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DESIGN AND DEVELOPMENT OF WALK AID COMPONENT

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Abstract

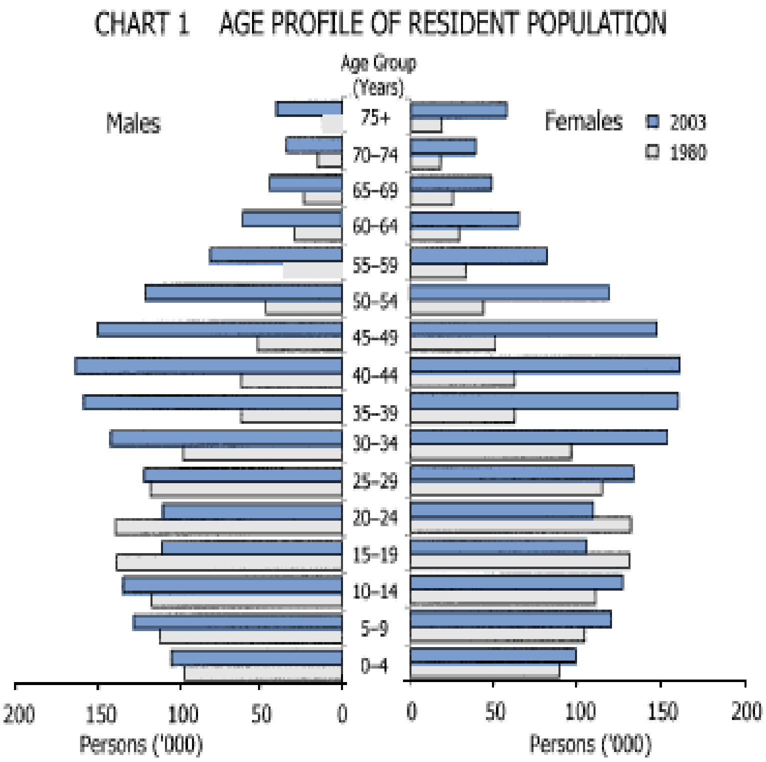
The world growth of the population ratio of elders who is 65 years old or more is growing by approximately860, 000 people per month. This trend is clear on both developed and developing countries including Egypt, Japan, France, China, India, Italy, USA, and so on. In aging society, many elderly people cannot perform normal daily activities because they have not enough physical strength. For example, in India, about 23% of elderly people which have low mobility and do not stay at hospital cannot perform daily activity without the help of caregivers. Therefore, nowadays, assistive devices have been introduced to improve the movement autonomy of elderly people. Usually, the most important activities for elderly people who have not enough physical strength are walking and sit to standing activities .Several studies have been done for developing assistive devices.

I. INTRODUCTION

The assistive devices assist elderly people or patient in performing daily life activities due to the inability of relearning. In contrast, the therapy rehabilitation robots assist patients to recover and reduce the task of clinicians on assisting the patients.

With the rapid ageing of the population, the size of elderly population is expected to increase further in years to come. The existence of better healthcare facilities and services and improved quality of life which lead to increased life expectancy and falling fertility rates which result in faster rate of growth of the overall elderly population in India.

It is a fact that India's population is ageing. A large proportion of the baby boomers are moving into their prime ages and the total population of age 60 and above will grow. Figure 1 shows that the number of elderly has been a steady increase in the number of elderly in India.



1. Fig: elderly people population

With the increase longevity, the number of old population is expected to increase in the future. This can be seen by the bee hive demographic graph where the bulge lies mainly age 30 to 60. With reference to the statistics provided by Sing stat, by the year 2020, the size of the old population is expected to double then that of 1999. This represents an average annual growth of 3.6 per cent over the period 1999 to 2020. They are going to constitute a bigger proportion of the resident population of the resident population; 0.8 per cent in 2020 as compared with 0.5 per cent in 1999. In 1999, there were 16,000 age 85 years and over.

