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Design & Implementation of an Electronics Elevator Model

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***Abstract:** Due to the development in the construction of buildings and the trend towards vertical buildings that require few construction spaces, especially in crowded and densely populated cities, the need has arisen to establish electric elevators to move furniture and people, especially to high floors, to reduce effort and tim Electric elevators of all kinds share basic components, including motors, control panels, and the trolley carrying the load. Accordingly, the study of electric elevators has become one of the topics that must be recognized in electrical and electronic engineering departments, in terms of their basic components, method of operation, and maintenance. In this research paper, the design and construction of an electric elevator model were addressed to explain to the students, it consisted of a carrier car, a set of weights, and a step motor, and it was controlled by an Arduino board-type Mega and a seven-segment display to view the role numbers and a set of end-stroke switches to stop the elevator in the limited floor.The model was built in the form of a vertical building consisting of three floors using wood, and the main objective of this model is to clarify the work of the electric elevator and how it moves between the floors*.

***Keywords:** Electric Elevator, Arduino, Seven Segment Display, Limit Switch.*

1. INTRODUCTION

It is a means of transportation used within buildings consisting of several layers, it transports passengers or goods between specific floors, it consists of a closed room (upward) that moves vertically or with a certain curvature between fixed metal guides called rails, The planning of an elevator installation requires vast experience and knowledge[1]. This paper lists and discusses the steps that the consultant needs to go through to plan and design the elevator installation in conjunction with the architect and the rest of the design team[2]. The front elevators are lifting and lowering mechanisms equipped with a cabin, car, or platform (as appropriate) that move along guides in a column or corridor, largely vertically way, and move

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passengers or cargo (freight) or both between two or more floors or levels, as in a building or mine. The lift generally refers to a unit with automatic safety devices; The nearest units are called winches. Lifts consist of a platform or a vehicle traveling in vertical guides in a shaft or lever, with related lift and lower mechanisms and a power source[3].
Modern elevator development has greatly affected the architecture and way of developing cities by making multi-story buildings functional, Lifts are required in all multi-story buildings for passenger and freight traffic, it may be required under local building codes for any buildings over two floors or for the transportation of persons with disabilities. However, elevators are usually not accepted as an exit method , because a coherent strategy has not been developed to ensure proper operation of elevators in emergency situations[4].
Modern energy elevator is largely the product of the nineteenth century. Most of the elevators were operated in the nineteenth century with steam engines, either directly or through some form of hydraulic drive. In the early nineteenth century, hydraulic piston elevators were used in some European factories. In this type of elevator, the car is installed on a hollow steel piston that falls into a cylinder soaked in the ground. The water or some other fluid that is pushed to the cylinder under the pressure of the piston and the car 2 raises the gravity when the liquid is released. One of the pioneers of modern traction lifts was in use in Britain in 1835. In this case, the lifting rope passed over beams or a belt-driven pulley to a counterweight in the guides. The downward pull of the two weights secured the rope securely to its belts, creating sufficient sticky friction, or traction, between the two so that the coils pulled the rope along[5]. In this control system, pressure buttons and magnetic contact sensors are part of the microcontroller. Seven-segment display and Arduino operating circuit is the output part of the microcontroller output, Seven-segment display shows actual floor information of elevator drive system. The schematic diagram of the elevator control system is shown in Figure (1).

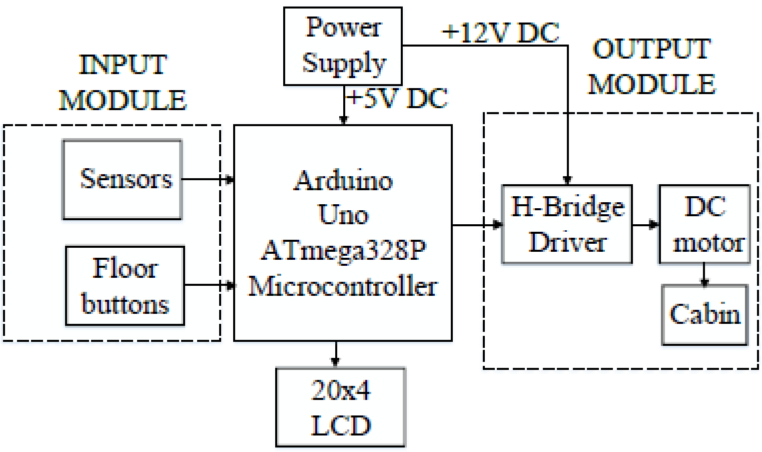

Figure (1): Overall Block Diagram of the Elevator Control System

1.1 Electricity and Elevators
Modern technology has entered the world of electric lifts, which are providing more comfort, for a smaller cost, in terms of operation, maintenance, and environmental damage. The most important technique used in this field is: regenerating energy from the autonomous movement

