A Project Report on

# Wifi Internet(IoT) Controlled Hydraulic Scissor Lifter Model

*Submitted by*


**Govind Singh Rathore (ST-681875-2)**

*Under the guidance of*

**Dr Rajender Kumar (M-160408-7)**


**In partial fulfillment for the requirement of passing section-B Examination**

**in the MECHANICAL ENGINEERING Branch.**


The Institution of Engineers (India)

AN ISO 9001: 2008 CERTIFIED ORGANIZATION

(ESTABLISHED 1920, INCORPORATED BY ROYALCHARTER 1935)

8 Gokhale Road, Kolkata 70002

## 2. Table of Contents

## 3. Acknowledgement

It is a great pleasure to present this project report on the topic of '**Wifi Internet(IoT) Controlled Hydraulic Scissor Lifter Model**' carried out at **FuturisticIOx** at **Gurgaon(Haryana)**, for the fulfillment of Degree Programme in **Mechanical Engineering** under **'THE INSTITUTION OF ENGINEERS (INDIA), KOLKATA'**. I express my sincere thanks to **The Director (EEA), IEI Kolkata** for allowing me to work on a project for partial fulfillment of the requirement of the Degree in Mechanical Engineering.

I am highly thankful to my Project guide **Dr Rajender Kumar** for guidance, encouragement help and useful suggestions throughout project work.

I would also like to express my heartiest thanks to my beloved parents for their blessing for successful completion of the project work.

**Govind Singh Rathore**

**ST-681875-2**

# 4. Declaration

I hereby declare that I have completed my project work on the topic '**Wifi Internet(IoT) Controlled Hydraulic Scissor Lifter Mode**' for the fulfillment of the Degree Programme in **Mechanical Engineering** from **The Institution of Engineers INDIA**. It has not been previously submitted for fulfillment of any degree/examining body or university and it is a work of my own study.

**Place: Gurgaon** **Govind Singh Rathore**

**Date:** **(ST- 681875-2)**

**CERTIFICATE OF ORIGINALITY OF WORKS BY PROJECT GUIDE**

This is certified that the project is done under my guidance and the above statement of **Govind singh rathore (ST-681875-2)** is correct and true to the best of my knowledge.

**Place: Faridabad** **Dr Rajender Kumar**

**Date:** **(M-160408-7)**

**PROJECT GUIDE**

# 5. Synopsis

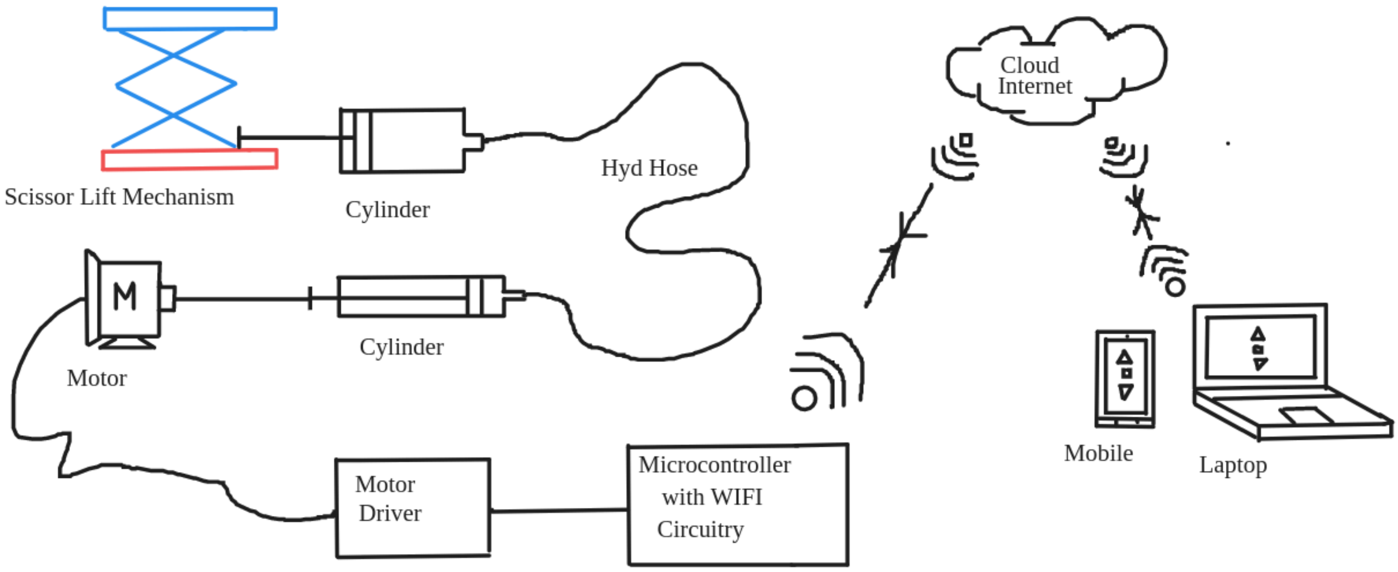
1. **Title of Project-**
   **Wifi Internet Controlled Hydraulic Scissor Lifter Model**

2. **Objective of the study-**
   (i) To make a Hydraulic Scissor Lifter by using Scissor Mechanism for compact design.
   (ii) To lift heavy loads by Hydraulic Leverage.
   (iii) Enable Hydraulic Scissor Lifter Wifi internet connected so it can be Controlled and Monitored remotely.

3. **Rationale for the study-**
   (i) Learn about Scissor Mechanism, Class-1 Leverage, Cross-braced arms(Criss-cross X-patterns), link systems, folding support.
   (ii) To study about Pascal's law and uses of Hydraulic leverage to lift heavy loads.
   (iii) To learn the process of how to connect physical things to the Internet and control & monitor remotely. Learn about IoT & Electronics and integrate to a Mechanical system.

4. **Detailed Methodology used for study-**
   (i) Research and Understanding using the Internet and books about scissor mechanisms, class-1 leverage, and hydraulic systems. Gain insights into IoT technology and its application in connecting physical objects to the internet for remote control and monitoring.
   (ii) Design and Planning- Based on Load capacity, desired Height range, compactness and stability. For the model we will use Wood Sticks as Scissors arm, Syringe as a Lift cylinder and Motor- Syringe combination as a Hydraulic pump. To integrate this mechanical system with Wifi internet will use a Wifi internet enabled Microcontroller module and design schematics & circuit accordingly.
   **Project Planning and Resources Folder-**
   https://drive.google.com/drive/folders/1Q-h4NLbMkmBsdpBlGQFpYtT1N3Pb2OyV?usp=sharing
   (iii) Assembly and Fabrication- Assemble the hydraulic scissor lifter according to our design plan.Start by constructing the scissor mechanism using cross-braced arms and link systems. Install the hydraulic cylinders and valves, ensuring proper alignment and connections. Fabricate any additional support structures or components as needed.
   (iv) Integration of IoT- Program the microcontroller to communicate with a designated IoT platform or mobile application via WiFi. Implement features such as lift Up/down, real-time status updates, remote activation/deactivation, and safety protocols to enhance usability and convenience.
   (v) Calibration and Testing- Calibrate the hydraulic system to ensure optimal performance, stability and load-bearing capacity according to the commands and analog signal

received via the wifi internet from the operator.Gather feedback from test users and stakeholders to identify any areas for improvement or optimization.
(vi) We will document the entire process of designing, building, and testing the hydraulic scissor lifter, including detailed schematics, assembly instructions, and test results.




5. **Expected contribution from the study-**
(i) Make Hydraulic Scissor Lifter smart and more useful for the world.
(ii) Make a more safe work environment for operators.
(iii) Learn and make improvements for betterment of the system while making.
(iv) Find new Uses and Application of system in the field of
Manufacturing: Integrating into assembly lines to position components during production processes, enhancing efficiency and productivity with remote control for adjustments;
Events and Entertainment: Simplifying stage setup and equipment installation for events, ensuring quick adjustments with remote control for lighting, audio, and visual elements;
Agriculture: Facilitating loading and unloading of agricultural inputs onto vehicles or storage areas, reducing manual labor and enhancing operational efficiency;
Healthcare: Supporting logistics within medical facilities by transporting equipment and supplies between departments, improving responsiveness to patient care needs with remote monitoring and control.

6. **List of activities to be carried out to complete the project-**
**bar chart showing the time schedule -**
https://docs.google.com/spreadsheets/d/12D7LvYo3ZcQqr0GbzJkJ_AkvYqSnVup9g-LpVx7bYBw/edit?usp=sharing

## Wifi Internet Controlled Hydraulic Scissor Lifter Model Project Bar chart

| SNo. | Activity | Start Date | End Date | Duration | Status |
|---|---|---|---|---|---|
| 1 | Identification of a problem or Need | 12-Apr-2024 | 13-Apr-2024 | 2 | Completed |
| 2 | Synopsis and Project Selection | 13-Apr-2024 | 14-Apr-2024 | 2 | Completed |
| 3 | Research and Understanding | 15-Apr-2024 | 17-Apr-2024 | 3 | Pending |
| 4 | Design and Planning | 17-Apr-2024 | 19-Apr-2024 | 3 | Pending |
| 5 | Materials and Resource Procurements | 20-Apr-2024 | 24-Apr-2024 | 5 | Pending |
| 6 | Assembly and Fabrication | 23-Apr-2024 | 29-Apr-2024 | 7 | Pending |
| 7 | Integration of IoT | 28-Apr-2024 | 4-May-2024 | 7 | Pending |
| 8 | Calibration and Testing | 3-May-2024 | 7-May-2024 | 5 | Pending |
| 9 | Instructions and Documentations | 17-Apr-2024 | 11-May-2024 | 25 | Pending |
| 10 | Feedbacks and Improvements | 11-May-2024 | 12-May-2024 | 2 | Pending |

### 7. Places/labs/equipment and tools required and planning of arrangements-

(i) Basic cutting, shaping, fabrication tools like cutter, plier, screw drivers, measuring tape, scale.
(ii) Plastic adhesive, glue.
(iii) Electronics lab equipment like Multimeter, Variable power supply, Programming USB cables etc. and electronics tools like screwdrivers, wire stripper , cutter, soldering iron.
(iv) Electronics Components Manuals and Data sheets.
(iv) Arduino IDE software, IoT Website platform and necessary software things.

### 8. Problem envisaged in carrying out the project, if any-

No Problem

**Govind Singh Rathore**
**ST-681875-2**

**Dr Rajender Kumar**
**M-160408-7**
**(Project Guide)**

# 6. FINAL PROJECT REPORT

## 6.1 TITLE OF THE PROJECT

## 'Wifi Internet(IoT) Controlled Hydraulic Scissor Lifter Model'

We built  a model of IoT HydraulicScissor lifter which can be operated anywhere from the world. In today's era of technological advancement, the fusion of traditional mechanical systems with digital innovations has opened up new avenues of efficiency and control. This project focuses on developing a "Wi-Fi Internet Controlled Hydraulic Scissor Lifter Model" to showcase the potential of integrating Wi-Fi IoT capabilities into hydraulic systems.

Our goal is to design and demonstrate a prototype lifter that can be remotely controlled and monitored via Wi-Fi, offering enhanced flexibility, convenience, and safety. This project highlights the synergy between mechanical engineering and digital technology, paving the way for future advancements in industrial automation and smart infrastructure.

