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Smart Ladder: A Survey

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Abstract -*Now a days ladders are important and essential tools that are used widely in a variety of industries. A ladder is a piece of equipment consisting of a series of bars or steps between two upright lengths of wood, metal or rope used for climbing up or down something. They help us move up and down and work at different heights. Portable ladders, in particular, are useful tools because they can be readily moved or carried. They are simply built and come in many sizes, shapes and styles.*

Key Words: Hydraulic cylinder, Pulley, Microcontroller, Belt, Lock, Battery, Motor.

1. INTRODUCTION

1.1 Different type of mechanism:

1. Hydraulic Scissor ladder:

"The machine which is achieved desired height by the using of linkages, folding support in the scissor form is known as scissor mechanism." A scissor ladder mechanism is a device used to extend or react a platform by hydraulic means. The extension and or displacement motion is achieved by application of force by hydraulic cylinder to one or more support. This forces results is an elongation of the cross pattern. Retraction through hydraulic cylinder is also achieved when lowering of platform is desired. A scissor life table has many useful purposes. The applications of a scissor lift table include a variety of things, but the platform is ultimately designed to help lift and raise heavier objects. The industrial lift is most often seen in behind the scenes of retail establishments and warehouses, although manufacturing engineers are always redesigning the lift for various uses like lifting heavy loads. A hydraulic scissor lift is a mechanical device used for various applications for lifting of the loads to a height or level [1]. A lift table is defined as a scissor lift used to stack, raise or lower, convey and/or transfer material between two or more elevations

Fig1. Hydraulic Scissor ladder [1]

2. Automatic Loft / Attic Ladder:

An attic ladder (US) or loft ladder (UK) is a retractable ladder that is installed into the floor of an attic and ceiling of the floor below the attic. They are used as an inexpensive and compact alternative to having a stairway that ascends to the attic of a building. They are useful in areas with space constraints that would hinder the installation of a standard staircase. Attic ladders typically consist of a ladder with wider steps and a steep slope.[1] A drawstring will hang down to allow the ladder to be manually extended. Attic ladders are usually made of wood, metal, aluminum. The fire departments carry attic ladders on fire apparatus for use to locate and extinguish fires in attic spaces. They are in a single ladder that is often used by firefighters for interior attic access and have hinged rungs, which allow them to be folded inward so that one beam rests on the other, with the rungs hidden away in the middle[7]. This compatibility allows it to be carried in attic scuttle holes, narrow passageways, and small rooms or closets.

Fig2. Automatic Loft / Attic Ladder [7]

3. Rotary car parking system:

It is simple to operate with the driver parking and leaving the vehicle in the system at the ground level. Once the driver leaves the incorporated safety zone the vehicle is automatically parked by the system rotating to lift the parked car away from the bottom central position. This leaves an empty parking space available at the ground level for the next car to be parked on. The parked car is easily retrieved by pushing the button for the relevant position number the car is parked on. This causes the required car to rotate down to ground level ready for the driver to enter the safety zone and reverse the car out of the system [14].

Fig3. Rotary car parking system

4. Automatic Liquid filing mechanism horizontal ladder:

Nowadays with many industrial applications, a conveyor system is used to move object from one location to another effective way to reduce losing time and effort and it is very useful in packaging process. A conveyor system has several forms but in this paper, a Flat belt type is used to move the bottles as shown in Fig. (4). Conveyors are especially useful in applications which including the transportation of heavy or large materials. A Flat belt conveyer has a dimensions of (120*70*30) cm the belt is made from elastic material [15]. Six pulleys a distributed along the belt, the first one rotates with the rotation of motor shaft and it usually called drive pulley and the other five pulley called idler pulley.

Fig4.Automatic liquid filling ladder [15]

5. Ladder Automatic Vending Machine:

During this industrialization vending machines play an important role for fulfilling the process immediate needs of the society. In a challenge to competitive industrial world, a system must be flexible, efficient and cost effective; so automation in machines is very much essential. When to design a program under which whenever a user's insert 5 rupees coin it will dispense tea and for 10 rupees coin it will dispense coffee and also count the number of coffee and tea served for the time. It requires a PLC Brand and model of SIEMENS S7 SERIES 312, IFM Communication and SIMATIC Manager [16].

