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EVALUATION OF ENTARANCE AND EXIT MOTION OF USERS FOR CTU BUSES

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ABSTRACT

The ease of getting in and out of a vehicle (or ingress/egress) is one of the most important ergonomic issues for automotive manufacturers. Urban transport is quintessential to the usability of urbanites**;** enabling the carrying out of activities in their daily lives. Due to its public nature, it should be inclusive enough to cater to all the members in society of diverse ages, abilities and sizes. With special concerns on embarkation and disembarkation of bus, this research attempts to identify physical attributes of settings and devices that would not merely make provisions for access by the older persons who need facilitations but for other passengers as well. It has been found that during ingress and egress motion of passenger in CTU buses, there is awkward posture; lifting awkward items by passengers during ingress and egress motion and due to this awkward posture, passengers face various type of problem like low back pain, painful disorders of muscles, tendons, and nerves.

I. INTRODUCTION

It has been found that during ingress and egress motion of passenger in CTU buses, there is awkward posture; lifting awkward items by passengers during ingress and egress motion and due to this awkward posture, passengers face various type of problem like low back pain, painful disorders of muscles, tendons, and nerves. Awkward posture of passenger can be due to improper step height of bus entrance, width of footstep, improper height of handrails, driver skills, other passenger attitude etc. The aim of this study is evaluate the ingress motion of passengers with respect to the existing design of CTU buses with collecting data through questionnaires, video recording etc., analysis of ingress/egress using video recording and using questionnaires collected from 130 passenger at 10 different location in Chandigarh and design for ingress is to be evaluated and identifying the difficulties people may encounter when they are using public bus service in Chandigarh in particular issues related to ingress and egress. This work is divided into two phases. In the first phase, data has been collected through questionnaire and video recording technique to see the difficulties during ingress/egress motion. Further data has been analyzed to see the major effected passenger through statistical technique paired t-distribution. In the second phase, simulation study has been carried out for effected person to see the awkward posture due to various factors such as step height, handrail height, door width and bus driver attitude. In this phase, the passenger posture is recorded with the help of Microsoft kinect motion sensor and different angle with kinect camera of skeleton body of passenger is applied into simulation software Delmia. Software simulation is carried out on Delmia human to evaluate the ergonomic aspects of the Ingress. Virtual environment i.e. the digital 3D

model of vehicle is created in mechanical drawing module of CATIA is imported into the ergonomic module of Delmia. Actual activities and postures of passenger are recorded with the help of Microsoft Kinect motion sensor camera. After the simulation in "Human builder" module of Delmia, the simulation is subsequently saved and analyzed for biomechanics single action analysis. Based on the input postures, the Bio-mechanical report may be generated which provides the values of L4- L5 Lumber spine joint compression as well as L4-L5 Joint shear.

Paired t-distribution is conducted on two age group on each and every question of questionnaire and based of deviation of mean final result is obtain. A biomechanical and RULA analysis have been done on different posture of a passenger while ingressing. Through a review of ingress/egress motion in buses and alighting questionnaire filled by passenger are documented in google form and paired t-distribution is applied in statistical analysis software.

Improper bus driving, handrail size, step height, door width leads to various musculoskeletal disorder(MSD) which would lead to several injuries like whiplash and low back pain. So in order to avoid to it various ergonomic techniques are used in which RULA and REBA is one of the best technique used in order to find the comfort and discomfort for passenger.

II. OBJECTIVES

1. To study the Ingress/Egress motion of passengers with respect to the existing design of CTU buses with collecting data through Questionnaires, video recording etc.
2. To analysis of ingress/egress using video recording and Delmia digital human model, most significant age group is to be evaluated.
3. To identifying the difficulties people may encounter when they are using public bus service in Chandigarh in particular issues related to ingress and egress
4. To minimize the musculoskeletal disorder (MSD) resulted due to bad body posture during Ingress/Egress. This was achieved by using Rapid upper limb assessment (RULA) and Rapid entire body assessment technique

III. METHODOLOGY

Phase I- Collection of Data: Questionnaires has been used to collect the following information from user population,

1. Basic information
2. Travelling mode and frequency
3. Bus shelter design
4. Ingress and egress issues
5. Handrail size and placement.

Appropriate usability rating scale would be used to record the responses. Video recording of passenger during ingress and egress has been done by Microsoft kinect motion sensor,camera on CTU buses.

Phase II - Analysis of Data: Data obtained in Phase1 has been suitably analysed to draw inferences regarding difficulties encountered by public bus users during ingress and egress and the impact of age-related changes on

the same.Statistical techniques paired t-distribution has been utilized to quantify the comparison of different age group as follows,

1. Below 30
2. Between 30-40
3. Between 40-50
4. Between 50-60

Phase III – Reports and dissemination of results; Evaluation of different buses in CTU fleet with respect to ingress/egress is to be analysed. Potential measures for improving use of public bus service in the city have been specified. Bus driver skills and attitude could have a large impact on satisfaction of bus user population and result in better usability of public transport system. RULA/RBA and biomechanics techniques has been used for postures analysis.