## 6.2 OBJECTIVE OF THE STUDY

(i) To make a Hydraulic Scissor Lifter by using Scissor Mechanism for compact design:

The primary aim of this objective is to utilize the scissor mechanism to design a compact hydraulic scissor lifter. The scissor mechanism offers an efficient means of achieving vertical movement while maintaining a relatively small footprint. By employing this mechanism, the lifter can be compactly designed, making it suitable for various applications where space is limited.

Learn about Scissor Mechanism, Class-1 Leverage, Cross-braced arms (Criss-cross X-patterns), link systems, folding support:

Understanding these mechanical principles is essential for designing an efficient and stable hydraulic scissor lifter. The scissor mechanism provides a compact means of achieving vertical movement, while class-1 leverage and cross-braced arms ensure the lifter's stability and strength. Learning about link systems and folding support mechanisms further enhances our understanding of how to optimize the lifter's design for practical applications.

(ii) To lift heavy loads by Hydraulic Leverage:

This objective focuses on harnessing the power of hydraulic leverage to lift heavy loads efficiently. Hydraulic systems are renowned for their ability to generate high forces with minimal input effort. By utilizing hydraulic cylinders and pumps, the lifter will be capable of lifting substantial loads with ease, making it suitable for a wide range of industrial and commercial tasks.

To study Pascal's law and uses of Hydraulic leverage to lift heavy loads:

Pascal's law forms the foundation of hydraulic systems, dictating that pressure applied to a fluid is transmitted equally in all directions. This principle enables hydraulic leverage to lift heavy loads with minimal effort, making it indispensable in various industrial and commercial settings. Studying Pascal's law and its application in hydraulic systems provides insights into the underlying mechanics driving the lifter's functionality.

(iii) Enable Hydraulic Scissor Lifter Wi-Fi internet connected so it can be Controlled and Monitored remotely:

This objective involves integrating Wi-Fi Internet of Things (IoT) capabilities into the hydraulic scissor lifter, enabling remote control and monitoring. By incorporating Wi-Fi connectivity, operators can remotely command the lifter's movements and monitor its status from any location with internet access. This feature enhances flexibility, convenience, and safety, as operators can oversee operations without being physically present, thus reducing the need for manual intervention and enhancing productivity. Additionally, remote monitoring allows for real-time feedback and troubleshooting, further improving operational efficiency and minimizing downtime.

To learn the process of how to connect physical things to the Internet and control & monitor remotely. Learn about IoT & Electronics and integrate to a Mechanical system:

In today's interconnected world, the ability to connect physical objects to the internet and remotely control and monitor them has become increasingly valuable. Learning about IoT technology and electronics integration equips us with the skills to bridge the gap between mechanical systems and digital connectivity. Integrating these capabilities into the hydraulic scissor lifter enhances its functionality, usability, and efficiency.

## 6.3 Methodology of the study

### (i) Research and Understanding-

A lever is a simple machine consisting of a rigid bar or beam that pivots around a fixed point called a fulcrum. Levers are commonly used to amplify force or exert a mechanical advantage by applying a smaller input force over a longer distance to move a larger load over a shorter distance. They are fundamental components in various mechanical systems and are categorized into three classes based on the relative positions of the fulcrum, effort (applied force), and load (resistance). Levers play a crucial role in everyday objects and machinery, from seesaws and crowbars to hydraulic systems and industrial equipment.

**A.** First-Class Lever:

- **a.** In a first-class lever, the fulcrum is positioned between the effort and the load.
- **b.** Examples include a seesaw or a crowbar.
- **c.** These levers can either increase force or increase distance, depending on the positioning of the effort and load relative to the fulcrum.
- **d.** Mechanical advantage can be varied by adjusting the distance between the fulcrum and the effort or load.

**B.** Second-Class Lever:

- **a.** In a second-class lever, the load is positioned between the fulcrum and the effort.
- **b.** Examples include a wheelbarrow or a nutcracker.
- **c.** These levers provide a mechanical advantage by allowing a smaller force to lift a larger load.
- **d.** The effort arm is longer than the load arm, resulting in greater force multiplication.

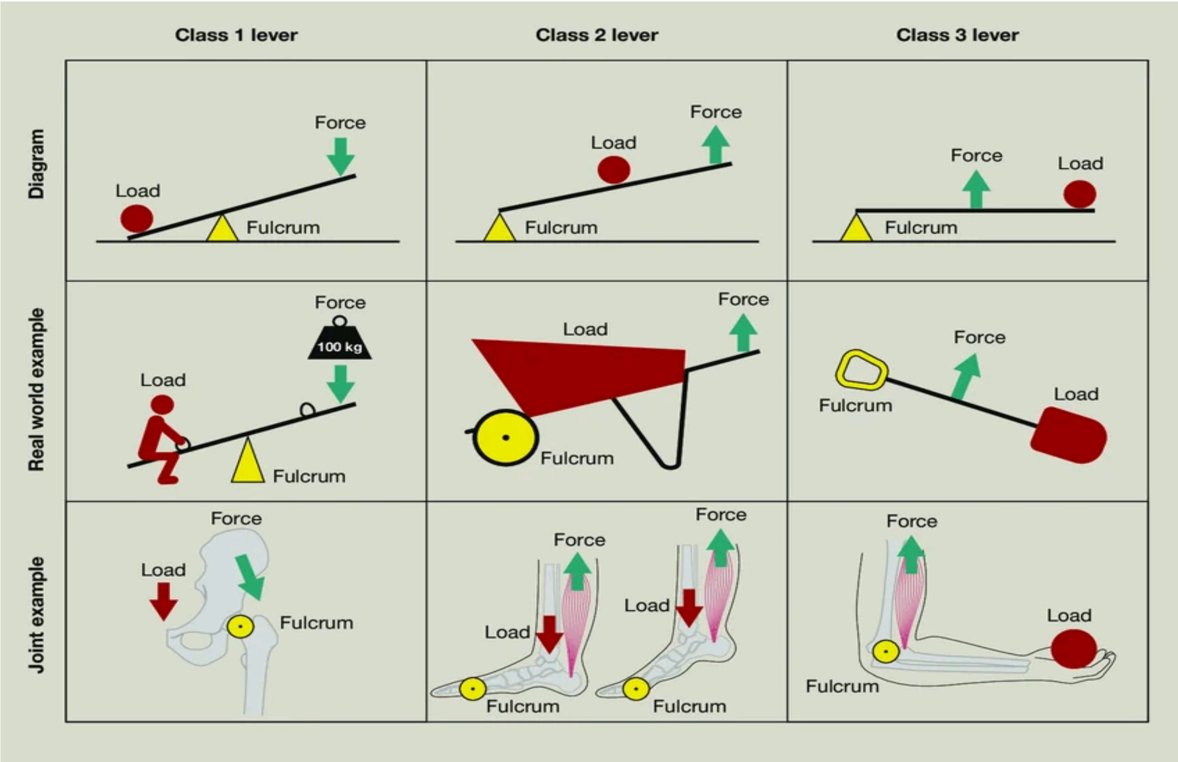
**C.** Third-Class Lever:

- **a.** In a third-class lever, the effort is positioned between the fulcrum and the load.

**b.** Examples include a pair of tweezers or a baseball bat.

**c.** These levers trade mechanical advantage for increased speed or distance traveled.

**d.** The load arm is longer than the effort arm, requiring a larger effort force to move the load, but allowing for greater speed or range of motion.

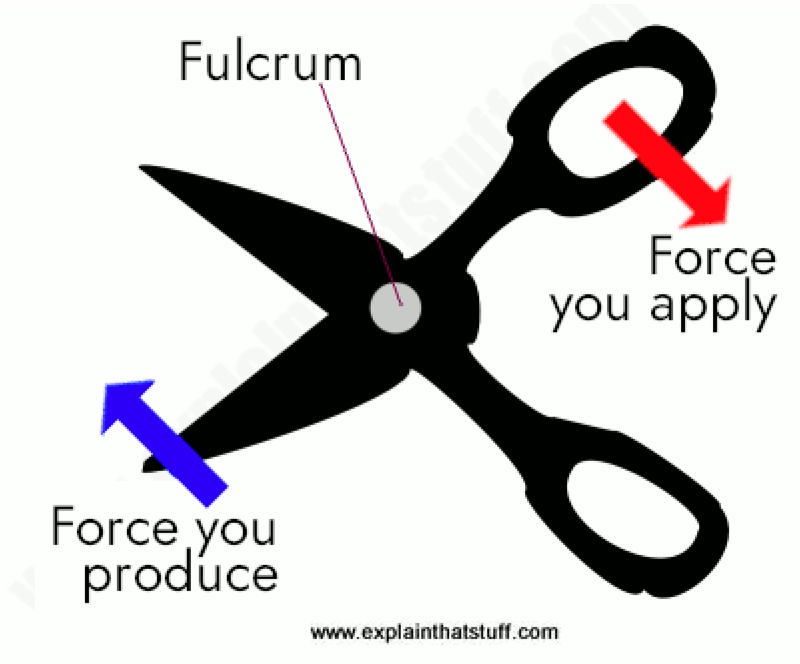



## A. Class 1 Lever:

A class 1 lever is one of the three types of levers in which the fulcrum (pivot point) is positioned between the effort (applied force) and the load (resistance being moved). This lever configuration allows for a variety of applications, including both increasing force or increasing distance, depending on the relative positioning of the effort and load.

Explanation of Class 1 Lever:

In a class 1 lever, the fulcrum acts as the pivot point around which the lever rotates. The effort is applied on one side of the fulcrum, while the load is on the opposite side. When the effort is applied, it creates a turning effect around the fulcrum, enabling the movement of the load.




**Scissor Lifter Mechanism:**

The scissor lifter mechanism is a prime example of a class 1 lever in action. It consists of two sets of crossed, pivoting arms connected at the fulcrum. These arms are typically made of sturdy materials like metal or strong plastic. When the effort is applied to one end of the mechanism, it creates a rotational force around the fulcrum, causing the arms to pivot and lift the load.

