Design and Fabrication of Safety Measures in Elevator
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Abstract:
Safety is an important aspect in all machines and in all places and at all times. Elevator is lift powered by motors transports people and goods from floor to floor. If maintenance is not good, the elevator rope may break causing accidents and injuring people. To make the lift safer, a breaking system which incorporates a limit switch is to be designed. Actuator switch are also be placed on the bottom of the elevator to reduce the speed of the falling weight of the cab. The system would reduce the damage done to people and materials if the rope breaks, enhancing safety.

I. INTRODUCTION

1.1. ELEVATOR
An elevator (us and Canada) or lift (common wealth countries) is a type of vertical transportation that moves people or goods between floors (levels, decks) of a building, vessel or other structure. Elevators are typically powered by electric motors that drive traction cables and counterweight systems like a hoist, although some pump hydraulic fluid to raise a cylindrical piston like a jack. In agriculture and manufacturing, an elevator is any type of conveyor device used to lift materials in a continuous stream into bins or silos.

1.2. TYPES OF ELEVATOR
Several types exist, such as the chain and bucket elevator, grain auger screw conveyor using the principle of Archimedes screw or the chain and paddles or forks of hay elevators. Languages other than English may have loan words based on either elevator or lift. Because of wheelchair access laws, elevators are often a legal requirement in new multistore buildings, especially where wheelchair ramps would be impractical. There are also some elevators which can go sideward in addition to the usual up and down motion. Some sources from later historical periods mention elevators as cabs on a hemp rope powered by hand or by animals.

1.3. EVOLUTION IN ELEVATORS
The earliest known reference to an elevator is in the works of the Roman architect Vitruvius, who reported that Archimedes (c. 287 BC - C.212 BC) built his first elevator probably in 236 BC. In 1000, the book of secrets by Al-Muradin in Islamic Spain described the use of an elevator-like lifting device, in order to raise a large battering ram to destroy a fortress. In the 17th century the prototypes of elevators were located in the palace buildings of England and France. Louis xiv of France had a so-called flying chair built for one of his mistresses at the chateau de Versailles in 1743. Ancient and medieval elevators used device systems based on hoists or windlasses. The invention of the system based on screw drive was perhaps the most important step in elevator technology since ancient times, leading to the creation of modern passenger elevators. The first screw drive elevator was built by Ivankallidin and installed in the winter palace in 1793. Several years later another of kaibun’s elevators was installed in the Arkhangelsk near Moscow. The development of elevators was led by the need for movement of raw materials including coal and lumber from hillsides. The technology developed by by these industries and the introduction of steel beam construction worked together to provide the passenger and freight elevators in use today. Starting in the coal mines, by the mid-19th century elevators were operated with steam power and were used for moving goods in bulk in mines and factories. It elevated paying customers to a considerable height in the canter of London, allowing them a magnificent panoramic view of downtown. Early, crude steam driven elevators were refined in the ensuing decade; in 1835, an innovative elevator called the TEAGLE was developed by the company frost an Stutt in England. The elevator was belt driven and used a counterweight for extra power. The hydraulic crane was invented by sir William Armstrong in 1846, primarily for use at the Tyneside docks for loading cargo. These quickly supplanted the earlier steam driven elevators: exploiting pascal’s law, they provide much greater force. A water pump supplied a variable level of water pressure to a plunger encased inside a vertical cylinder, allowing the level of the platform (carrying heavy load) to be raised and lowered. Counterweights and balances were also used to increase the lifting power of the apparatus. Henry waterman of new York is credited with inventing the standing rope control for an elevator in 1850.
1845, the Neapolitan Gaetano Genovese installed in the royal palace of Caserta the flying chair, an elevator ahead of its time, covered with chestnut wood outside and with maple wood inside. It included a light, two benches and a hand operated signal, and could be activated from the outside, without any effort on the part of the occupants. Traction was controlled by a motor mechanic utilizing a system of toothed wheels.

2. LITERATURE SURVEY:

- Peter spies, method and device for stopping of an elevator cage due to a deviation of the elevator position, acceleration, or speed from a travel curve in excess of a certain predetermined safety margin. Travel parameters, computed by the elevator control, may be passed on to a drive control of a cage drive for moving and positioning of the elevator cage, and may also be passed on to a drive control of a reference drive for moving and positioning the trigger part.