II. BACKGROUND INFORMATION

THINGS TO CONSIDER WHEN CHOOSINGWALKING EQUIPMENT

Below are listed some aspects which need to be considered when choosing walking equipment.

HEIGHT

Walking frames

- It is very important to have the frame at the correct height for use. If the frame is too high, the person will find it difficult to straighten out his/her elbows sufficiently and will not take enough body weight through the arms.
- If the frame is too low, it will encourage the person to be bent over in a poor posture. However, a physiotherapist may deliberately set up a frame at a low height for people who tend to fall backwards - this will encourage them to lean forwards.

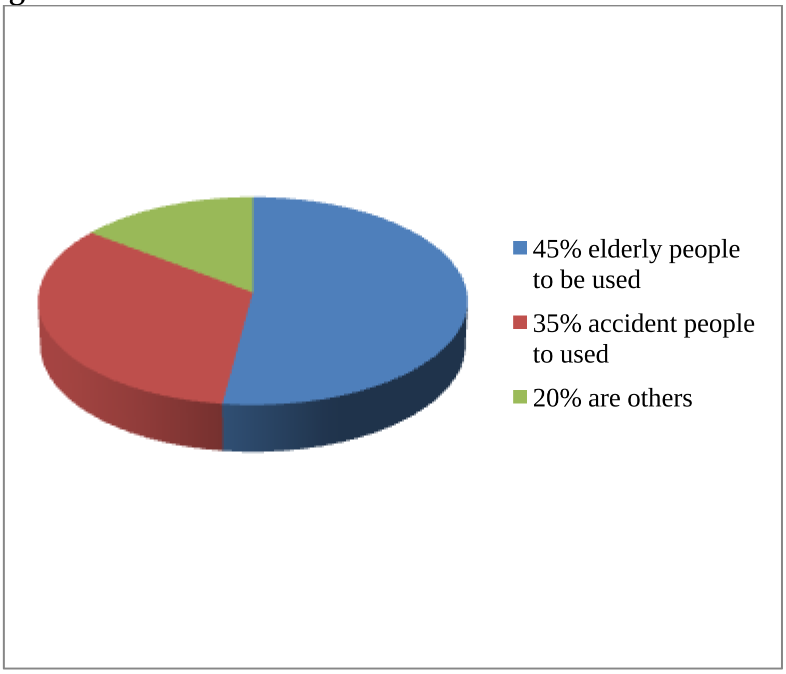
- Always be measured for the height of your walking frame wearing appropriate and supportive footwear.
  To use the frame correctly, people should lift and move it slightly in front of them. They can then lean on the frame, taking their weight through the handgrips, and take two equal length steps into the centre of the frame.
  To ensure that the arms are in the best position for weight bearing, the height of the handgrips should be at the level of the wrist bone when the user's elbows are very slightly bent Some models are available in a number of fixed heights - the nearest suitable height should be chosen. Others have telescopic legs so that their height can be more finely adjusted using spring loaded.

CUSTOMER REQUIREMENTS

Best results from the problems

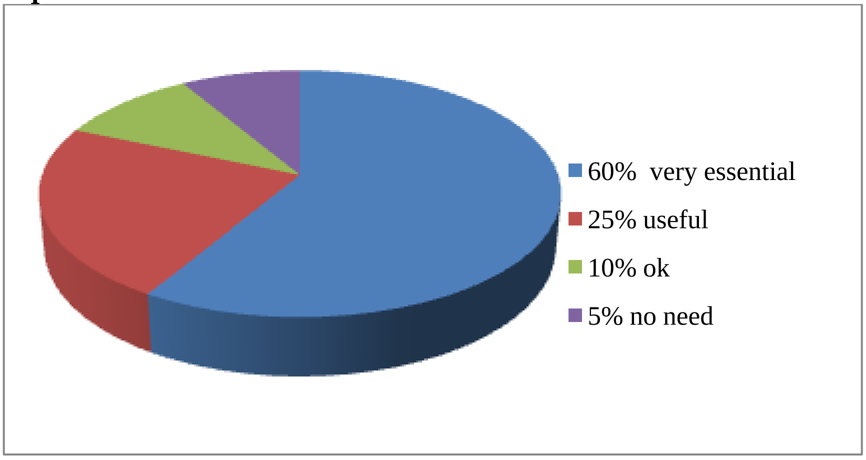
From the customer problems based we develop one new two wheeler walk aid with stand to explain about my product features to customers to respond below