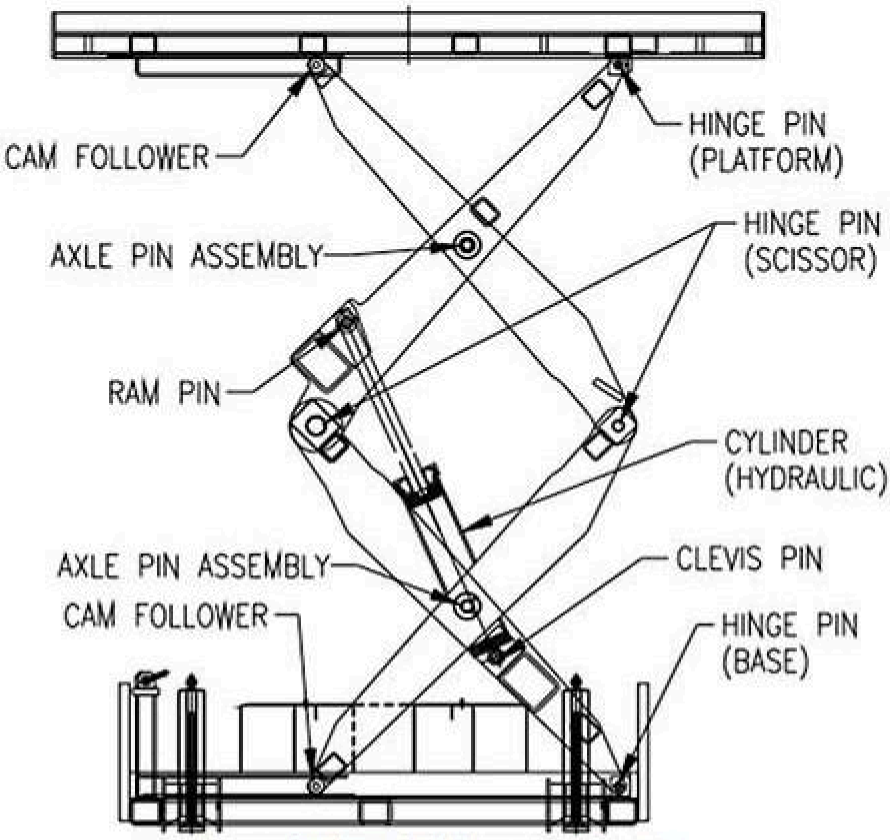
Working Principle:

- Crossed Arm Design: The scissor lifter mechanism consists of two sets of crossed arms arranged in a criss-cross or X-pattern. These arms are connected at the fulcrum, forming a stable pivot point.
- Fulcrum Positioning: The load to be lifted is placed between the crossed arms, while the effort is applied to one end of the mechanism. The fulcrum is typically located at the center of the crossed arms.
- Application of Effort: When the effort is applied to one end of the mechanism, it creates a rotational force around the fulcrum. This force causes the crossed arms to pivot, pushing against the load and lifting it upwards.
- Mechanical Advantage: Depending on the relative positioning of the effort and load, the scissor lifter mechanism can provide mechanical advantage by either amplifying force or increasing the distance over which the load is lifted.
- Stability and Control: The crossed arm design of the scissor lifter mechanism provides inherent stability during lifting operations. Additionally, the angle of the crossed arms can be adjusted to control the height and speed of the lifting motion.

Applications:

The scissor lifter mechanism is widely used in various industrial, commercial, and residential applications, including:

- Automotive repair shops for lifting vehicles during maintenance and repairs.
- Material handling and loading in warehouses and factories.
- Hydraulic elevators and platform lifts for accessibility purposes.
- Construction sites for lifting heavy equipment and materials.
- Home furniture such as lifting tables and adjustable height desks.



Typical 2 Stage Lift Pivot Components

**Pascal's Law:**

Pascal's Law states that the pressure exerted at any point in a confined fluid is transmitted equally in all directions throughout the fluid. Mathematically, this can be expressed as:

$P=F/A$

Where:

- $P$ is the pressure exerted on the fluid (in Pascals, Pa or N/m²),
- $F$ is the force applied to the piston (in Newtons, N), and
- $A$ is the area of the piston (in square meters, m²).

Pascal's Law, formulated by the French mathematician and physicist Blaise Pascal in the 17th century, is a fundamental principle in fluid mechanics that describes the behavior of fluids (liquids and gasses) under pressure. Pascal's Law states that pressure exerted at any point in a confined fluid is transmitted equally in all directions throughout the fluid, regardless of the shape or size of the container.

Explanation:

Imagine a container filled with a fluid, such as water or hydraulic oil, with a piston inserted into it. When a force is applied to the piston, it exerts pressure on the fluid. According to Pascal's Law, this pressure is transmitted uniformly throughout the fluid in all directions.

This means that if you push down on the piston with a certain force, the pressure created by that force will be distributed evenly throughout the entire fluid. As a result, the fluid will exert an equal force on all surfaces of the container, including any additional pistons or surfaces within the fluid.

Applications in Hydraulic Systems:

Pascal's Law is the underlying principle behind hydraulic systems, which use confined fluids to transmit force and amplify mechanical power. In hydraulic systems, a small force applied to a small area can generate a much larger force on a larger area, allowing for the lifting or moving of heavy objects with relatively little effort.

Hydraulic Lifter:

In a hydraulic lifter, a small piston with area $A_1$ is connected to a larger piston with area $A_2$. When a force $F_1$ is applied to the small piston, it creates pressure $P_1$ in the fluid, which is transmitted to the larger piston, generating a force $F_2$ capable of lifting a load.

The relationship between force and pressure is given by Pascal's Law. Considering the pressure in the fluid is constant throughout the system, we can use the following equation:

$$P_1 = P_2$$

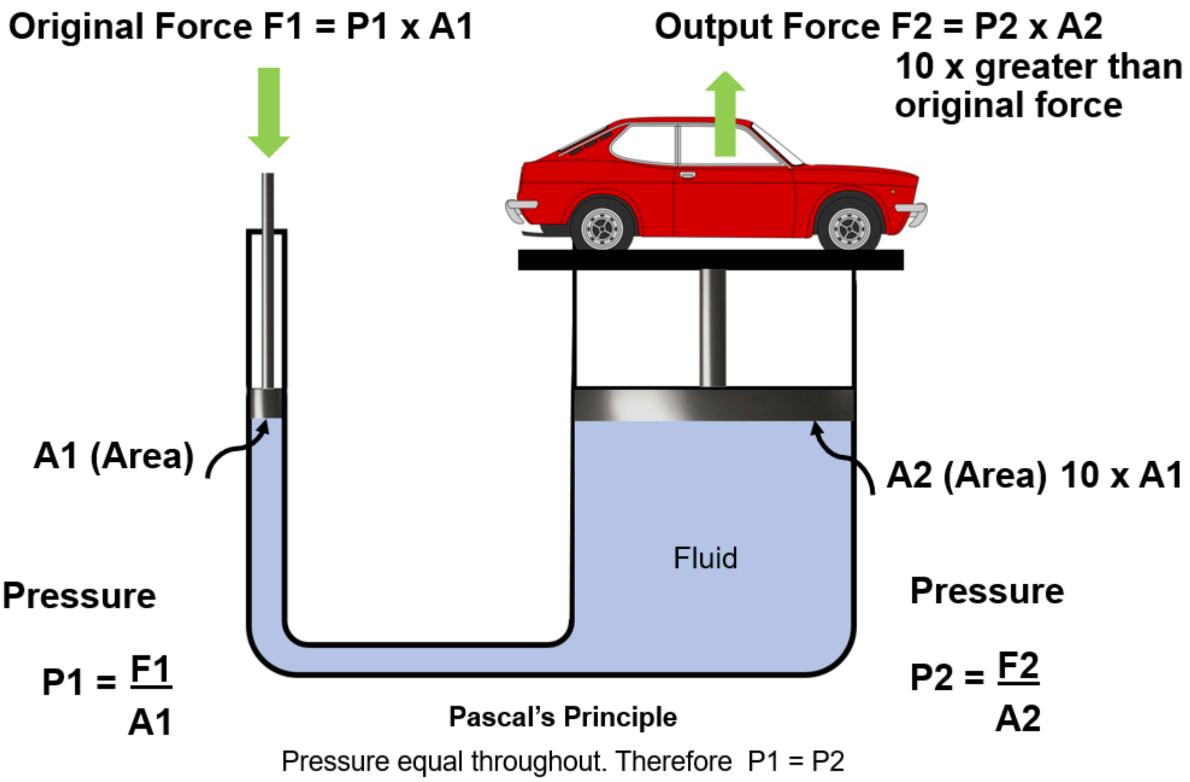
Using the formula for pressure, we get:

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

Rearranging the equation to solve for $F_2$:

$$F_2 = \frac{F_1 \times A_2}{A_1}$$

This equation demonstrates how a small force $F_1$ applied to the small piston can generate a larger force $F_2$ on the larger piston, provided that the ratio $\frac{A_2}{A_1}$ is greater than 1.



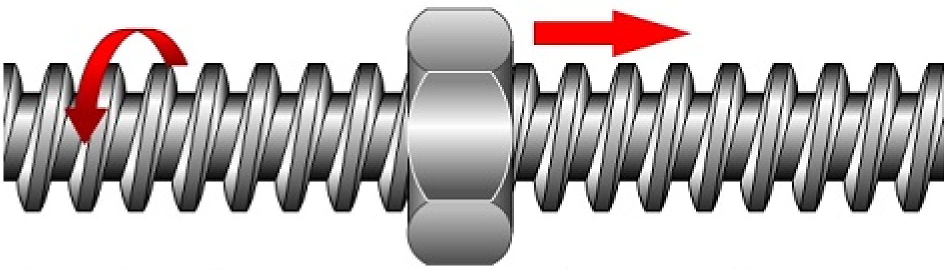
A Pascal hydraulic lifter is a device that utilizes Pascal's Law to lift heavy loads. It consists of a hydraulic cylinder filled with fluid and fitted with a piston. When a force is applied to the piston, it creates pressure within the fluid, which is transmitted equally in all directions. This pressure acts on a larger piston connected to the load, generating a force large enough to lift the load.

Working Principle:

- Compression Phase: When a force is applied to the small piston, it compresses the fluid in the hydraulic cylinder, increasing the pressure throughout the fluid.
- Transmission of Pressure: According to Pascal's Law, this pressure is transmitted uniformly to all parts of the fluid, including the larger piston.
- Expansion Phase: The pressure exerted by the fluid on the larger piston creates a force large enough to lift the load attached to it.
- Mechanical Advantage: The force exerted by the larger piston is proportional to the ratio of the areas of the two pistons. By increasing the size of the larger piston relative to the smaller piston, the hydraulic lifter can provide a mechanical advantage, allowing for the lifting of heavy loads with relatively little force applied to the small piston.

### lead screw-

A lead screw, also known as a power screw or translation screw, converts rotary motion into linear motion. A lead screw is a threaded metal bar with a threaded nut that's in direct contact with the screw. When the screw rotates, the nut moves along the screw in a linear motion. The linear speed of the load is determined by the screw's rotational speed and its lead, which is how far the nut moves per turn



The screw rotates, the nut does not rotate, the nut moves along the screw.

### Lead Screw Mechanism:

A lead screw mechanism is a mechanical device used to convert rotational motion into linear motion. It consists of a screw (threaded rod) and a nut (threaded sleeve) that engages with the screw. When the screw is rotated, the nut moves along the screw's thread, causing linear motion.

Principle:

The principle behind the lead screw mechanism is based on the concept of translating rotational motion into linear motion through the interaction of threads on the screw and nut. As the screw is rotated, the threads on the screw and nut mesh together, creating a force that moves the nut along the length of the screw. This movement can be used to drive various mechanical systems, such as lifting platforms, linear actuators, or positioning devices.

Example:

Lead Screw in Lifting Mechanism:

One common application of lead screw mechanisms is in lifting systems, where the rotational motion of a motor or hand crank is converted into vertical motion to raise or lower a load. For example, in a scissor lift or a vertical platform lift, a lead screw mechanism may be used to raise or lower the platform.

Principle of Operation:

- The lead screw is mounted vertically, with one end attached to a motor or hand crank.
- A nut with internal threads matching the screw's external threads is securely attached to the load platform.
- When the motor or hand crank rotates the lead screw, the threads on the screw and nut engage, causing the nut to move along the screw's axis.
- As the nut moves, it raises or lowers the load platform, depending on the direction of rotation of the lead screw.
- By controlling the rotation of the lead screw, the height of the load platform can be adjusted precisely.