- J.W. meeker patented a method which permitted elevator doors to open and close safely. In 1887, American inventor Alexander miles of Duluth, Minnesota patented an elevator with automatic doors that would close off the elevator shaft. The first elevator in India was installed at the raj bhavan in Calcutta (now Kolkata) by Otis in 1892. By 1900, completely automated elevators were available, but passengers were reluctant to use them.

- Elmer F chapman, the elevators for use in the 21st century must be designed for safety under all conditions that may be expected in the building in which they are to be installed. The integration of smoke control systems and fire protection systems along with evacuation procedures for the use of elevators systems during fire emergencies are discussed.

3. PART DISCRIPTION

3.1 PULLEY:
A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. A pulley may have a groove or grooves between flanges around its circumference to locate the cable or belt. The drive element of a pulley system can be a rope, cable, belt, or chain. A rope and pulley systems that is, a block and tackle is characterised by the use of a single continues rope to transmit a tension force around one or more pulleys to lift or move a load.

3.1.3 FIXED PULLEY:
A fixed pulley has an axle mounted in bearings attached to a supporting structure. A fixed pulley changes the direction of force on a rope or a belt that moves along its circumference.

3.1.2 MOVABLE PULLEY:
The movable pulley is used to reduce the amount of input force to lift a load. The most popular system that uses this pulley would be a well. Unlike the fixed pulley, the movable pulley is attached to the load, and is lifted by pulling up on the rope, making it twice as easier to lift a heavy object. In this case, a 20 pound load could be lifted with just 10 pounds of input force. The tradeoff is that you would have to pull twice the amount of rope, and gravity is not in your favour by pulling off.

3.2 WIRE ROPE:
Wire rope is several strands of metal wire twisted into a helix forming a composite rope in a pattern known as laid rope. Large diameter wire consists of multiple strands of such laid rope in a pattern known cable laid. In stricter senses the term wire rope refers to diameter larger than 3/8 inch (9.52mm), with smaller gauges designated cable or word initial wrought iron wires were used, but today steel in the main material used for wire ropes. Historically, wire ropes evolved from wrought iron chains, which had a record of mechanical failure.
3.3 DC MOTOR:
Dc motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common type rely on the forces produced bu magnetic fields. Nearly all types of dc motors have some internal mechanism, either electromechanics or electronic, to periodically change the direction of current flow in the part of a motor. Dc motors were the first form of motor widely used, as they could be powered from existing direct current lighting power distributions systems. A dc motor speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of the current in its field windings.

3.4 SPRINGS:
A spring is an elastics object that stores the mechanical energy. Springs are typically made of spring steel. There are many spring designs. In everyday use, the term often refers to coilsprings. When a conventional spring, without stiffness variability features, is compressed or stretched from its resting positioning, it exerts an opposing force approximately proportional to its change in length (this approximation breaks down for larger deflections).the rate or spring constant of a spring is the change in the force it exerts, divided by the change in deflection of the spring. That is, it is the gradient of the force versus deflections of the curve.

3.5 ACTUATOR SWITCH:
An actuator is a component of a machine that is responsible for moving and controlling a mechanism or systems, for example by opening a valve.in simple terms, it is a mover .an actuator requires a control signal and a source of energy. The control signal is relatively low energy and may be a electric voltage or current, pneumatic hydraulic pressure, or even human power, its main energy source may be an electric current, hydraulic fluid pressure, or pneumatic pressure. When it receives the control signal, an actuator responds by converting the signals energy into mechanical motion.

3.6 FRAMES:
Steel frame is a building technique with a skeleton frame of vertical steel columns and horizontal I-beams, constructed in a rectangular grid to support the floors, roof and walls of a building which are all attached to the frame.

The development of this technique made the construction of the skyscrapers possible. The use of steel for structural purposes was initially slow. The Bessemer process in 1855 made steel production more efficient, and cheap steels, which had high tensile and compressive strength plus good ductility were available from about 1870, but wrought and cast iron continued to satisfy most of the demand for iron based building products.