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of elevators, transferring it to the public electrical network, or storing it for later use. The blackout causes the elevator to stop and not be used for long periods, this problem does not exist where the modern electric elevator is available, as it does not need large electrical energy, in addition to the energy stored in the stacks allowing it to run[6].

1.2 The beginning of the Skyscrapers

The English scientist Henry Bessemer is considered the first inventor to produce large and cheap steel sections, and this was the basis for building and developing skyscraper buildings in the United States of America, Then the American scientist William Kelly filed a patent to blow carbon out of the cast iron in an air manner and sold this patent to Henry Bessemer, who was working similarly in 1855, then Henry Bessemer made available the steel sections used in building the buildings, The skyscrapers were created by the scientist, architect George Fuller, who worked to solve the problems of buildings in a way (load bearing capacity) along the building, and George Fuller built in 1889 the first skyscraper building in the name of Tacoma where the outer walls do not bear the weight of the building using iron sections Produced by Henry Bessemer where Fuller Created Steel Cages that support and bear all weight on the height of a building or a skyscraper.

The designation of skyscrapers first appeared in 1880, and in 1913 a skyscraper,793 feet high, was created under the name Wall Street in New York.Today, the electric lift has become one of the most important service systems in buildings, and it is considered one of the applications of electromechanical engineering or mechatronics[7].

1.3 Types of Elevators

According to the regulatory code, ASME A17.1, elevators are classified as either residential or commercial. People and materials can be transported vertically between floors or levels of a building using elevators. Every elevator has a platform or cab that slides along rails inside a shaft and is propelled by one or more motors[8]. How the cab or platform is transferred between levels is a difference between elevator systems. Hydraulic elevators and traction elevators are the two main kinds of elevators used in residential and commercial buildings, Hydraulic elevators and traction elevators differ significantly in that regard[9].

1.3.1 Hydraulic Elevators

A hydraulic elevator consists of a cab connected to a hydraulic jack either directly or indirectly. There are two types of hydraulic elevators: direct-acting and holeless[10]. In contrast, the cylinder for holeless hydraulic elevators is located in the shaft above the level of the pit. The hydraulic jack assembly of direct-acting hydraulic elevators extends below the lowest floor into the pit zone, A hydraulic pump and reservoir that are both often housed in a room next to the elevator shaft run both types of hydraulic elevators. In low-rise residential and commercial construction, hydraulic elevators are typically used. Traction elevators, on the other hand, are now more frequently used in low-rise residential construction[8].

1.3.2 Traction Elevators

The majority of traction elevator systems are placed in high-rise residential and commercial structures. The top of the cab is connected to cables that are powered by an electric motor

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housed in a penthouse above the elevator shaft in conventional geared traction elevator systems. Depending on the building's height, the required speed, and the cost, traction elevators can be either geared or gearless, Similar to geared traction elevators, new machine room-less (MRL) traction elevators use a similar mechanical setup; however, the machinery is located inside the elevator shaft at the top of the hoistway, as shown in Small low-rise buildings typically use geared traction elevators, while larger high-rise buildings where speed is essential typically use. more expensive gearless traction elevators[7].