Fig5. Automatic vending machine ladder [16]

2. LITREATURE SURVEY

1. Jaydeep et.al Design And Kinematic Analysis Of Gear Powered Scissor Lift Conventionally a scissor lift or jack is used for lifting a vehicle to change a tire, to gain access to go to the underside of the vehicle, to lift the body to appreciable height, and many other applications Also such lifts can be used for various purposes like maintenance and many material handling operations. It can be of mechanical, pneumatic or hydraulic type. The design described in the paper is developed keeping in mind that the lift can be operated by mechanical means so that the overall cost of the scissor lift is reduced. Also such design can make the lift more compact and much suitable for medium scale work. Finally the analysis is also carried out in order to check the compatibility of the design values [2].
2. Gaffar G Momin, Rohan Hatti, Karan Dalvi, Faisal Bargi, Rohit Devare,et.al,have proposed Design Manufacturing Analysis of Hydraulic Scissor Lift, In their paper they have discussed about is mainly focused on force acting on the hydraulic scissor lift when it is extended and contracted. Generally, a hydraulic scissor lift is used for lifting and holding heavy weight components. Material selection plays a key role in designing a machine and also influence on several factor such as durability,reliability, strength. [1].
3. Karan Dalvi Design, et.al Manufacturing Analysis Of Hydraulic Scissor Lift is a simple mechanical device used to raise element or object from ground level to a certain height to perform a specific work with maximum load and minimum efforts. This project describes the design as well as analysis of a mechanical scissor lift which works on the principle of screw jack. The design will be developed keeping in mind that the lift can be operated by mechanical means so that the overall cost of the scissor lift is reduced [3].
4. Todd J. Bacon designed a belt-driven transportation system including a first set of pulleys rotatable attached to a second member and a second set of pulleys rotatable attached to a second member. The first and second members have relative movement to each other .The system further includes a unitary belt that is guided through a path defined by the first and second sets of pulleys. A plurality of range members maintain a proper positioning of the belt on the pulleys. [4].
5. Dong et al described that the tip-over of scissor lifts in operation has frequently resulted in the death and/or severe injuries of workers. Two series of experiments were performed under possible tip-over scenarios: curb impact and pothole depression. The results suggest that the lift should not be elevated on largely deformable and/or uneven surfaces such as bridged wood board or a soft soil base. The worker on the lift platform should avoid any large continuous periodic movement or forceful action in the horizontal plane, especially when the lift is fully elevated. Besides the tilt angle of the lift, the tilt speed should be monitored to help prevent the tipover. [5].
6. Richard et al developed a scissor lift apparatus that has three scissor units for supplying heavy 1oads. A central Scissor unit has its arms located inwardly of the immediately lower and upper scissor units, and folds into the upper and lower scissor units for storage within a chamber in a mobile chassis The scissor arms of the upper and lower scissor units includes rectangular box beams with a great vertical than horizontal dimension. Hydraulic cylinders are located within and coupled to the opposite two arms of the center scissor unit to expand and collapse the same. [6].
7. Divyesh Prafulla Ubale, et al. The conventional method of using rope, ladder lift getting person to a height encounter a lot of limitation (time and energy consumption, comfortability, amount of load that can be carried etc.) also there may be a risk of falling down in case of ladders hence hydraulic scissors lift is designed to overcome all these difficulties. The main aim of this paper is design and analysis and to construct a multiutility home equipment for senior citizens so that they can carry their daily activities efficiently. Also the equipment should be compact and cost effective. Lifting height achieved by scissor mechanism is of

1 m from bottom level. Buckling and bending failure analysis of scissor is also done in this paper. With ceaseless development of science and technology, more and more new technologies are applied to lifting appliance design. This project aims at making equipment multifunctional, easy to use/operate, cost effective and portable so that it will be used conveniently at home and may be used in hospitals, hotels and other common places. Senior citizens face many problems to carry out their day to day activities, as this equipment is designed in such a way that (e.g. it is remote operated with battery) they can easily move in house and perform day to day activities. All safety considerations are taken into account while designing equipment. Scissor lifting mechanism is designed to lift person to desired height. A scissor lift mechanism is a device used to extend or retract a platform by hydraulic means. The Extension or displacement motion is achieved by the application of force by hydraulic cylinder to one or more supports. This force results in an elongation of the cross pattern. Retraction through hydraulic cylinder is also achieved when lowering of platform is desired [8].