Purpose of the using walk-aid:



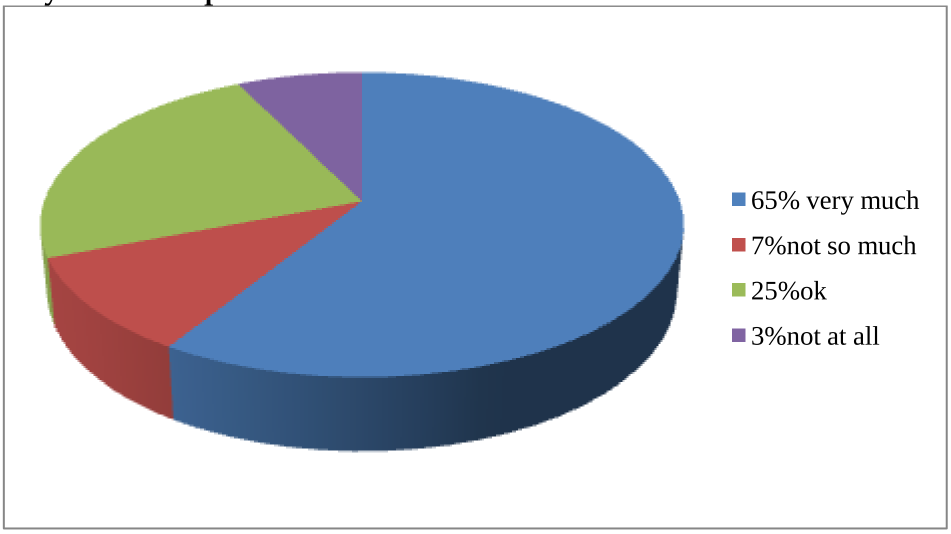
As we see in the above diagram most of the elderly to be used, next accident people to used only at a certain time. Hence for our project, it implies that the probability of use of the product could be almost daily.

2.2.2 Need for the product:



From the above diagram almost all the people said that the product is useful and more than half of them said that it is very essential. For us it implies that the scope of the product is very high and that we need to meet as much of the people's needs as possible.

2.2.3 Desirability to use the product:



It was interesting to note that, though most people said that they think that the product is useful, not all of them said that they would like it very much to use the product. But definitely the majority said that they would very much like to use such a product.

III. MAIN RESULT

ALUMINUM A360.

Properties of the AlA360

Composition: Al=88.7%, Mg=0.5% Si=9.5% Fe=1.3%

Density(gram/cc)	Young's modulus(Mpa)	Yield strength(Mpa)	Tensile strength(Mpa)
2.6 to 2.8	**70,000 to 80,000**	**165**	**320**

Table1: Properties of the AlA360

Load applied on the handle:

We taking the factor of safety (sf) =4

Bending stress σ = load/area

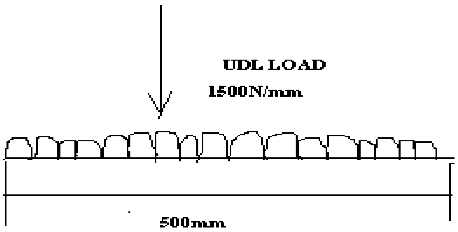
=F/a

F is the maximum force find out before calculation

=663.7*4/157

Bending stress σ =16.09 N/mm^2

Load applied on the seat:



Bending moment M = $wl^2/8$

M= 1500 * $500^2/8$

M= 46875 *10^3 N-mm

M/I=F/Y

$I_{xx}=b.h^3/12$

= 500 * 200 ^{3} /12=333333333.3mm^4

Y=H/2=200/2=100mm

Z=I/Y=333333333.3/100

Z=3333333.333mm^3

Bending stress f=m/z =46875 * 10^3/333333.33=14.06 N/mm^2

Bending stress f=14.06 N/mm^2

The yield strength of the AlA360 material is 165Mpa

When compare both (handle, seat) stresses values is less than

Hence design is safe

To calculate the mass of the walk-aid

Density= mass/volume

Mass= density*volume

= 2.6*$\frac{\pi}{4}$(d_1^2-d_2^2)*L

=2.6*0.785*(5.0625-3.0625)*384.667

= 1571grams

=1.571kgs

Mass=1.571kg

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3.2 STAINLESS STEEL 316L

Composition:

Properties of SS316L

Density(gram/cc)	Young's modulus(Mpa)	Yield strength(Mpa)	Tensile strength(Mpa)
7.19	**2,00,000**	**280**	**580**

Table2: Properties of SS316L

Load applied on the handle:

We taking the factor of safety (sf) =4

Bending stress σ = load/area

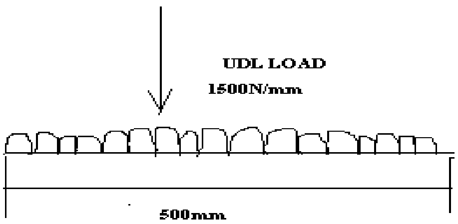
=F/a

F is the maximum force find out before calculation

=663.7*4/157

Bending stress σ =16.09 N/mm²

Load applied on the seat:



Bending moment M = $wl^2/8$

M= 1500 * $500^2/8$

M= 46875 *10^3 N-mm

M/I=F/Y

$I_{xx}=b.h^3/12$

= 500 * 200 ^{3} /12=333333333.3mm^4

Y=H/2=200/2=100mm

Z=I/Y=333333333.3/100

Z=3333333.333mm^3

Bending stress f=m/z =46875 * 10^3/333333.33=14.06 N/mm²

Bending stress f=14.06 N/mm²

The yield strength of the SS316L material is 280Mpa

When compare both (handle, seat) stresses values is less than

Hence design is safe

To calculate the mass of the walk-aid

Density= mass/volume

Mass= density*volume

$= 7.19*\frac{\pi}{4}(d_1^2-d_2^2)*L$

=7.19*0.785*(5.0625-3.0625)*384.667

= 4345grams

=4.345kgs
Mass=4.345kgs

IV. IMPLEMENTATION DETAILS OF THE PROPOSED METHOD

MODELING OF THE OF WALK-AID

INTRODUCTION TO CAD

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the use of computer technology for the process of design and design-documentation. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provide the user with input-tools for the purpose of streamlining design processes; drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD-based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, etc.) typically uses vector-based (linear) environments whereas graphic-based software utilizes raster-based (pixilated) environments.
CADD environments often involve more than just shapes. As in the manual drafting of technical and engineering drawings, the output of CAD must convey information, such as materials, processes, dimensions, and tolerances, according to application-specific conventions.

CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) objects.

CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more. CAD is also widely used to produce computer animation for special effects in movies, advertising and technical manuals. The modern ubiquity and power of computers means that even perfume bottles and shampoo dispensers are designed using techniques unheard of by engineers of the 1960s. Because of its enormous economic importance, CAD has been a major driving force for research in computational geometry, computer graphics (both hardware and software), and discrete differential geometry.

The design of geometric models for object shapes, in particular, is often called computer-aided geometric design (*CAGD*).

Current computer-aided design software packages range from 2D vector-based drafting systems to 3D solid and surface modelers. Modern CAD packages can also frequently allow rotations in three dimensions, allowing viewing of a designed object from any desired angle, even from the inside looking out. Some CAD software is capable of dynamic mathematic modeling, in which case it may be marketed as **CADD** — computer-aided design and drafting.