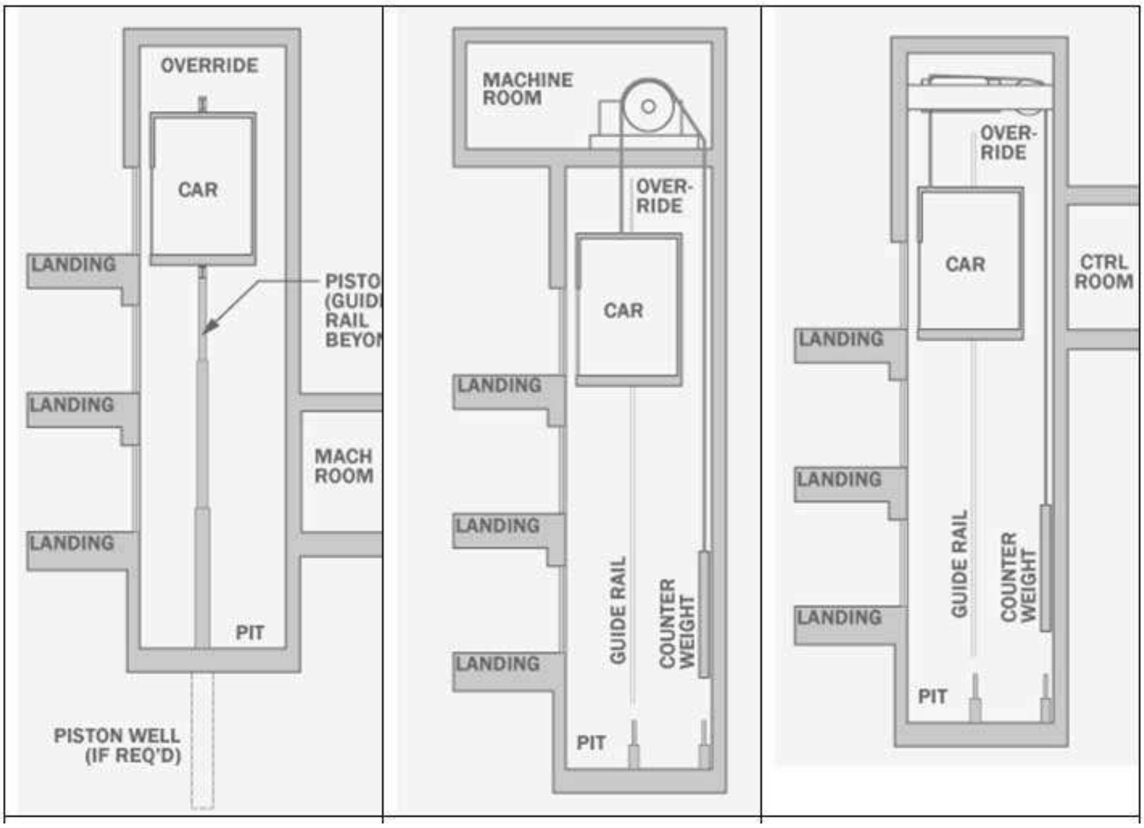

Figure (1-2): shows Elevator building plans

1.3.3 A Different Conveyance Mechanism

Pneumatic elevators are compact, vacuum-like elevators that are often seen in homes. A roof-mounted suction system operates the pneumatic elevator cabs[10]. Although pneumatic elevators for single-family homes are typically less expensive than hydraulic elevators, they are not as popular due to the technology's youth and the cabs' propensity for being small. The BFE is frequently positioned above pneumatic elevator systems because they are typically found inside buildings[11].

2. RELATED WORKS

Muhammad Farhan Mustaqim and Eka Taufiq Firmansjah P.A. In 2021 the control system was designed utilizing the Arduino Uno IDE, and an elevator simulation was developed using CX-

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Programmer and CX-Designer. The primary goal was to achieve specific functionalities, including adjusting the rotating motor's speed, enabling upward and downward motor rotations, and programming the control system for proper functionality. The lift's movement was facilitated using a 12-volt motor power coupled with the Dual H-Bridge L298N Motor driver. The Arduino Uno pin was powered by a 5-volt source, and within this pin configuration, multiple inputs were integrated. These inputs included six pushbuttons corresponding to the first to the third floor, with two pushbuttons and a limit switch on each floor. The elevator control system orchestrated through a series of programmed commands, enabled seamless movement according to the predefined specifications. This comprehensive setup allowed for the simulation of elevator operations, incorporating precise control over the motor's speed, directional changes, and floor selections via the pushbuttons. The inclusion of limit switches ensured adherence to safety protocols, creating an effective and functional chain of elevator control systems[12].