Advantages of Lead Screw Mechanisms:

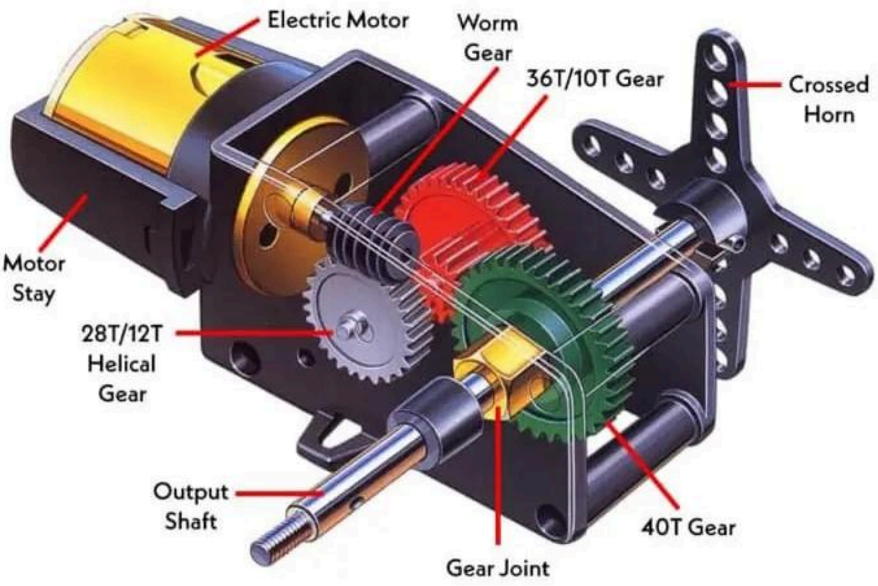
- High Efficiency: Lead screw mechanisms can achieve high mechanical efficiency, converting a large portion of the input rotational motion into linear motion.
- Precision Control: The pitch of the screw threads determines the linear displacement for each revolution of the screw, allowing for precise control over the movement of the load.
- Self-locking: Lead screw mechanisms are inherently self-locking, meaning they can hold a load in position without the need for additional braking mechanisms.

Applications of Lead Screw Mechanisms:

- Lifting platforms in automotive repair shops or assembly lines.
- Adjustment mechanisms in machinery for precise positioning of components.
- Linear actuators in robotics and automation systems.
- Height adjustment mechanisms in furniture, such as adjustable desks or chairs.

**Gear Motor:**

A gear motor is a mechanical device that combines an electric motor with a gearbox to achieve specific torque and speed requirements for various applications. It operates by converting electrical energy into mechanical power through the rotational motion of gears. Here's an overview of gear motors and their applications:




Components of a Gear Motor:

- Electric Motor: The electric motor serves as the primary power source in a gear motor. It converts electrical energy into rotational mechanical energy, driving the motion of the gears within the gearbox. Electric motors used in gear motors can be of various types, including DC motors, AC motors (induction motors, synchronous motors), or stepper motors, depending on the application requirements.
- Gearbox: The gearbox, also known as a gear reducer, is a mechanical component that reduces the speed of the motor's output shaft while increasing the torque output. It consists of a series of gears of different sizes arranged in specific configurations (gear ratios) to achieve the desired speed reduction and torque multiplication. The gearbox provides mechanical advantage by trading speed for torque or vice versa, depending on the gear arrangement.

Working Principle of a Gear Motor:

- Motor Rotation: When electrical power is supplied to the electric motor, it generates rotational motion in its shaft. The speed and direction of rotation depend on the type of motor and the electrical input provided.

- Gear Reduction: The rotational motion from the motor's shaft is transmitted to the input shaft of the gearbox. Within the gearbox, the motion is transferred through a series of gears with varying sizes and tooth counts. As the motion passes through each gear stage, the speed decreases, and the torque increases due to the mechanical advantage provided by the gear reduction.
- Output Shaft: The final output shaft of the gearbox delivers the mechanical power to drive the load. The speed and torque characteristics of the output shaft depend on the gear ratios and configuration of the gearbox. Gear motors can be designed to provide high torque at low speeds (high reduction ratio) or high speed with lower torque (low reduction ratio), depending on the application requirements.

Applications of Gear Motors:

- Industrial Machinery: Gear motors are widely used in various industrial applications, including conveyor systems, packaging machinery, material handling equipment, and automation systems, where precise control of speed and torque is essential for efficient operation.
- Automotive Systems: They are employed in automotive applications such as power windows, power seats, windshield wipers, and HVAC systems to provide mechanical power for actuation and control of vehicle components.
- Home Appliances: Gear motors find applications in household appliances such as washing machines, dryers, dishwashers, and garage door openers for driving rotating components and providing mechanical motion.
- Robotics and Automation: They are utilized in robotics and automation systems for driving robot joints, grippers, actuators, and other moving parts, enabling precise control of motion and manipulation.

Cyclo Drive:

A cyclo drive is a gearbox that converts rotational motion into precise output motion using a unique cycloidal mechanism. It consists of an input shaft, a cycloidal disk with lobes, and an eccentric shaft with pins or rollers. As the input shaft rotates, the cycloidal disk generates smooth and controlled output motion by engaging with the pins or rollers. Cyclo drives offer high torque, precise motion control, compact design, and quiet operation, making them suitable for various applications such as material handling equipment, industrial machinery, automotive systems, and construction equipment.

**Electrical and Electronics Hardware-**

Motor Driver:

A motor driver is an electronic device or circuit that controls the speed, direction, and torque of an electric motor. It acts as an interface between a microcontroller or control system and the motor, providing the necessary power and signals to drive the motor according to desired parameters. Here's an overview of motor drivers and their functionalities:

Components of a Motor Driver:

- Power Stage: The power stage of a motor driver consists of power transistors (typically MOSFETs or IGBTs) arranged in an H-bridge configuration. This configuration allows the motor driver to control both the speed and direction of the motor by varying the polarity and magnitude of the voltage applied to the motor terminals.
- Control Circuitry: The control circuitry of a motor driver includes various components such as microcontrollers, gate drivers, current sensing circuits, and feedback mechanisms. These components work together to process input signals, generate PWM (Pulse Width Modulation) signals, and monitor motor parameters such as speed and current.
- Protection Features: Motor drivers often incorporate protection features such as overcurrent protection, overtemperature protection, and short-circuit protection to safeguard the motor and driver circuitry from damage due to fault conditions.

Functionalities of a Motor Driver:

- Speed Control: Motor drivers can regulate the speed of the motor by adjusting the duty cycle of the PWM signal applied to the power transistors. By varying the PWM duty cycle, the average voltage applied to the motor terminals is adjusted, thereby controlling the motor speed.
- Direction Control: Motor drivers can change the direction of rotation of the motor by reversing the polarity of the voltage applied to the motor terminals. This is achieved by changing the state of the H-bridge configuration in the power stage.
- Torque Control: Motor drivers can control the torque output of the motor by adjusting the voltage and current supplied to the motor terminals. This is typically achieved by modulating the amplitude of the PWM signal or by implementing closed-loop control algorithms based on feedback from sensors.
- Feedback Control: Advanced motor drivers incorporate feedback mechanisms such as encoders, Hall effect sensors, or current sensors to provide real-time feedback on motor performance. This feedback is used to adjust motor parameters dynamically and ensure accurate control of speed, position, and torque.

Applications of Motor Drivers:

- Robotics: Motor drivers are widely used in robotics applications for controlling the movement of robot joints, grippers, wheels, and actuators with precision and accuracy.
- Automation Systems: They are employed in automation systems for controlling conveyor belts, pick-and-place machines, CNC machines, and other industrial equipment requiring motor control.
- Electric Vehicles: Motor drivers play a crucial role in electric vehicle propulsion systems for controlling the speed, torque, and regenerative braking of electric motors.

- Consumer Electronics: They are used in various consumer electronics products such as drones, RC vehicles, 3D printers, and home appliances for motor control and actuation.

### Microcontroller Development Board with WiFi Capabilities:

A microcontroller development board with WiFi capabilities is a versatile platform designed for prototyping and developing Internet of Things (IoT) projects, smart devices, and connected systems. It integrates a microcontroller unit (MCU) with built-in WiFi connectivity, allowing developers to create wireless-enabled applications easily. Here's an overview of such development boards and their features:

Components of a Microcontroller Development Board with WiFi:

**A.** Microcontroller Unit (MCU): The heart of the development board is a microcontroller unit (MCU), which serves as the central processing unit for executing program instructions and controlling peripheral devices. The MCU typically features a powerful processor core, embedded memory (Flash, RAM), and various integrated peripherals (GPIO, ADC, PWM, UART, SPI, I2C).

**B.** WiFi Module: The WiFi module is a key component of the development board, providing wireless connectivity to the Internet or local network. It incorporates a WiFi chipset and antenna, along with software libraries and protocols for establishing WiFi communication, such as TCP/IP stack, HTTP, MQTT, and TLS/SSL.

**C.** Power Management: The development board includes power management circuitry to regulate voltage levels and supply power to the MCU, WiFi module, and other components. It may support multiple power sources, such as USB, battery, or external power adapter, and include features like low-power modes for energy-efficient operation.

**D.** Peripheral Interfaces: The board offers various peripheral interfaces to interact with external sensors, actuators, displays, and communication devices. These interfaces may include digital GPIO pins, analog-to-digital converters (ADC), pulse-width modulation (PWM) outputs, serial UART ports, I2C and SPI interfaces, and USB connectivity.

**E.** Onboard Memory: Some development boards come with onboard memory (Flash and RAM) for storing program code, data, and configuration settings. This memory may be expandable via external storage options such as microSD cards or external Flash chips.

**F.** Integrated Development Environment (IDE): The development board is typically supported by an integrated development environment (IDE) that provides software tools, compilers, debuggers, and libraries for writing, compiling, and debugging firmware code. Popular IDEs for microcontroller development include Arduino IDE, PlatformIO, and MPLAB X.

Features and Capabilities:

- Wireless Connectivity: The primary feature of the development board is its WiFi capability, allowing devices to connect to local networks or the Internet wirelessly. This enables IoT applications such as remote monitoring, control, data logging, and over-the-air (OTA) firmware updates.

- IoT Protocols: The development board supports various IoT protocols and communication standards, including MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol), HTTP (Hypertext Transfer Protocol), and WebSocket, facilitating seamless integration with cloud platforms and IoT services.
- Security Features: To ensure data privacy and integrity, the board may incorporate security features such as WPA2/WPA3 encryption, secure boot, secure firmware update mechanisms, and hardware-accelerated cryptographic algorithms (AES, RSA, ECC).
- Compatibility and Expandability: Many development boards are compatible with popular development platforms and programming languages, making it easy for developers to leverage existing libraries, frameworks, and community resources. They may also feature expansion headers (e.g., Arduino-compatible headers) for connecting shields, modules, and sensor boards to extend functionality.

Applications:

**A.** Home Automation: Control and monitor smart home devices such as lights, thermostats, and security cameras remotely via WiFi connectivity.
**B.** Industrial Automation: Implement IoT solutions for industrial monitoring, predictive maintenance, asset tracking, and process automation in factories and manufacturing plants.
**C.** Environmental Monitoring: Deploy wireless sensor networks for collecting environmental data (temperature, humidity, air quality) in agricultural, environmental, and smart city applications.
**D.** Healthcare: Develop IoT-enabled medical devices for remote patient monitoring, telemedicine, and health tracking applications.
**E.** Consumer Electronics: Create WiFi-connected gadgets, wearables, and appliances with IoT functionality for consumer markets.