8. S. B. Naik, et al A special type of beam lifting device is designed for textile industries. The machine is hydraulically operated and is having two frames one horizontal and another vertical. Horizontal frame is mounted with two telescopic cylinders used for beam lifting to required height. The mobility for the structure is provided by using castor wheels. Finite element analysis of the frames is done by ANSYS software considering the need of the textile industries, a special purpose machine has been designed to lift the beams in textile industries. The finite element analysis of the frame of this machine is done to get the idea of the stresses & deformation of the structure in order to modify the same if needed [10].
9. M. Abhinay, P.Sampath Rao Aerial scissor lifts are generally used for temporary, flexible access purposes such as maintenance and construction work or by fire-fighters for emergency access, etc which distinguishes them from permanent access equipment such as elevators. They are designed to lift limited weights usually less than a ton, although some have a higher safe working load (SWL). The increasing demand of Aerial Scissor Lifts in companies in order to improve their manufacturing flexibility and output by providing variable height access to their work. This is especially true when the work being accessed is raised off the floor and outside an operator's normal ergonomic power zone. In either case, it is much more economical to bring the worker to the work rather than bringing the work to the worker. In this project, we have modeled an aerial scissor lift by using ANSYS software which is one of the software used for modeling components in most of the design based industries. While the modeling of the components the material selection is carried out simultaneously based on the design considerations related to loads, etc. Later the stress and strain concentration, deformation on the aerial scissor lift have been found by applying certain load on the lift's platform, using the Finite Element Analysis (FEA) by using ANSYS software that provides best output within few seconds. Finally the stress and strain concentration, deformation result [11].
10. M. Kiran Kumar1, J. Chandrasheker2, Mahipal Manda3, D.Vijay Kumar4. This paper is mainly focused on force acting on the hydraulic scissor lift when it is extended and contracted. Generally, a hydraulic scissor lift is used for lifting and holding heavy weight components. Material selection plays a key role in designing a machine and also influence on several factor such as durability, reliability, strength, resistance which finally leads to increase the life of scissor lift. The design is performed by considering hydraulic scissor lift as a portable, compact and much suitable for medium type of load application. Drafting & drawing of hydraulic system scissor lift is done using solid works with suitable modeling and imported to Ansys work bench for meshing and analysis. Hence, the analysis of the scissor lift includes Total deformation load, Equivalent stress, was done in Ansys and all responsible parameters were analyzed in order to check the compatibility of the design value. The computational values of two different materials such as aluminum and mild steel are compared for best results [12].

3. METHODOLOGY

Based on our types of ladders we observe following methods can be proved useful in life.

1. Fixed Ladder :-
   A fixed ladder is a vertical ladder mounted permanently to a structure. These ladders are primarily used to access roofs or other structures for industrial purposes. Two side members joined by several rungs; affixed to structure with no moving parts. In addition, fixed ladders must meet the following requirements:
   - Fixed ladders must be able to support at least two loads of 250 pounds (114 kg) each, concentrated between any two consecutive attachments. Fixed ladders also must support added anticipated

loads caused by ice buildup, winds, rigging and impact loads resulting from using ladder safety devices.
- Individual rung/step ladders must extend at least 42 inches (1.1 m) above an access level or landing platform either by the continuation of the rung spacing as horizontal grab bars or by providing vertical grab bars that must have the same lateral spacing as the vertical legs of the ladder rails.
- Each step or rung of a fixed ladder must be able to support a load of at least 250 pounds (114 kg) applied in the middle of the step or rung.
- Minimum clear distance between the sides of individual rung/step ladders and between the sides rails of other fixed ladders must be 16 inches (41 cm).
- Rungs of individual rung/step ladders must be shaped to prevent slipping off the end of the rungs.
- Rungs and steps of fixed metal ladders manufactured after March 15, 1991, must be corrugated, knurled, dimpled, coated with skid-resistant material or treated to minimize slipping.