CAD is used in the design of tools and machinery and in the drafting and design of all types of buildings, from small residential types (houses) to the largest commercial and industrial structures (hospitals and factories).

CAD is mainly used for detailed engineering of 3D models and/or 2D drawings of physical components, but it is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies to definition of manufacturing methods of components. It can also be used to design objects.

CAD has become an especially important technology within the scope of computer-aided technologies, with benefits such as lower product development costs and a greatly shortened design cycle. CAD enables designers to lay out and develop work on screen, print it out and save it for future editing, saving time on their drawings

ANALYSIS OF THE WALK-AID

INTRODUCTION TO FEA

Finite Element Analysis (FEA) was first developed in 1943 by R. Courant, who utilized the Ritz method of numerical analysis and minimization of variational calculus to obtain approximate solutions to vibration systems. Shortly thereafter, a paper published in 1956 by M. J. Turner, R. W. Clough, H. C. Martin, and L. J. Top established a broader definition of numerical analysis. The paper centered on the "stiffness and deflection of complex structures".

By the early 70's, FEA was limited to expensive mainframe computers generally owned by the aeronautics, automotive, defense, and nuclear industries. Since the rapid decline in the cost of computers and the phenomenal increase in computing power, FEA has been developed to an incredible precision. Present day supercomputers are now able to produce accurate results for all kinds of parameters.

FEA consists of a computer model of a material or design that is stressed and analyzed for specific results. It is used in new product design, and existing product refinement. A company is able to verify a proposed design will be able to perform to the client's specifications prior to manufacturing or construction. Modifying an existing product or structure is utilized to qualify the product or structure for a new service condition. In case of structural failure, FEA may be used to help determine the design modifications to meet the new condition.

There are generally two types of analysis that are used in industry: 2-D modeling, and 3-D modeling. While 2-D modeling conserves simplicity and allows the analysis to be run on a relatively normal computer, it tends to yield less accurate results. 3-D modeling, however, produces more accurate results while sacrificing the ability to run on all but the fastest computers effectively. Within each of these modeling schemes, the programmer can insert numerous algorithms (functions) which may make the system behave linearly or non-linearly. Linear systems are far less complex and generally do not take into account plastic deformation. Non-linear systems do account for plastic deformation, and many also are capable of testing a material all the way to fracture.

FEA uses a complex system of points called nodes which make a grid called a mesh. This mesh is programmed to contain the material and structural properties which define how the structure will react to certain loading conditions. Nodes are assigned at a certain density throughout the material depending on the anticipated stress levels of a particular area. Regions which will receive large amounts of stress usually have a higher node density than those which experience little or no stress. Points of interest may consist of: fracture point of previously tested material, fillets, corners, complex detail, and high stress areas.

The mesh acts like a spider web in that from each node, there extends a mesh element to each of the adjacent nodes. This web of vectors is what carries the material properties to the object, creating many elements.
A wide range of objective functions (variables within the system) are available for minimization or maximization:

- Mass, volume, temperature
- Strain energy, stress strain
- Force, displacement, velocity, acceleration
- Synthetic (User defined)

There are multiple loading conditions which may be applied to a system. Some examples are shown:

- Point, pressure, thermal, gravity, and centrifugal static loads
- Thermal loads from solution of heat transfer analysis
- Enforced displacements
- Heat flux and convection
- Point, pressure and gravity dynamic loads

Each FEA program may come with an element library, or one is constructed over time. Some sample elements are:

- Rod elements
- Beam elements
- Plate/Shell/Composite elements
- Shear panel
- Solid elements
- Spring elements
- Mass elements
- Rigid elements
- Viscous damping elements

Many FEA programs also are equipped with the capability to use multiple materials within the structure such as:

- Isotropic, identical throughout
- Orthotropic, identical at 90 degrees
- General anisotropic, different throughout

Types of Engineering Analysis
Structural analysis consists of linear and non-linear models. Linear models use simple parameters and assume that the material is not plastically deformed. Non-linear models consist of stressing the material past its elastic capabilities. The stresses in the material then vary with the amount of

deformation as in.