WORKING PRINCIPLE:
The rope passes between two fixed pulley and a movable pulley. The movable pulley is held against the spring. The tension in the spring reduces if the rope breaks and expands causing the pulley to move forward. The forward motion triggers the actuation of the brake sensed by the sensor. The actuator actuates the brakes which strikes against the wall, reducing the speed of the wall. The spring at the bottom on the floor cushions the fall.

DESIGN CALCULATION:
TENSION ON THE ROPE
\[ T = m \times (v^2) \]
Where \( m \) = mass, \( V \) = velocity
\[ F_c = m \times v^2 / r \]
\[ = 10 \times 2^2 / 1.5 \]
\[ = 10 \times 2.67 \]
\[ F_c = 26.7N \]
Mass of the lift is not constant because the weight of the elevator varies in according to the number of person travelling on the lift.so that the tension acting on the rope of the elevator is not constant at all time.it varies as per the number of people travelling on the elevator.

PLAN OF WORK:
A work plan is an outline of a set of goals and processes by which a team and or person can accomplish those goals, and offering the reader a better understanding of the scope of the
project. Work plans, whether used in professional or academic life, help you stay organized while working on projects. Through work plans, you break down a process into small, achievable tasks and identify the things you want to accomplish.

**SOLUTION FOR THE PROBLEM:**
The problem is identified and the solution for the problem is identified by discussion. The solution provided is to provide a rectification to the problem in various terms such as the safety, cost efficient etc.

**DESIGN:**
The design is developed in order to satisfy the aim of the project or the solution. By choosing the proper material, clear design is setup. The design developed in the project is to make the lift more safer to users.

**FABRICATION:**
Fabrication is defined as the action of manufacturing or inventing the products in accordance to design. Here the fabrication is done with the design plan which is made already either by a team or a person.

**ASSEMBLY:**
It is the process by which the products is assembled in accordance with the design. The part is get assembled as per the plan design produced which develops the project to its finished stage with the required output.

4. CONCLUSION:
The braking system using a limit switch is developed. The breaks get actuated when the ropes breaks, which reduces the speed of fall of the cab by causing friction against he wall surface. Actuator switch installed at the bottom of the elevator reduces the speed of the fallen cab. The system reduces the injuries us caused to the people it makes lift more safer and cost effective. It is the end or finish of the event, process etc. Here the project is get developed as per the plan and the required output is get achieved so that it makes the elevator more safer.

5. RESULT AND ANALYSIS:
It is the thing that is produced by someone’s or a consequence or outcome of the plan. Analysis is defined an action of viewing the product whether it satisfies the aim of the project.

Thus the project developed increases the safety of the users of the elevators.

**ADVANTAGES:**
The injuries caused due to the hitting on the side walls of the elevators during the accidents.
- The setup is very simple.
- The fast hitting of the elevator towards the floor is get avoided by using the springs.
- The comfortless of the rescue is get increased and loss of the life is get reduced.
- Time consumption for the rescue is get reduced which leads to lesser losses.

**DISADVANTAGE:**
- This setup requires a frequent maintenance.
- The materials used can be easily recorded
- Failure in the actuator can be attained.

6. REFERENCES:


[2]. Sybron Carter and A. Selvaraj, design and implementation of plc based elevator.

[3]. International journal of computer applications (0975-8887)volume 68 - n0.7,April 2013

[4]. T.Y.LADAKHL et.al, application of pilfer elevator control system international symposium on devices MEMS intelligent systems and communication (ISDMISC).international journal of computer application (IJCA)4,2011.

[5]. Abdul rahimar meditherali, sham jiang In Design of five floors elevator with SCADA system based on s7200 plc, international journal of science and research (IJSR),volume 5 issue 4,April 2016.

[6]. Alvaro a. patino et.al., modelling of an elevator group control system using programmable logic control system,ABCM symposium series in mechatronics -vol.4-pp.433-441(2010)

[7]. Sanderstead, susunyi mon, implementation of plc based elevator control system international journal of electronics and computer cience engineering -ISSN-2277-1956.