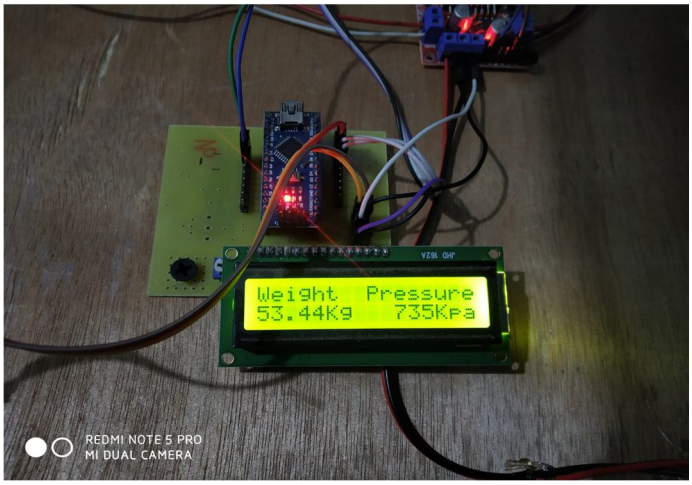

Fig6. Show Weight And Pressure on LCD Display

5) Complete Smart Seat

Fig6. Complete Smart Seat

VII. APPLICATION

It will be helpful in following applications:

A. For connecting rural area patients with specialized doctors.
B. Use By hospitals.
C. Used For Ulcers Patient.
D. Used For Office Employees.

VIII. CONCLUSION

The goal of WCM development described in this paper was to provide wheelchair bound SCI patients with a pressure monitoring system that can aid in the prevention of pressure ulcers. Potentially, this affordable device may improve the life of individuals with SCI, as it alerts patients and/or caregivers in the events of pressure hazards. The initial prototype of the device demonstrates technical feasibility of implementing WCM as an accurate, low-cost and low-power, always-on device for monitoring of air-filled wheelchair cushions. Further
work on the device will include further extension of its functionality and formal testing in human studies.
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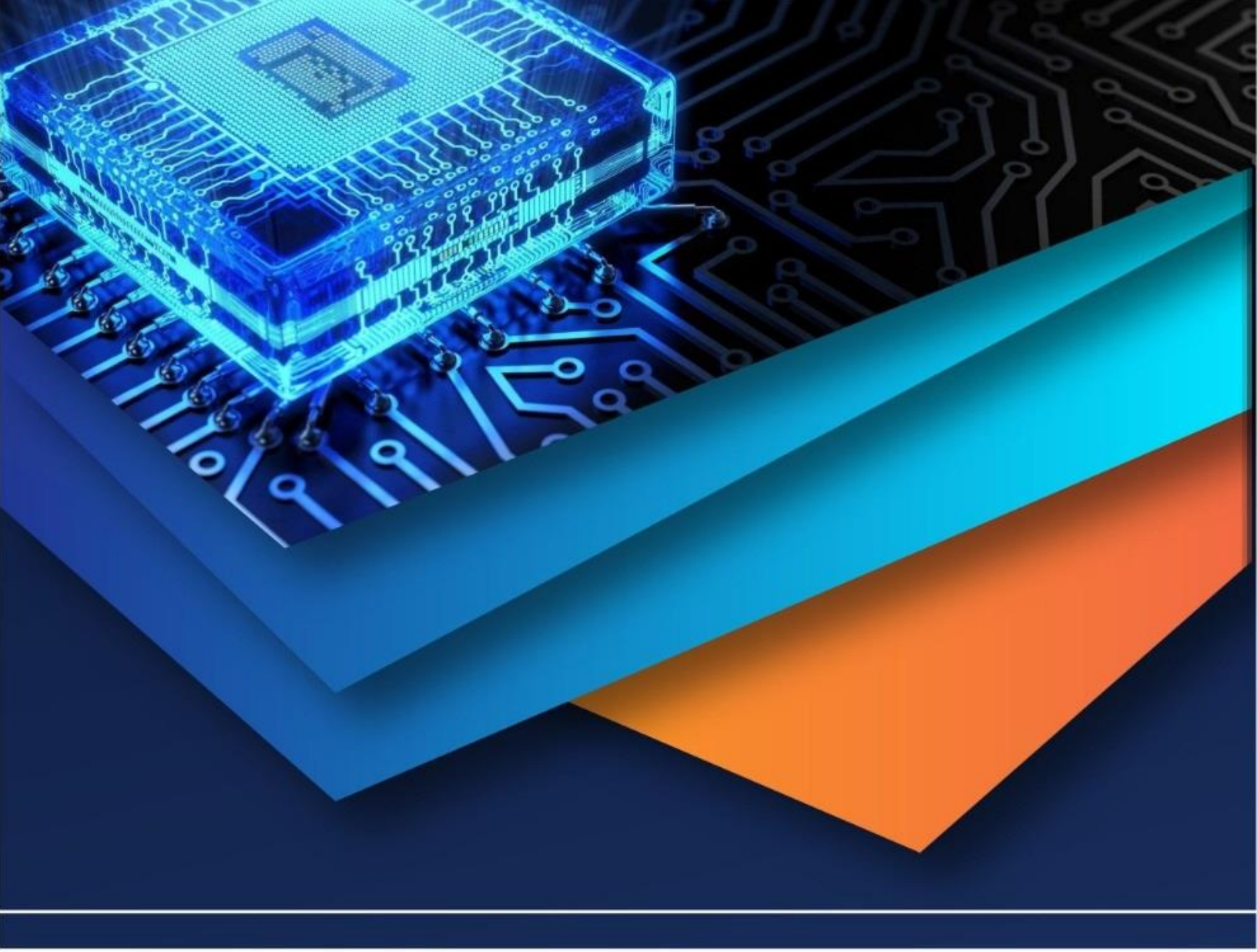

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