Advantages:

- The price is cheap
- Durable
- Simple shape

Disadvantages

- Not adjustable high
- Can't be move
- Fix shape(can't be form into other shape)
- Fix to the wall

2. Step Ladder :-

You can use either one or both sides for climbing, depending on the step design. The twin-step ladder describes the latter. However, you'll find some models where you can only use one side. These are called simple front step ladders. The other side is for support only. Spreaders join both and limit how far each can move out from the center. They lock in place to keep it from buckling when you're stepping onto it. The bottom portions are the feet or shoes. They typically have some type of anti-skid material on the end of them.

Advantages:

- Stable to use
- Foldable to store
- Durable

Disadvantages:

- Heavy to lift
- Not for high place maintenances job
- Difficult to carry
- Use a lot of space to store
- Only one side can be use(have rungs)
- Fix for one angle

3. Multi Purpose Folding Ladder:

The multipurpose ladder combines the features of the step and extension models that increase its versatility. It can be self-supporting or require that you place it against something stable. It can even stand in as scaffolding, depending on the product. It's a smart choice for a contractor or the DIY handyman.

Advantages:

- Foldable
- Stable
- Adjustable high (can be form into many shape for different high)
- Did not use a lot of space to store

Disadvantages:

- Heavy
- Difficult to bring

4. Telescopic Ladder:

Telestep is a company focused on producing ladders and other tools that are able to quickly and easily transform from compact and easy to carry items to full size and usable tools. Telescoping ladder, commonly used to refer to a hybrid between a step ladder and an extension ladder with 360-degree hinges; has three parts and can be taken apart to form two step ladders. Telesteps has three models of their famous telescoping ladder. Titled after their maximum height the three models are the 10.5 Foot Model, the 12.5 Foot Model and the 14.5 Foot Model. The obviously distinction between each is the maximum height they are capable of reaching; however weight should also be taken into consideration as well as the size of the ladder when it is in storage position. The higher the maximum height of the ladder, the more it weighs

and the larger it will be in the storage position. For some, of course, the biggest difference comes when looking at the price tag. For every size you move up, you have to be willing to pay a little extra.

Advantages:

- Adjustable for high and medium high place for maintenances job
- Foldable
- Stable to use because the base part is more width
- Light weight (easy to lift to other place)

Disadvantages:

- Large and hard to keep or stored
- Difficult to lift to other place

5. Extension Ladder:

Extension ladders usually have two sections that operate in brackets or guides that allow for the ladder to be used at adjustable lengths. Extension ladders are not self-supporting and require a stable structure that can withstand the intended load. Place ladders on a firm, level surface and ensure the footing is secure.

- Erect extension ladders so that the upper section rests on (e.g., in front of) the bottom section. This placement means the bottom section "faces" a wall or other supporting surface (see figures below).
- Place the ladder feet so that the horizontal distance between the feet and the top support is 1/4 of the working length of the ladder. The ladder will be leaning at a 75 degree angle from the ground. Raise and lower ladders from the ground. Ensure that locking ladder hooks are secure before climbing.
- For access to an elevated work surface, erect ladders so that a minimum of 1 m (3 ft) extends above a landing platform. Tie the top at support points.
- Use care when getting on and or off the ladder at the top or bottom in order to avoid tipping the ladder over sideways or causing the ladder base to slide.
- Brace or tie off the ladder near the base. If there is no structure to tie off to, use a stake in the ground.
- Leave all tie-off devices in place until they must be removed before taking the ladder down.
- Maintain the minimum overlap of sections as shown on a ladder label. Refer to safety regulations.
- Set up barricades and warning signs when using a ladder in a doorway or passageway.

5. CONCLUSION

We studied Hydraulic Scissor ladder, Automatic Loft or Attic Ladder, Rotary car parking system, Automatic liquid filling ladder & Automatic vending machine ladder. The main scope of the devices used for lifting purposes is to make the table adjustable to a desired height and scope for fire departments carry. Attic ladders on fire apparatus for use to locate and extinguish fires in attic spaces. Scope for automated car rotating system has been implemented to reduce excess use of land place which is very scarce in metro system. The automatic vending machine work is to encourage small scale industries for the implementation of automation in beverage preparation and its bottling plant for Painting purpose, Electrical wireman, Plumber & House working system.

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