Ergonomic Evaluation and Design of School Backpacks

PEC University of Technology

Centre of Excellence in Industrial & Product Design

ABSTRACT

The Burden of course work in Indian schools has exposed the school children to various postural/gait disorders due to heavy backpack. The purpose of this project is to test the suitability of an ergonomically designed backpack that distributes the carrying loads on the school children's shoulders, chest and back. One hundred school children with pre selected BMI range will going to participate in the study representing fifth, sixth, seventh and eighth grade from three different group of schools i.e. private day school, public day school and boarding school. They will carry 0%, 5%, 10%, 15%, 20% and 25% of body weight in both existing and modified backpacks while walking for 5 min. Main response measures will be biomechanical and physiological characteristics. Participants feel more comfortable and their characteristics will improve when they will wear the modified backpack in comparison to existing backpack. This project will show that modified backpack will be superior to commercial backpack in terms of less muscular activities, less cardiac costs and less exertion ratings. Moreover, the propose design will prevent the students from carrying their loads in one side. This project will provide the community with a modified backpack that increases comfort and decreases pain.

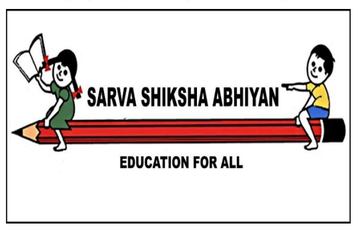
Relevance to industry: The issue of backpack safety is getting more and more attention among health care professionals. This project proposes a new designed backpack which is superior to the existing backpack in terms of less muscular activities, less cardiac costs, and less exertion ratings. This study provides the community with a new backpack that increases comfort, decreases pain, and occupational illness.

TARGET CUSTOMER

School Children

Pizza delivery/Courier Boys

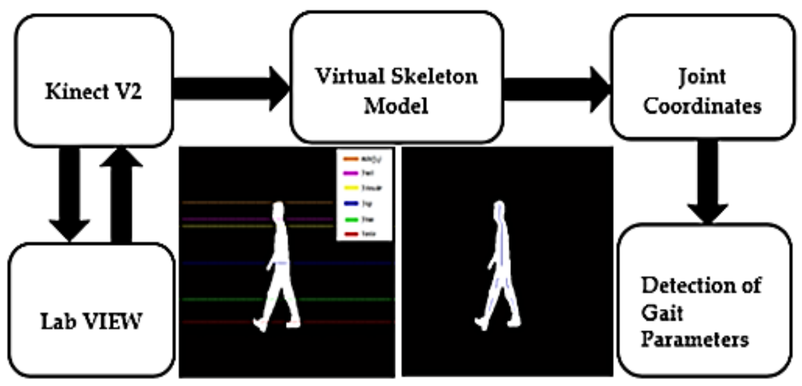
Hikers



Government

Backpack Industries

METHODOLOGY



- **Subjects**

Approximately 100 school students aged 11 to 15.

- **Backpack design**

Existing backpack and designed backpack will be used in this study.

- **Experimental design**

Type of backpack, load carried, activity level of student and school type will be the independent variables in the study. The dependent variables will include biomechanical and physiological characteristics

TEAM DETAILS

PEC University of Technology

Dr. Parveen Kalra
Journal Publications: 13 (Scopus)
Projects: 2 (completed)

Mr. Ishant Gupta
Journal Publications: 1 (Scopus)
Projects:0

National Institute of Industrial Engineering

Dr. Rauf Iqbal
Journal Publications:11 (Scopus Indexed)
Projects:10 (Completed)

PROBLEM DEFINITION

Backpacks are used for load carriage by students. With the growing trend of e-commerce, delivery boys also use backpacks. Recent studies carried out globally indicate prevalence of back pain in large number of school children. However, limited studies in identified area have been carried out in India. There has been growing concern among health practitioners, parents and school management regarding the effects of increasing load in school backpack on the gait and posture of the students. School going children and others suffer from back pain, less walking stability, and are uncomfortable due to the un-ergonomic design of school backpack. Children are the building blocks of the nation but recently large number of schoolchildren are reporting various disorders due to heavy backpacks. The concept of modified backpack is to combine the ergonomic principles of innovative trekking backpacks while ensuring that everything required for a school bag is provided for.

The objectives of the study is (i) to carry out study on backpack carriage by school children/e-commerce delivery boys (ii) to design and evaluate an ergonomic backpack. Gait and physiological parameters will be used in the evaluation. (iii) to develop backpack assessment framework and usage module.

A pilot study was carried out for phase I along the following lines:

- Validation of measurement of gait parameters (stride length, stride width, height of earlobe) using Kinect V2 sensor.
- Analysis of variation in gait parameters of students studying in different group) on carrying a backpack compared to the parameters when walking without a backpack.
- Evaluation of proper packing and wearing of school bag recommended by American Occupational Therapy Association (AOTA) on variation in gait parameters

UNIQUE INSIGHTS/BENIFITS

The issue of backpack safety is getting more and more attention among health care professionals. This project discusses and proposes a new designed backpack which is superior to the traditional backpack in terms of less muscular activities, less cardiac costs, and less exertion ratings. This project provides the community with a new backpack that increases comfort, decreases pain, and occupational illness.

This project proposed a modified design of backpack to reduce the negative impact of school backpack on the musclo-skeletal system. In other words, the objective of this project is to design a modified school backpack with an internal frame and It mimics the mechanics of body, taking the load off from shoulders without restricting the freedom of movement.

Two Key benefits of our modified backpack are as following

- **Move Freely**
- **Unload your Spine**

KEY IMPLEMENTATION CHALLENGES

- Backpack used in this study will only evaluated in the static mode.
- Only male participants were employed in this study. Future study with female subject pool may elucidate differences between gender types.

PROJECT POTENTIALS

Patent Potential: 2
Publication Potential:4-6
Industrial and Government Partnership potential
Financial Potential