## Battery and Battery Management System (BMS):

Batteries are essential energy storage devices used in various applications, from portable electronics to electric vehicles and renewable energy systems. A battery management system (BMS) is a crucial component that ensures the safe and efficient operation of batteries by monitoring and controlling their charging, discharging, and overall performance. Let's explore batteries and BMS in detail:

Battery:

**A.** Types of Batteries: Batteries come in various types, including:
  **a.** Lithium-ion (Li-ion): Widely used in portable electronics, electric vehicles (EVs), and renewable energy storage systems due to their high energy density and long cycle life.

   b. Lead-acid: Commonly used in automotive starting, lighting, and ignition (SLI) applications, uninterruptible power supplies (UPS), and backup power systems.
   c. Nickel-cadmium (NiCd) and Nickel-metal hydride (NiMH): Found in older electronics, power tools, and rechargeable batteries.

B. Battery Capacity: Battery capacity refers to the amount of electrical energy a battery can store and is typically measured in ampere-hours (Ah) or watt-hours (Wh). It determines how long a battery can power a device or system before needing to be recharged.
C. Charging and Discharging: Batteries undergo charging (absorbing electrical energy) and discharging (releasing electrical energy) cycles. Proper charging and discharging methods are crucial for maximizing battery life and performance.
D. Battery Safety: Batteries can pose safety risks if mishandled, including overheating, fire, and explosion. Safety measures such as thermal management systems, overcharge protection, and short-circuit protection are implemented to mitigate these risks.

Battery Management System (BMS):

A. Functions of BMS:
   a. Cell Balancing: BMS ensures uniform charging and discharging of individual battery cells within a battery pack to prevent overcharging or over-discharging of any cell, which can lead to reduced capacity and premature failure.
   b. State of Charge (SoC) Estimation: BMS accurately estimates the state of charge of the battery pack based on voltage, current, temperature, and other parameters, allowing users to monitor the remaining battery capacity.
   c. Temperature Management: BMS monitors battery temperature and implements thermal management strategies such as active cooling or heating to maintain optimal operating conditions and prevent thermal runaway.
   d. Overvoltage and Undervoltage Protection: BMS safeguards the battery pack by disconnecting the load or activating safety mechanisms when the voltage exceeds safe limits (overvoltage) or drops below the minimum threshold (undervoltage).
   e. Current Limiting: BMS regulates the charging and discharging current to prevent excessive current flow, which can damage the battery cells and associated electronics.
   f. State of Health (SoH) Monitoring: BMS assesses the overall health and performance of the battery pack over time by analyzing factors such as capacity degradation, internal resistance, and cycle life.
B. Types of BMS:
   a. Passive BMS: Utilizes passive components such as resistors and diodes to perform basic monitoring and protection functions.
   b. Active BMS: Employs microcontrollers, sensors, and intelligent algorithms to provide advanced monitoring, diagnostics, and control capabilities.
   c. Distributed BMS: Consists of distributed modules that communicate wirelessly or via a wired network to coordinate monitoring and control functions across multiple battery cells or packs.

C. Integration with Energy Systems: BMS interfaces with energy management systems (EMS), inverters, chargers, and other components in electric vehicles, renewable energy systems, and grid storage applications to optimize energy efficiency, reliability, and safety.

## 1-Way and 2-Way Rocker Switch:

- 1-Way Rocker Switch: A 1-way rocker switch, also known as a single-pole single-throw (SPST) switch, has two terminals and controls the flow of electricity in a single circuit. It can either be in an "on" or "off" state, allowing or interrupting the current flow when pressed.
- 2-Way Rocker Switch: A 2-way rocker switch, also called a double-pole single-throw (DPST) switch, has four terminals and controls two separate circuits simultaneously. It can be used to switch two independent circuits on or off simultaneously.

## Limit Switch:

A limit switch is a type of electromechanical device used to detect the presence or absence of an object or to limit the motion of a mechanical system. When activated by the motion of a machine or an object, it triggers a response, such as stopping or reversing the motion, or activating a control signal.

## Power Jack:

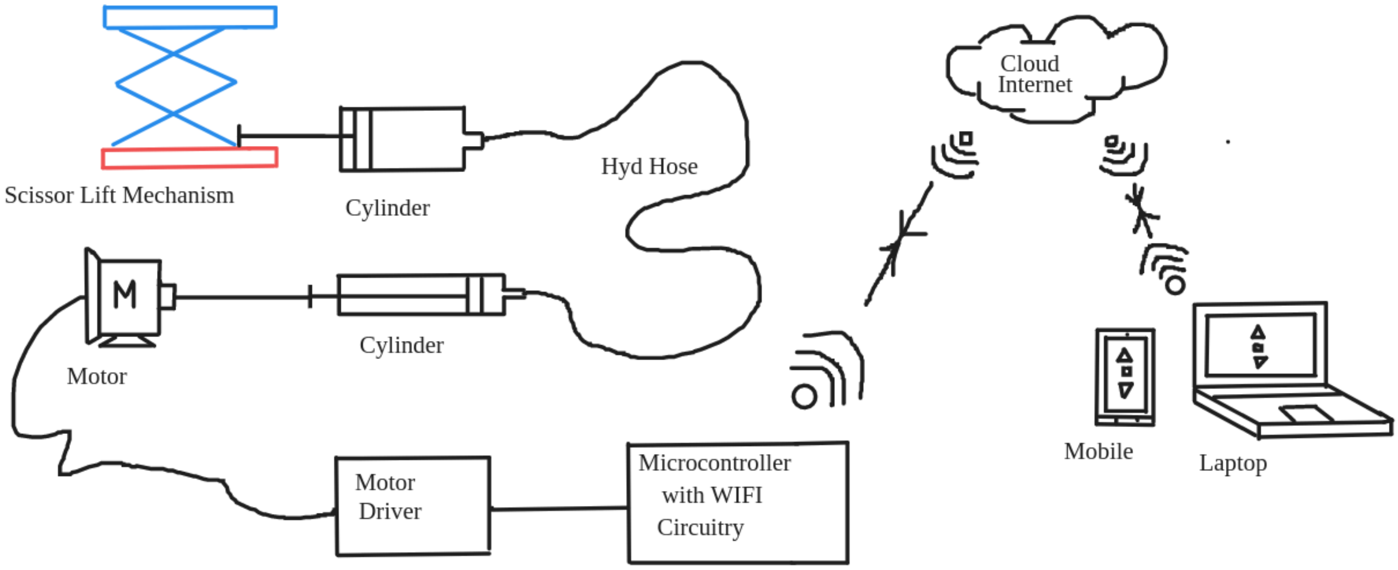
A power jack, also known as a DC power connector or barrel jack, is a common type of electrical connector used to supply power to electronic devices. It consists of a cylindrical plug and a corresponding socket, with the plug typically having a center pin for positive (+) and an outer sleeve for negative (-) connections. Power jacks are commonly used in applications such as power supplies, laptops, routers, and audio equipment.

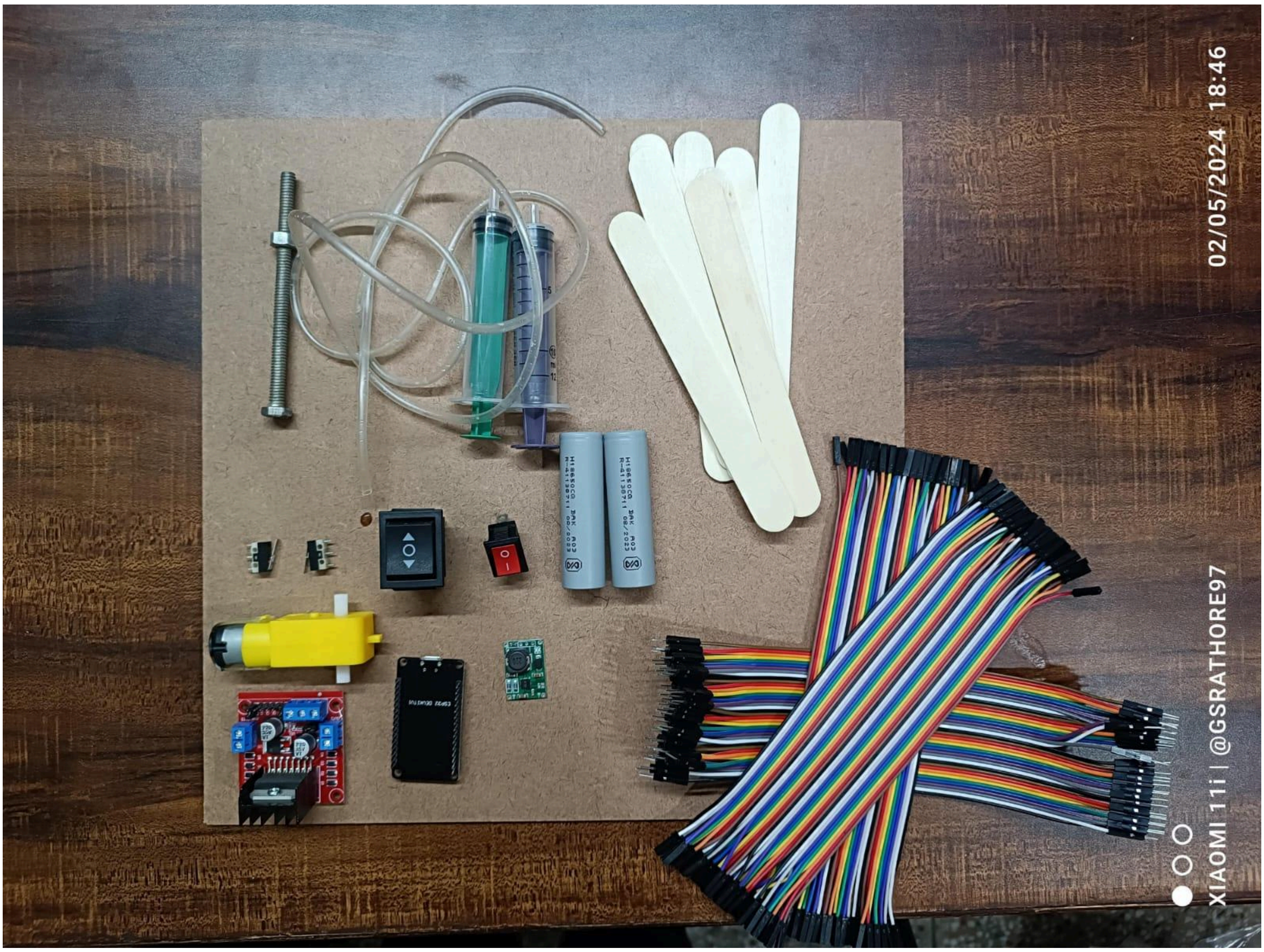
## Wires:

Wires are electrical conductors used to carry electrical current between components in an electrical or electronic system. They are typically made of copper or aluminum and are insulated to prevent electrical shorts and protect against electrical shock. Wires come in various sizes (gauges) and types (solid or stranded) depending on the application requirements. They are used to connect components such as switches, sensors, motors, and power sources in electrical circuits.

### (ii) Design and Planning-

**According to our research and conceptualization, we have carefully selected the components listed below for the construction of our Wi-Fi Internet Controlled Hydraulic Scissor Lifter Model:**



Scissor Lifter Structure:

- Popsicle Sticks (Ice Cream Sticks): These are used as the arms of the scissor lifter to create a lightweight and sturdy framework.

- Wood Skewer as Shaft: Utilized as the central shaft to connect and provide stability to the scissor lifter structure.