Vibrational analysis is used to test a material against random vibrations, shock, and impact. Each of these incidences may act on the natural vibrational frequency of the material which, in turn, may cause resonance and subsequent failure. Fatigue analysis helps designers to predict the life of a material or structure by showing the effects of cyclic loading on the specimen. Such analysis can show the areas where crack propagation is most likely to occur. Failure due to fatigue may also show the damage tolerance of the material.

Heat Transfer analysis models the conductivity or thermal fluid dynamics of the material or structure. This may consist of a steady-state or transient transfer. Steady-state transfer refers to constant thermo properties in the material that yield linear heat diffusion.

Results of Finite Element Analysis

FEA has become a solution to the task of predicting failure due to unknown stresses by showing problem areas in a material and allowing designers to see all of the theoretical stresses within. This method of product design and testing is far superior to the manufacturing costs which would accrue if each sample was actually built and tested.
In practice, a finite element analysis usually consists of three principal steps:

1. **Preprocessing**: The user constructs a model of the part to be analyzed in which the geometry is divided into a number of discrete sub regions, or elements," connected at discrete points called nodes." Certain of these nodes will have fixed displacements, and others will have prescribed loads. These models can be extremely time consuming to prepare, and commercial codes vie with one another to have the most user-friendly graphical "preprocessor" to assist in this rather tedious chore. Some of these preprocessors can overlay a mesh on a preexisting CAD file, so that finite element analysis can be done conveniently as part of the computerized drafting-and-design process.

2. **Analysis**: The dataset prepared by the preprocessor is used as input to the finite element code itself, which constructs and solves a system of linear or nonlinear algebraic equations

$$K_{ij}u_j = f_i$$

Where u and f are the displacements and externally applied forces at the nodal points. One of FEA's principal advantages is that many problem types can be addressed with the same code, merely by specifying the appropriate element types from the library.

3. **Post processing**: In the earlier days of finite element analysis, the user would pore through reams of numbers generated by the code, listing displacements and stresses at discrete positions within the model. It is easy to miss important trends and hot spots this way, and modern codes use graphical displays to assist in visualizing the results. Typical

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postprocessor display overlays colored contours representing stress levels on the model, showing a full field picture similar to that of photo elastic or moiré experimental results.

V. RESULTS

1. Design calculation has been carried and find out the stress and observed design is safe for all materials
2. The designs of walk-aid has been carried out through ansys software, and observed design safe shown below table of stress and displacements for different materials

MATERIAL	VON MISES STREESS(Mpa)	DIAPALCEMENT(mm)
AlA360	**17.414**	0.041083
SS316L	**17.515**	0.143526
S-GLASS EPOXY	**17.418**	0.072720

Table 7: stress of all three materials

We observed the above table AlA360 is less stress and displacement when compared to remaining two materials

3. Weight of the walk-aid for different materials

MATERAIL	WEIGHT(kgs)
AlA360	**1.5**
Stainless steel 316L	**4.3**
S- glass Epoxy	**1.0**

Table 8: Weight of all three materials

We observed the above table when compared all three materials s-glass Epoxy walk-aid having less weight

4. Cost of the walk-aid for different materials

MATERIAL	COST(Rs)
AlA360	**805**
Stainless steel 316L	**1763**
S-glass Epoxy	**950**

Table 9: Cost of all three materials

By observing the above table the cost of the AlA360 walk-aid is less remaining two materials

VI. CONCLUSION

From the obtain results it is conclude that the design is safe for all three materials but we take the weights of three materials having different weights, s-glass Epoxy is lees weight but cost purpose it is very high. So finally when compared of three materials AlA360 is less stress, better weight and low cost so it is preferable for manufacturing of walk-aid.

MATERIAL	STRESS(Mpa)	WEIGHT(kgs)	COST(Rs)
AlA360	**17.414**	**1.5**	**805**

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