Farag Mahel Mohammed et al. in 2018 represented a cost-effective and straightforward construction and implementation method for an electro-pneumatic vacuum elevator system. The prototype of the elevator system encompasses three floors and can lift a maximum load of 6kg. The automation of the elevator system is achieved through a Programmable Logic Controller (PLC) from the LS\GLOFA-G7M-DR30U series, featuring 16 inputs and 12 outputs. The PLC is programmed using ladder diagram software for full automation. This innovative elevator system is envisioned to find widespread application in low-rise residential buildings. The pneumatic vacuum elevator introduces a novel concept derived from the traditional pneumatic elevator, where the use of compressed air is replaced with a vacuum air approach. Notably, this vacuum elevator can efficiently transport individuals between building floors without the need for cables, counterweights, or pulleys. The simplicity and affordability of this system make it an attractive option for practical implementation in various settings[13].

Yan Dou et al. in 2019 the initiative involves the formulation of a comprehensive structure for a compact four-layer, four-station elevator model. This design meticulously considers the authentic reduction ratio of the elevator, adhering strictly to the stipulations outlined in GB7588-2003. It ensures not only the fulfillment of strength requirements but also the preservation of uniform safety functions. The manipulation of the elevator's control and parameters is executed through a touchscreen interface seamlessly connected to a Programmable Logic Controller (PLC). Furthermore, a monitoring system, meticulously configured for real-time observation, is implemented to supervise the elevator model. This elevator model, meticulously crafted with a primary focus on the training and development of elevator professionals, faithfully replicates the genuine structure and operational principles of an actual elevator. The incorporation of a Human-Machine Interface (HMI) and configuration software streamlines the control and monitoring aspects of the elevator model. This configuration offers distinct advantages to educational institutions specializing in elevator engineering, providing a platform for conducting elevator structure recognition and experimental training. Additionally, enterprises can leverage these advanced elevator models for training and orienting recruits[14].

Abdel-Nasser Sharkawy in 2022 designed and implemented a prototype for an elevator control system. The mechanical design of this prototype is thoroughly presented, encompassing dimensions, sizes, weights, calculations, and detailed analyses of each component. Through

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systematic calculations, the MG996R High Torque Metal Gear Dual Ball Bearing servo motor has been chosen for operating the elevator prototype. The control circuit for the developed elevator system is fashioned with the Arduino Uno serving as the primary controller, and the 4x4 Matrix Membrane Keypad acting as the interface for human interaction. Experimental investigations have been conducted on the elevator prototype, incorporating varying loads (0.3 kg, 1.0 kg, and 2.5 kg) to assess and scrutinize its operational effectiveness. The outcomes reveal that the performance of the developed elevator is commendable and satisfactory, demonstrating reliable functionality in both upward and downward movements[15].

3. METHODOLOGY

3.1 Design Development and Considerations

A key factor in the selection of materials for design and cost was their availability. These materials are chosen based on characteristics including strength, dependability, thermal factors, corrosion, wear resistance, safety, weight, shape, and dimensions.
The model consists of the following parts: Arduino mega 2560, Stepper motor, seven-segment display, LM298 Driver, Limit switch, Magnetic sensor, Button push, and Jumper wires as shown in Figure (3)

figure (3) : Parts of Design

3.2 Arduino Mega 2560

A microcontroller board called the Arduino Mega 2560 is based on the AT Mega 2560. It contains 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; to use it, To power it, simply connect a USB cable, an AC-to-DC adapter, or a battery.

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The majority of shields made for the Uno and previous Duemilanove or Decimal boards work with the Mega 2560 board. The Arduino Mega, which the Mega 2560 succeeds, has been updated. The features of the Arduino in Figure (4) are as follows:

Microcontroller	AT Mega 2560
Operating Voltage	5 V
Input Voltage (recommended)	7 – 12 V
Input Voltage (limit)	6 – 20 V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256KB of which 8KB used by boot loader
SRAM	8 KB
EEPROM	4 KB

figure(4) : Arduino Mega 2560

3.3 The Stepper Motor

It is an electric motor used in small devices that require accuracy in controlling their motors, like the laser cutter and printer in Figure 5.
One of the most crucial characteristics of this kind of engine is that it can control the number and speed of its turns and the stop angle accurately.
This engine is also used in robotic applications, and is offered to show its stopping control What makes this engine unique when seen from a certain angle is that it depends on the dual system for dual operation, where it is noted that it comes out of it four or five wires that allow it to receive a specific sequence. For instance, if the sequence 0001, which corresponds to 1 in the decimal system, is received, it is extended at an angle of 90 degrees in the direction of a given rotation, but in the case of receiving 1000 which is equivalent to 8 in the decimal system that rotates in the opposite direction. Technical Information for stepper motors