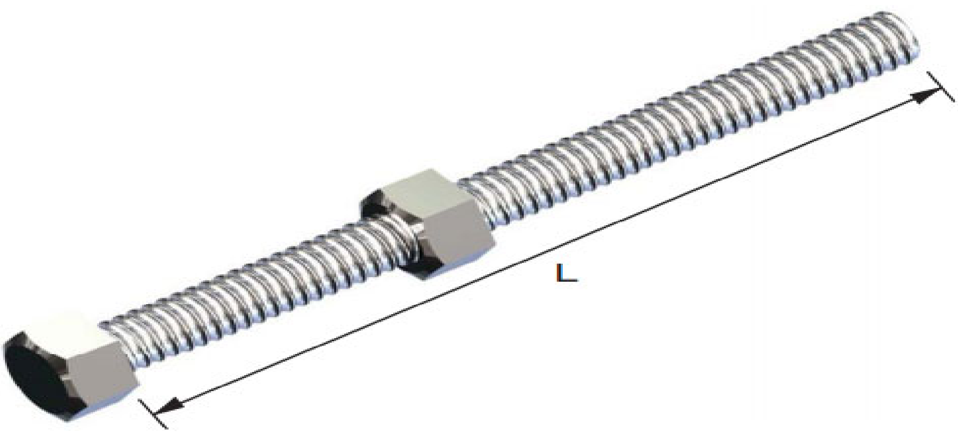
Hydraulic System:

- Syringes: Employed as piston-cylinders of different diameters and volumes to create the hydraulic mechanism. A larger diameter syringe is used for the lifting mechanism of the scissor lifter.


- Tube: Used as a hydraulic hose to transfer the hydraulic fluid between the syringes.

Lead Screw Mechanism:

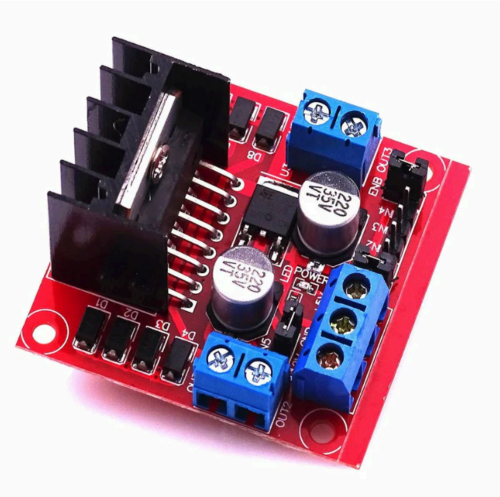
- Nut-Bolt and Hollow Plastic Cylindrical Piece: Used to construct the lead screw mechanism for moving the smaller diameter syringe (cylinder) backward and forward.



Motor and Motor Driver:

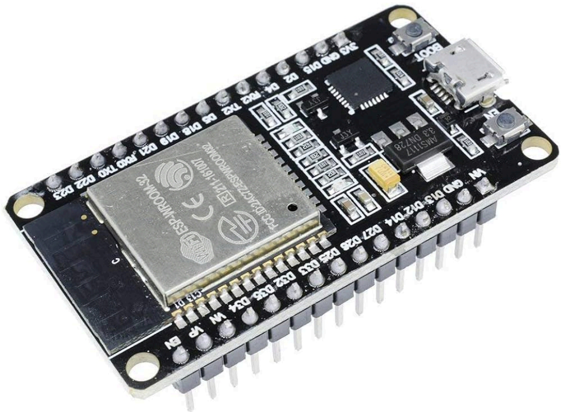
- BO Gear Motor 6V: Selected to drive the lead screw and ultimately the scissor lifter mechanism.

- L298 Motor Driver: Used to control and drive the motor with signals from the microcontroller.



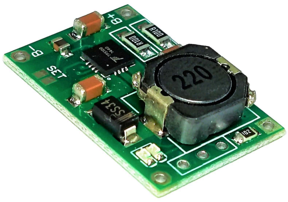
Microcontroller and Connectivity:

- ESP32 Development Board: Utilized as the microcontroller for controlling the overall operation of the scissor lifter and providing Wi-Fi connectivity.



Battery and Battery Management System (BMS):

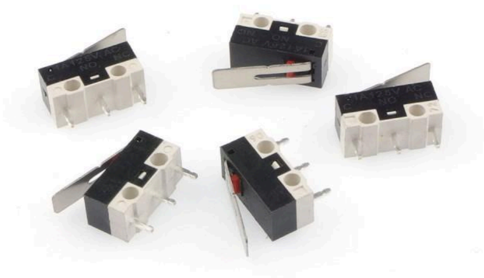
- TP5100 Charging Module and 18650 3.7V Li-ion Battery: Chosen for powering the device and managing the battery charging process effectively.





Control and Safety Mechanisms:

- Generic Limit Switch: Implemented to limit the up and down movement of the scissor lifter, ensuring safety during operation.



- Rocker Switch (2-Way): Used for manual control of the scissor lifter's up and down movement.

- Rocker Switch (1-Way): Employed for turning the device on/off.

- DC 9V Power Jack: Used for charging the device and providing power.

- We used the MDF board as a platform for the whole device.

## Operational Flow:

A. Signal Processing:
    a. Source of Signals: Signals and commands originate from our Arduino Cloud Android app and web dashboard.
    b. Transmission: These signals are transmitted over the internet to the ESP32 development board.
    c. Data Interpretation: The ESP32 board receives and interprets the signals, identifying the intended actions for the scissor lifter based on the commands received.
B. Microcontroller Processing:
    a. Data Processing: The ESP32 board processes the received signals and commands using pre-defined code, algorithms, and logic programmed into its firmware.
    b. Logic and Conditions: The microcontroller evaluates the received commands against predefined conditions, safety limits, and operational logic to ensure safe and efficient operation of the scissor lifter.
    c. Functions Execution: Based on the processed data, the microcontroller executes specific functions and commands to control the various components of the scissor lifter system.
C. Motor Control:
    a. Signal Reception: The L298 motor driver receives control signals from the microcontroller, indicating the desired motor operation, including direction (forward or reverse) and speed control.
    b. Motor Activation: Based on the received signals, the motor driver activates the BO gear motor, providing the necessary power and torque to drive the scissor lifter mechanism.
    c. Dynamic Control: The motor control system dynamically adjusts the motor speed and direction as per the input commands from the microcontroller, ensuring smooth and precise movement of the scissor lifter.
D. Hydraulic Operation:
    a. Lead Screw Mechanism: The motor drives the lead screw mechanism, which converts rotational motion into linear motion.
    b. Syringe Movement: The rotational motion of the lead screw causes the smaller diameter syringe (cylinder) to move backward and forward along its axis.
    c. Hydraulic Transfer: The motion of the smaller diameter syringe transfers hydraulic fluid through the connected tube to the larger diameter cylinder, resulting in the upward and downward movement of the scissor lifter mechanism.
E. Feedback Monitoring:
    a. Limit Switch Signals: Signals from the limit switch, positioned to detect the upper and lower limits of the scissor lifter's movement, are monitored by the ESP32 board.
    b. Status Update: The ESP32 board processes the feedback signals and updates the Arduino Cloud and monitoring systems with real-time information on the operational status of the scissor lifter.

c. Safety Assurance: Feedback monitoring ensures that the scissor lifter operates within safe limits and conditions, providing alerts or initiating safety protocols if any abnormalities or malfunctions are detected.

## User Interface Design:

- App Interface: The mobile app interface will be designed to provide a user-friendly experience for controlling and monitoring the scissor lifter remotely. It will feature intuitive controls for initiating lift operations, adjusting lift height and speed, and receiving real-time status updates.
- Web Dashboard: The web dashboard interface will offer a comprehensive overview of the scissor lifter's operational parameters, including lift height, battery level, and system status. It will enable users to monitor the device's performance, view historical data, and configure settings remotely.
- User Authentication: To ensure security and access control, both the app and web dashboard will implement user authentication mechanisms, requiring users to log in with their credentials before accessing the interface.

Arduino IDE:

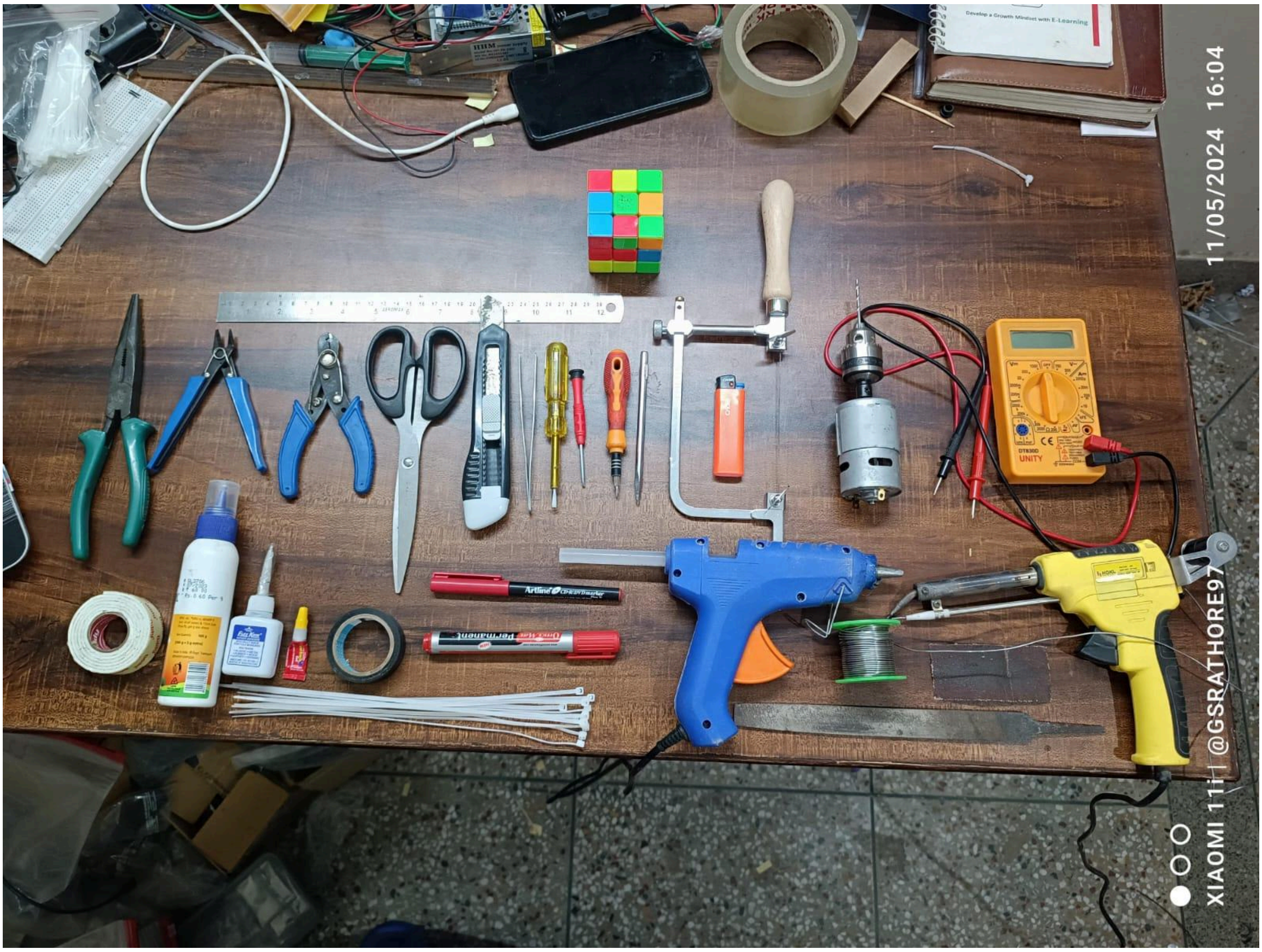
- Description: The Arduino Integrated Development Environment (IDE) is a software application used for writing, compiling, and uploading code to Arduino microcontroller boards.
- Purpose: Arduino IDE will be used for programming the ESP32 development board, which serves as the microcontroller for controlling the scissor lifter and interfacing with various sensors, actuators, and communication modules.
- Features: Arduino IDE provides an easy-to-use interface for writing Arduino sketches (code), compiling sketches into machine code, uploading code to the ESP32 board, and monitoring serial communication for debugging purposes.