IV. RESULTS

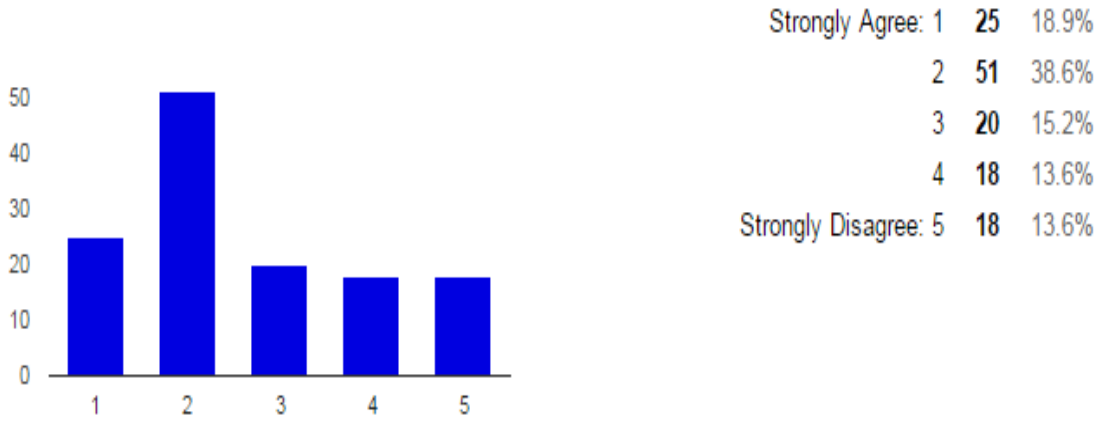

Fig.1: Improper Bus Parking

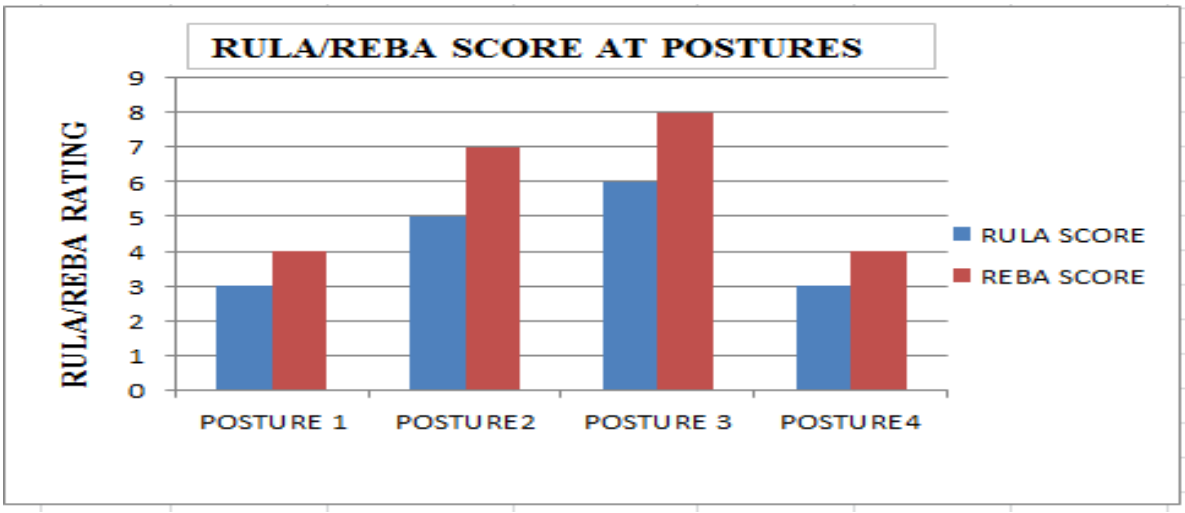

Fig. 2: RULA/REBA Scores At Different Postures

Figure 2 shows the RULA/REBA analysis scored obtained from 1 different postures of passenger. It has been seen that in both cases maximum score is in 3rd posture which means posture 3rd is a difficult posture during ingress.

Table1: Summary of Bio-mechanics report for the "Existing design variables" of CTU Bus (HMM Made)

Sr. No.	Analysis Type	Key Posture 1	Key Posture 2	Key Posture 3	Key Posture 4
1	L4-L5 Moment[kg]	17	2	4	-3
2	L4-L5 Compression [N m²]	815	1315	1845	556
3	L4-L5 Joint Shear [N m²]	28 (Posterior)	27 (Posterior)	69 (Anterior)	29 (Posterior)

L4-L5 Biomechanical parameters (Joint Compression, Shear and Moment) are noticed on all 4 key postures of the simulation of original CTU Bus (HMM Made) design as shown in table 1. General finding here is that all the biomechanical parameters of L4-L5 are maximum when the passenger is at key posture 3 i.e. the passenger is just about to enter in the doorway. Graphical analysis of bio-mechanics reports for variation of L4-L5 parameters is noticed during simulation of original design of CTU Bus (HMM Made).

V. CONCLUSION

The extract of outcomes of the study are enlisted below:

1. This present study mainly focused on exploring the effects of key problems faced by passengers while Ingress/Egress motion such as handrail height, bus driver attitude, step height, door width etc. on the human body.
2. Paired T-distribution suggested that there is significant difference during ingress -egress between the two age group namely as below40 and above 40 for convenience and comfort for majority of the questions.
3. It was found that, 67% passengers afraid of stumbling on moving buses. Further it was also observed that, 67% passengers feel that drivers usually do not park bus properly. In addition it was analysed that old age persons also faces problem of improper bus parking at bus stop.

4. 54% passengers think that bus drivers give proper time for Ingress or Egress however 46% think that bus drivers do not give proper time for Ingress or Egress. It should be noted that old age persons have same experience as with 46 % of the people.
5. Paired t-distribution results suggested that above 40 age group feel that gaps between the bus and the kerb is too wide to walk across. So proper training should be provided for drivers to park buses near the kerb.
6. The study demonstrates that the almost 36 % passenger agree that there is too wide gap between bus and kerb as well as almost 40% passengers disagree that kerb is not too wide to walk across. The remaining passengers have neutral view over it. So we should train driver that he/she must park the bus near the kerb.
7. The use of Delmia software proved to be effective for posture generation and L4-L5 Spine joint analysis as well as RULA and REBA analysis. It also has been suggested to replace the existing values of step height for low L4-L5 Compression and shear values.

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