1. "Rated Voltage: 12V DC"

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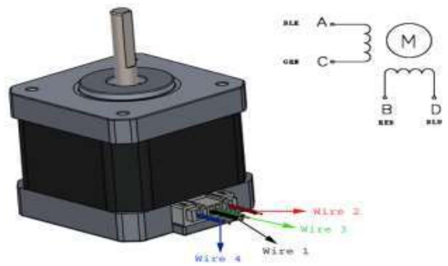
2. "Current: 1.2A at 4V"
3. "Step Angle: 1.8 deg"
4. "No. of Phases: 4"
5. "Motor Length: 1.54 inches"
6. "4-wire, 8 inch lead"
7. "200 steps per revolution, 1.8 degrees"
8. "Operating Temperature: -10 to 40 °C"

Figure (5): Stepper Motor



3.4 The 7-Segment Display

One type of electrical display is a seven-segment display to display decimal numbers that are an alternative to more complex dot matrix displays. The seven part screens are widely used in digital watches, Basic calculators, electronic meters, and other electrical devices with digital displays information as figure (6) , the features of 7-segment display is :

1. Available in many different sizes like 9.14 mm, 14.20 mm, 20.40 mm , 38.10 mm, 57.0 mm and 100 mm (Commonly used / available size is 14.20 mm)
2. White, Blue, Red, Yellow, and Green are the available colors. (Red is commonly used)
3. Low current operation
4. superior to traditional LCD displays in terms of quality, brightness, and size.
5. Current consumption: 30mA / segment
6. Peak current: 70mA

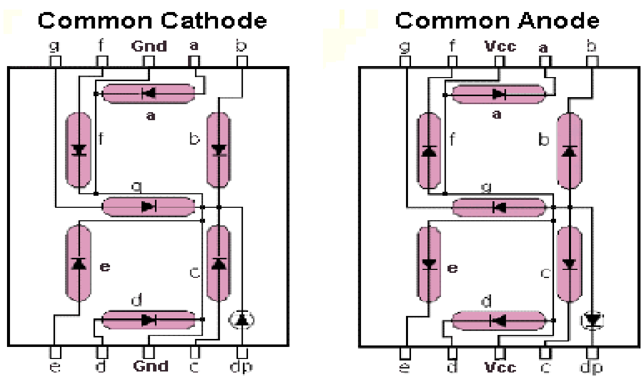


Figure (6): seven-segment display

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3.5 The Motor Driver L298N

Most microcontrollers run on extremely low voltage (5v) and current, while the motors require greater voltages and current, therefore the microcontrollers cannot provide them with such higher current. L298N motor driver IC has various uses in the embedded area, especially on the robotics side. We employ motor driver ICs for this purpose. A motor driver is a small current amplifier that converts low-current signals into high-current signals that can drive motors. Additionally, it has motor direction control.

Depending on the maximum supply voltage, maximum output current, rated power dissipation, load voltage, number of outputs, etc., there are several types of motor drives. As shown in figure (7), we'll talk about driver L298N here. It is used in DC motor speed control projects and makes it simple to connect DC motors to microcontrollers. It is also used in Bluetooth-controlled robots that employ pic microcontrollers; for more information on these applications, see the line follower robot.

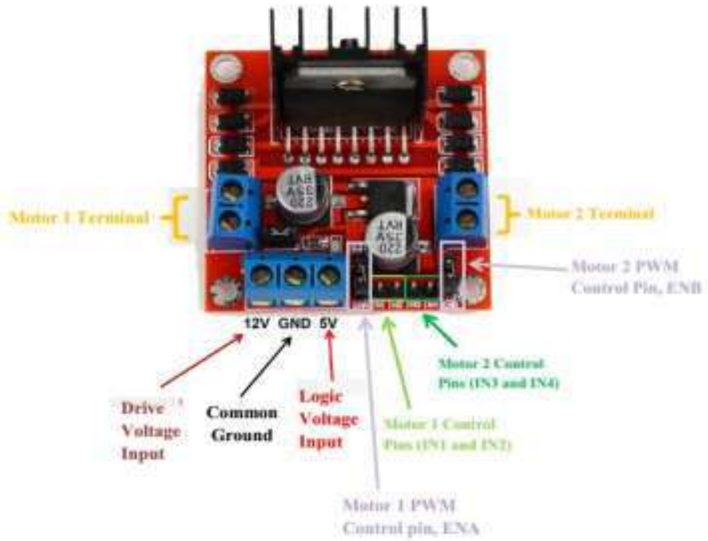

figure (7): L298N motor driver

3.6 The Limit Switch

Limit switches are used to govern equipment as part of a control system, as safety interlocks, or to count things passing a point. They are activated by the motion of a machine part or the presence of an object.