Arduino Cloud:

- Description: Arduino Cloud is a cloud-based platform provided by Arduino for IoT (Internet of Things) applications, offering features for remote monitoring, control, and data management.
- Purpose: Arduino Cloud will be used to establish communication between the ESP32 development board and the mobile app/web dashboard, allowing remote control and monitoring of the scissor lifter over the internet.
- Features: Arduino Cloud provides APIs and libraries for connecting devices, sending/receiving data, setting up dashboards for data visualization, and implementing remote control functionalities. It also offers security features for authentication and data encryption to ensure secure communication between devices and the cloud platform.

## Tools and Equipment required for Fabrication-

Following basic tools is required and plays a vital role in different applications, ranging from construction and maintenance to crafting and DIY projects. They are essential for completing tasks efficiently and effectively, making them indispensable in various professional and personal settings.




- **A.** Scale: A scale is a measuring tool used to determine the length, width, or height of objects. It typically features markings in centimeters or inches, allowing for precise measurements in various applications, such as drafting, construction, and crafting.
- **B.** Nose Pliers: Nose pliers, also known as needle-nose pliers, are versatile hand tools with long, slender jaws used for gripping, bending, and cutting wires or small objects. They are commonly used in electrical work, jewelry making, and model building.
- **C.** Wire Nipper: Wire nippers, or wire cutters, are specialized cutting tools designed to cleanly cut wires, cables, and small metal components. They feature sharp, precision blades that make quick and precise cuts without causing damage to the surrounding materials.
- **D.** Wire Stripper-Cutter: Wire stripper-cutters are multifunctional tools used to strip insulation from electrical wires and cables while also cutting them to size. They feature adjustable

blades and stripping notches for different wire gauges, making them indispensable for electrical work.

**E.** Scissors: Scissors are cutting tools consisting of two blades pivoted together at a central point. They are used for cutting various materials such as paper, fabric, plastic, and thin metal. Scissors come in different sizes and designs for specific applications.

**F.** Blade Cutter: A blade cutter, often referred to as a utility knife or box cutter, is a versatile cutting tool with a retractable razor-sharp blade. It is commonly used for cutting cardboard, plastic, leather, and other materials in construction, packaging, and crafting.

**G.** Tweezers: Tweezers are small, handheld tools with pointed tips used for grasping and manipulating small objects, such as splinters, hairs, or electronic components. They are available in various shapes and sizes for specific tasks.

**H.** AC Line Tester: An AC line tester, also known as a voltage tester or circuit tester, is a diagnostic tool used to detect the presence of electrical voltage in AC circuits. It helps identify live wires and ensure electrical safety during maintenance or installation work.

**I.** Electronics Screwdriver: An electronics screwdriver is a precision tool designed for handling small screws commonly found in electronic devices such as smartphones, laptops, and circuit boards. It features a slim, narrow shaft and interchangeable magnetic tips for accessing tight spaces.

**J.** Sharp big needle : A sharp big needle, or bodkin needle, is a large, sturdy needle with a sharp point and a large eye. It's commonly used in sewing, upholstery, and leatherworking for thicker materials like canvas and leather.

**K.** Wire Hex Saw: A wire hex saw, or hacksaw, is a handheld cutting tool used to cut through various materials such as metal, plastic, and wood. It features a fine-toothed blade tensioned in a frame, allowing for precise and controlled cuts.

**L.** Lighter: A lighter is a portable device used to produce a flame for igniting fires, candles, or cigarettes. It typically contains a flammable gas, such as butane, which is ignited by a spark generated when the trigger is depressed.

**M.** Drill Gun: A drill gun, or power drill, is a versatile tool used for drilling holes and driving screws in various materials such as wood, metal, and plastic. It consists of a motorized drill bit or screwdriver head powered by electricity or battery.

**N.** Multimeter: A multimeter is an electronic measuring instrument used to measure voltage, current, and resistance in electrical circuits. It features multiple functions such as voltage testing, continuity testing, and diode testing, making it indispensable for troubleshooting and maintenance tasks.

**O.** Soldering Iron Gun: A soldering iron gun is a tool used for soldering electronic components onto circuit boards or wires. It heats up to a controlled temperature, allowing solder to melt and create a strong electrical connection between components.

**P.** Solder Wire: Solder wire is a fusible metal alloy used to join or connect electrical components together through soldering. It melts at a relatively low temperature and forms a bond between the surfaces it contacts when cooled.

Q. File:A file is a hand tool used for shaping, smoothing, and finishing materials like metal and wood. It has a hardened steel blade with parallel ridges or teeth for abrasion, available in various shapes and cuts for specific tasks.

R. Sandpaper:Sandpaper, also called glasspaper, is abrasive material bonded to flexible backing used for smoothing and finishing surfaces by abrasion. It comes in various grit sizes for different applications, from rough shaping to fine polishing.

**S.** Glue Gun: A glue gun is a handheld tool that dispenses hot melt adhesive (glue) onto surfaces, creating a strong and durable bond when cooled. It is commonly used in crafts, woodworking, and DIY projects for bonding various materials such as wood, plastic, and fabric.

**T.** Glue Sticks: Glue sticks are cylindrical adhesive sticks designed for use with glue guns. They are available in various sizes and formulations for different applications, providing quick and reliable bonding for a wide range of materials.

**U.** Markers: Markers are writing instruments with a felt-tip or ink-filled reservoir used to create permanent or temporary markings on surfaces such as paper, cardboard, plastic, and metal. They come in different colors and tip sizes for various writing and drawing tasks.

**V.** Cable Ties: Cable ties, also known as zip ties or wire ties, are fastening devices used to secure and organize cables, wires, and other objects. They consist of a flexible nylon strip with a serrated surface and a locking mechanism, allowing for easy installation and removal.

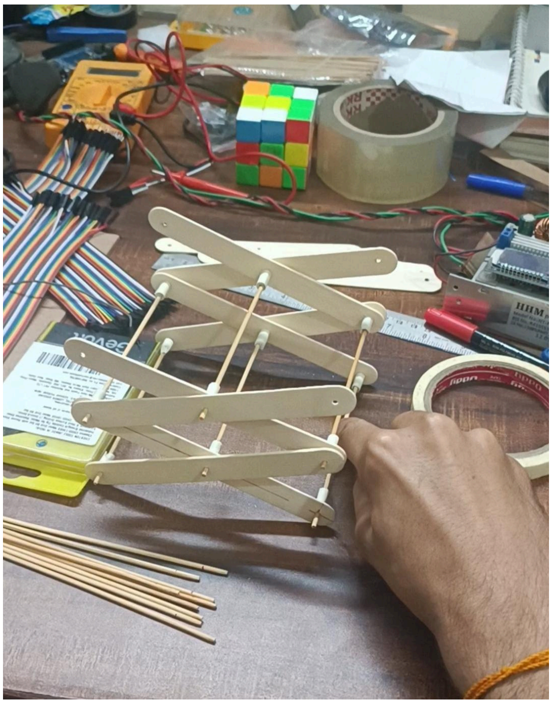
**W.** PVC Tape: PVC tape, or electrical tape, is a type of pressure-sensitive tape used to insulate and protect electrical wires and connections. It is made of durable PVC (polyvinyl chloride) material and is resistant to moisture, heat, and abrasion.

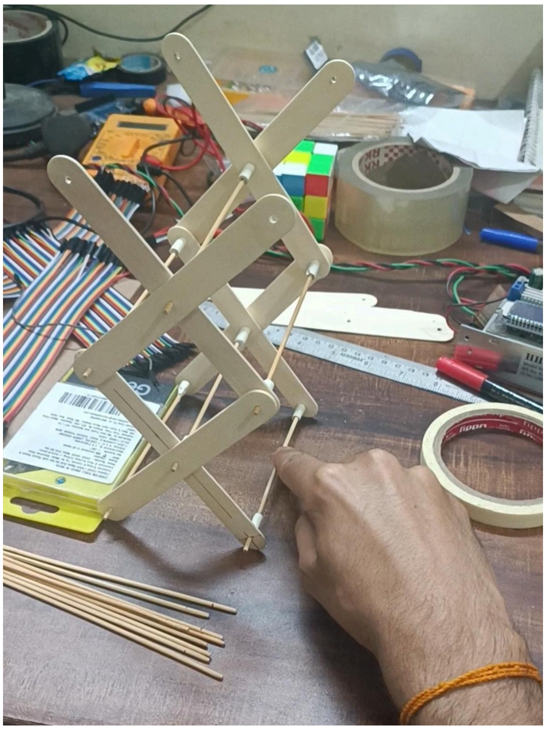
**X.** Fevikwik Adhesives: Fevikwik adhesives are cyanoacrylate-based instant adhesives used for bonding metal, plastic, rubber, and other materials. They provide fast and strong bonding within seconds, making them ideal for quick repairs and assembly tasks.

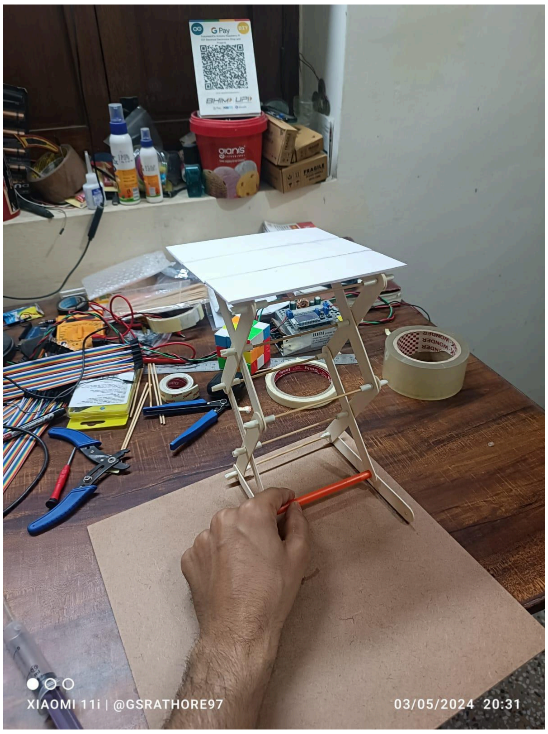
**Y.** Double-Sided Tape: Double-sided tape is a pressure-sensitive adhesive tape with adhesive on both sides, allowing it to bond two surfaces together. It is commonly used for mounting objects, securing carpets, and various crafting and DIY projects.

## (iii) Assembly and Fabrication-

Scissor Mechanism
Assemble the hydraulic scissor lifter according to our design plan. Drill holes in popsicle sticks and start by constructing the scissor mechanism using cross-braced arms, linked and supported with shafts .