A limit switch is an electromechanical device that makes or breaks an electrical connection when an object comes into contact with an actuator that is mechanically connected to a series of contacts.

Because of their durability, simplicity of installation, and dependability of operation, limit switches are utilized in a wide range of applications and environments, they can identify an object's presence or absence, passage, positioning, and end of travel.

Industrial control devices such as levers, roller plungers, and whisker-type operators are used to create standardized limit switches. Their original purpose was to specify an object's maximum allowable distance, hence the name "Limit Switch." As shown in the figure, limit switches can be mechanically moved to be used directly (8).

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figure (8): Limit switch

3.7 Magnetic Sensor

A magnetic sensor is a device that detects disturbances and changes in a magnetic field, such as its strength, direction, and flux.
Light, pressure, and temperature are just a few of the variables that might affect the operation of different types of detection sensors. These sensors are divided into two types. The first approach yields the overall magnetic field, whereas the second yields the vector components of the field. The magnetic field's vector components are discrete points, and the methods used to create these sensors often combine physics and electronics in various ways.
The magnetic sensor is shown in Figure (9) and consists of a chip with a magneto-resistive component that is used to detect magnetic vectors and a magnet intended to bias magnetic vectors that can be detected by the magneto-resistive component.

Figure (9): Magnetic Sensor

3.8 Push-Button Switch

A push-button, also spelled pushbutton, or just a button, is a straightforward switch mechanism to regulate a machine's or process's operation. The material used to make buttons is normally hard, usually plastic or metal.

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The surface is often flat or contoured to fit a human finger or hand, making it simple to push or depress, The majority of the time, buttons are biased switches, yet many un-biased buttons still need a spring to return to their un-pushed condition due to their physical nature. Pressing a button is also referred to as depressing it, mashing it, slapping it, hitting it, or punching it.
As shown in Figure (10), the "push-button" has been used in a variety of mechanical and electronic devices that are both domestic and commercial in nature.
In industrial and commercial applications, push buttons may be mechanically connected so that hitting one releases the other. For instance, pressing the stop button may "force" the start button to release. When a machine or process lacks an electrical control system, simple manual operations are performed using a mechanical linkage.

figure (10): Push Button Switch

3.9 Jump Wires

An electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them - simply "tinned"), is referred to as a jump wire (also known as a jumper wire, jumper, or jumper) and is typically used to connect the parts of a breadboard or other prototype or test circuit, internally or with other machinery or components, without soldering.
Individual jump wires are attached by slipping their "end connectors" into holes made available on a breadboard, a circuit board's header connector, or a piece of test equipment. Jumper wires are available in many colors, although the hues have no real significance. Therefore, a red jumper wire is equivalent to a black one technically. However, you can use the colors to distinguish between different types of connections, such as ground or power.

Figure (11): jumper wire

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The final form of the designed Electronics elevator model is shown in Figure (12).

Figure (12): shows the designed Electronics elevator model

4. RESULTS AND DISCUSSION

The simulator was established and utilized to replicate the operation of elevators to educate and instruct students on using modern techniques, thereby boosting the country and investing in young talent. The port model is a simplified model that simulates real huge elevators that can be developed using Razbere and using higher-efficient engines.

5. CONCLUSION

1. Through designing and implementing this elevator, and after conducting practical experiments on it through training a group of students from the Engineering Department, distinguished results were obtained, including the following:
2. The theoretical study aspect was linked to practical study and understanding of the topics more accurately.
3. Students desire to continue practical implementation and not feel time or boredom.
4. Seeing and understanding the research topic and their desire to implement designs for other engineering topics.

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6. REFERENCES

1. B. A. Farhan, A. K. Nawar, and N. B. Hassan, "Design and Implementation of a Training Educational Board for Electromagnetic Control Experiments," 2nd International Conference on Advanced Computer Applications, ACA 2023, pp. 117–122, 2023, doi: 10.1109/ACA57612.2023.10346862.
2. S. T. Park and B. S. Yang, "An implementation of risk-based inspection for elevator maintenance," Journal of Mechanical Science and Technology, vol. 24, no. 12, pp. 2367–2376, 2010, doi: 10.1007/s12206-010-1004-1.
3. B. A. Farhan, L. E. Kadhim, N. B. Hassan, and A. K. Nawar, "Design and Implementation of a Training Board for Basic Gates Using Switches, Diodes, Transistors, and Integrated Circuits," 6th Iraqi International Conference on Engineering Technology and its Applications, IICETA 2023, pp. 275–279, 2023, doi: 10.1109/IICETA57613.2023.10351250.
4. P. Gołuch, J. Kuchmister, K. Ćmielewski, H. B.- Measurement, and undefined 2018, "Multi-sensors measuring system for geodetic monitoring of elevator guide rails," Elsevier, 2018, doi: 10.1016/j.measurement.2018.07.077.
5. C. Zexi, Y. X.-2014 S. I. C. on, and undefined 2014, "Design of interconnection gateway in elevator remote monitoring system," ieeexplore.ieee.org, Accessed: Jun. 09, 2023. [Online]. Available: https://sci-hub.ren/https://ieeexplore.ieee.org/abstract/document/6802678/
6. Y. Zhou, K. Wang, H. L.-P. computer science, and undefined 2018, "An elevator monitoring system based on the internet of things," Elsevier, Accessed: Jun. 09, 2023. [Online]. Available: https://sci-hub.ren/https://www.sciencedirect.com/science/article/pii/S1877050918306422
7. S. Keputusan Dirjen Penguatan Riset dan Pengembangan Ristek Dikti et al., "Terakreditasi SINTA Peringkat 2 Pengamanan Pintu Ruangan Menggunakan Arduino Mega 2560, MQ-2, DHT-11 Berbasis Android," masa berlaku mulai, vol. 1, no. 3, pp. 66–72, 2017.
8. D. Mei, X. Du, and Z. Chen, "Optimization of dynamic parameters for a traction-type passenger elevator using a dynamic byte coding genetic algorithm," Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, vol. 223, no. 3, pp. 595–605, Mar. 2009, doi: 10.1243/09544062JMES1149.
9. D. Kataria, G. Sanchez, and S. Govindasamy, "Fundamentals of Automation Engineering: A hybrid project-based learning approach," International Journal of Electrical Engineering Education, 2020, doi: 10.1177/0020720920928460.
10. S. A. Soomro et al., "The Design of Automatic Lift Control with Status Alert Capabilities Through Internet."
11. M. Watanabe, Y. Okamoto, Y. Kuno, H. Asada, L. Wang, and W. H. Tsai, "Dynamic fuzzy control of genetic algorithm parameter coding," ieeexplore.ieee.org, vol. 29, no. 3, pp. 1482–1487, 1999, Accessed: Jun. 09, 2023. [Online]. Available: https://sci-hub.ren/https://ieeexplore.ieee.org/abstract/document/764878/
12. M. F. Mustaqim and E. T. Firmansjah, "Control Making for Elevator Simulation of Three Floor Building Based on Arduino Uno".

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ISSN: 2394-8299
Vol: 04, No. 04, June-July 2024
http://journal.hmjournals.com/index.php/IJRISE
DOI: https://doi.org/10.55529/ijrise.44.16.29

13. F. M. Mohammed, J. A.-K. Mohammed, and M. A. Naji, "Implementation of an Automated Vacuum Elevator System," Journal of University of Babylon for Engineering Sciences, vol. 26, no. 10, pp. 150–165, 2018.
14. Y. Dou, L. Guo, Y. Ge, and Y. Wang, "Design and Manufacture of Elevator Model Control System Based on PLC and HMI," in Advanced Manufacturing and Automation VIII 8, 2019, pp. 45–52.
15. A.-N. Sharkawy and G. Abdel-Jaber, "Design and Implementation of a Prototype of Elevator Control System: Experimental Work," SVU-International Journal of Engineering Sciences and Applications, vol. 3, no. 2. pp. 80–86, 2022. doi: 10.21608/svusrc.2022.149091.1057.