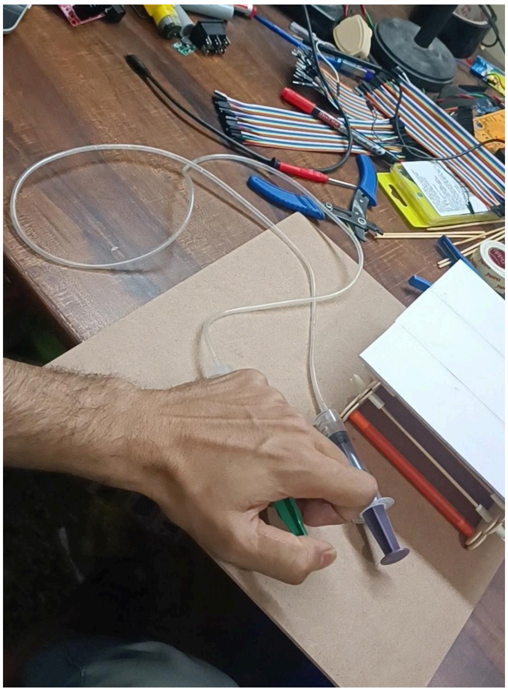




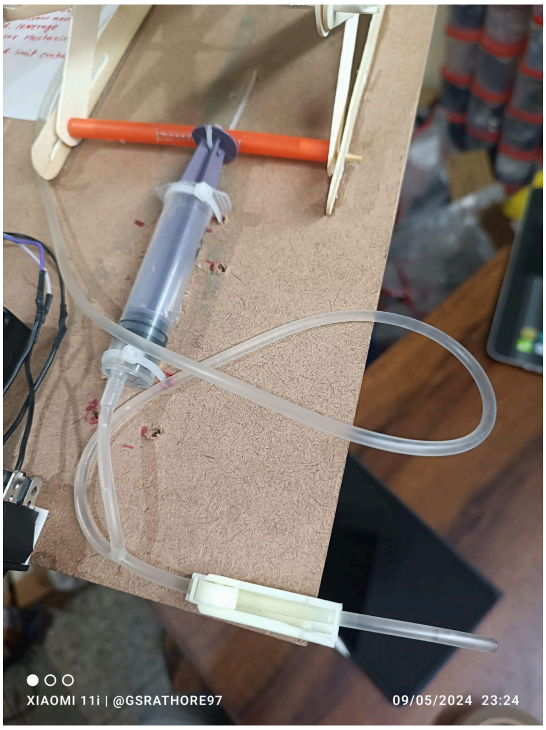

XIAOMI 11i | @GSRATHORE97
03/05/2024 20:31

**Hydraulic System-**

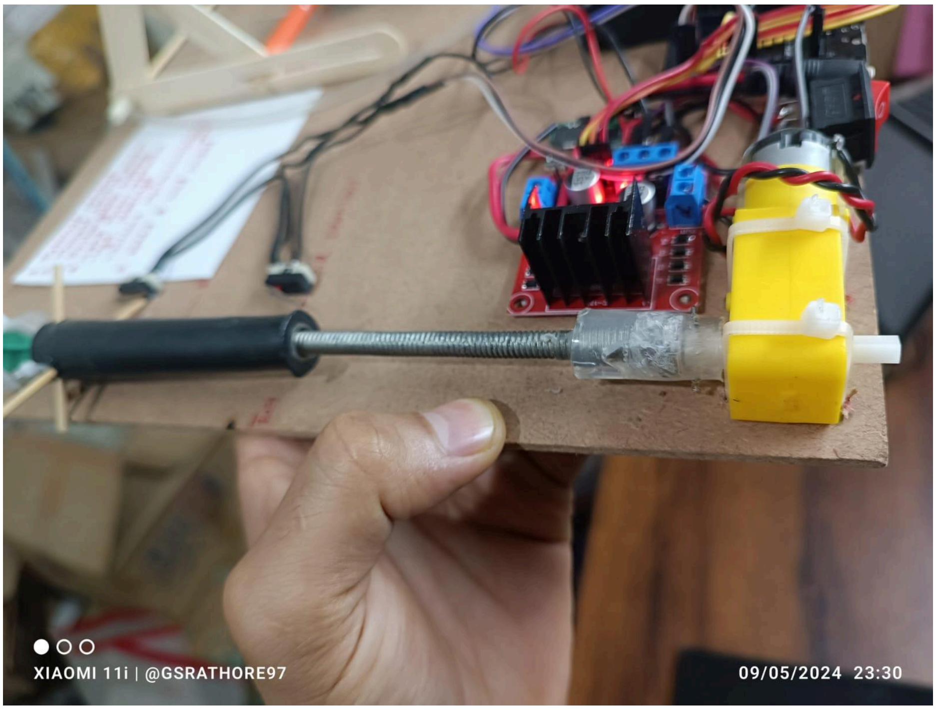
Connect the hydraulic cylinders and valves, ensuring proper alignment.



Fabricate any additional support structures or components as needed.

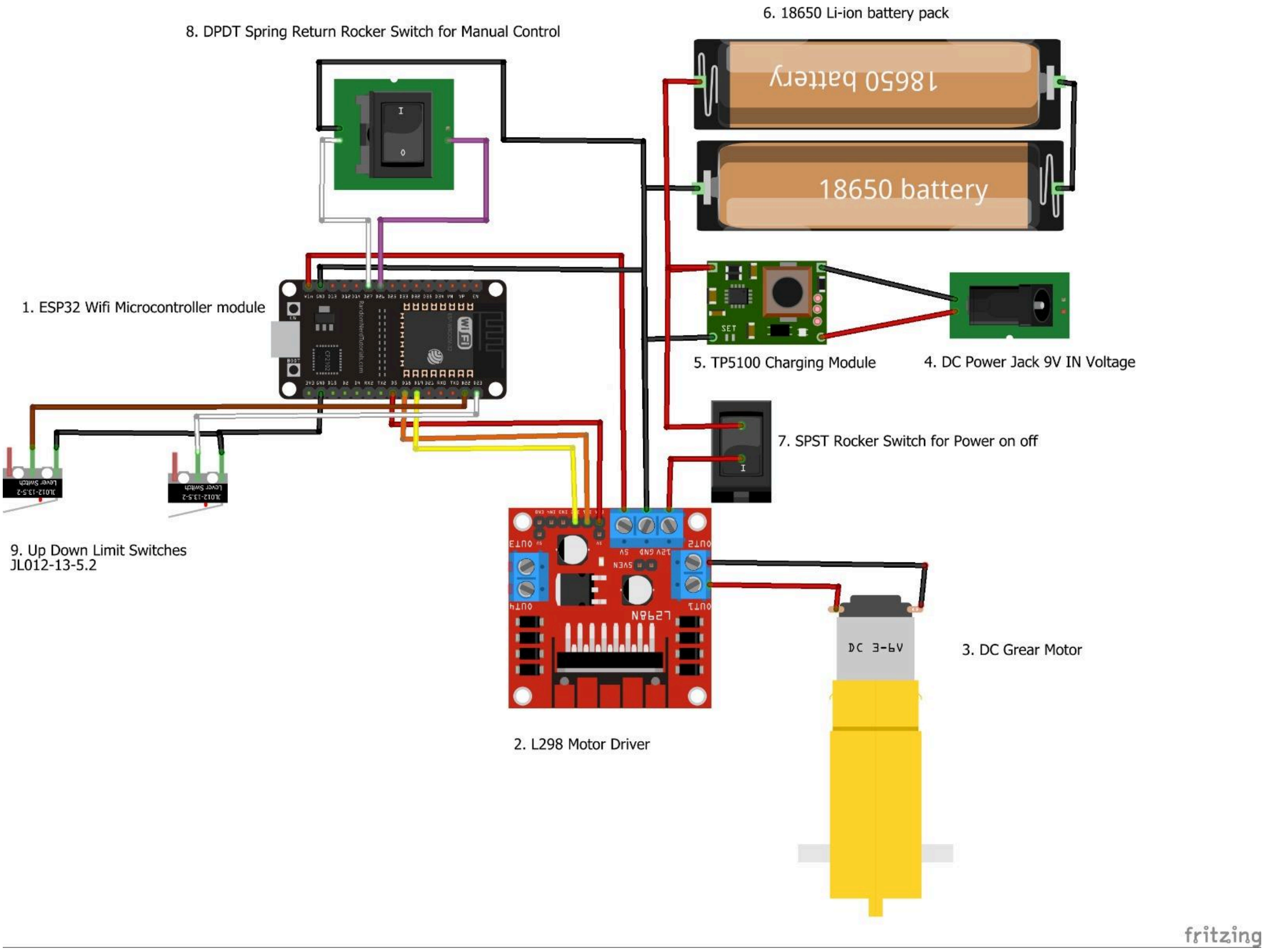


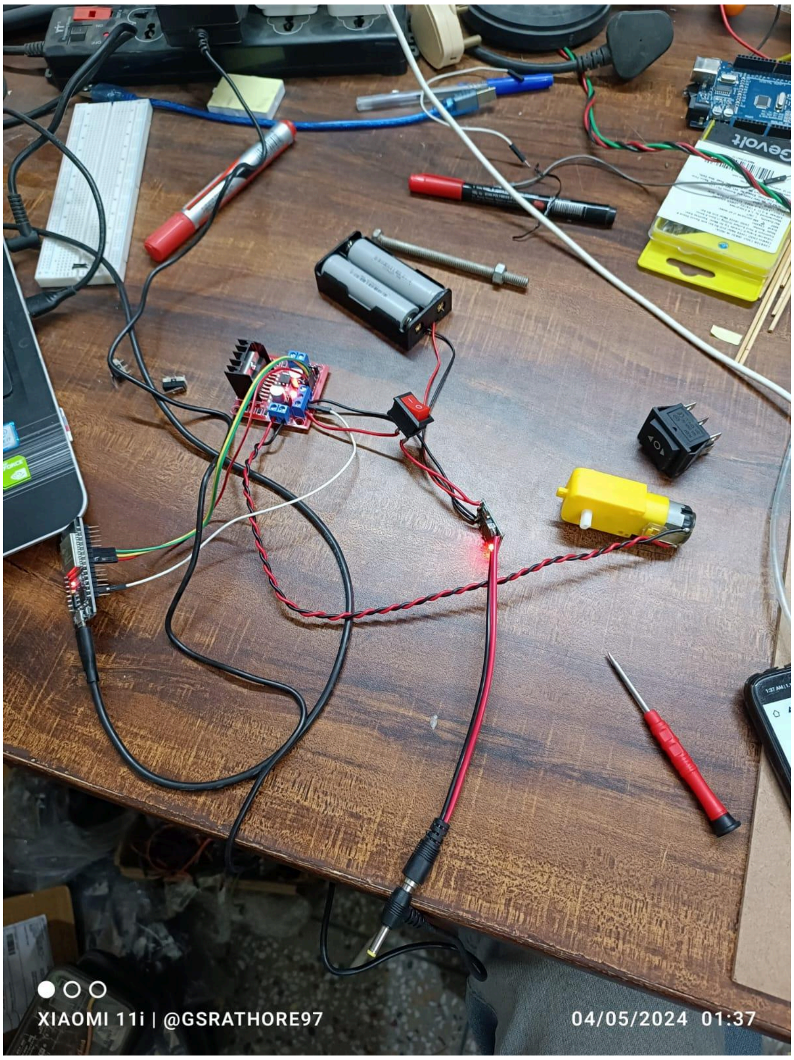

**Lead Screw mechanism and Coupling with motor-**
We heat the nut so when we fix it in a cylindrical plastic piece it is fixed at a place and to couple the bolt with the motor shaft we use a pin and hot glue.

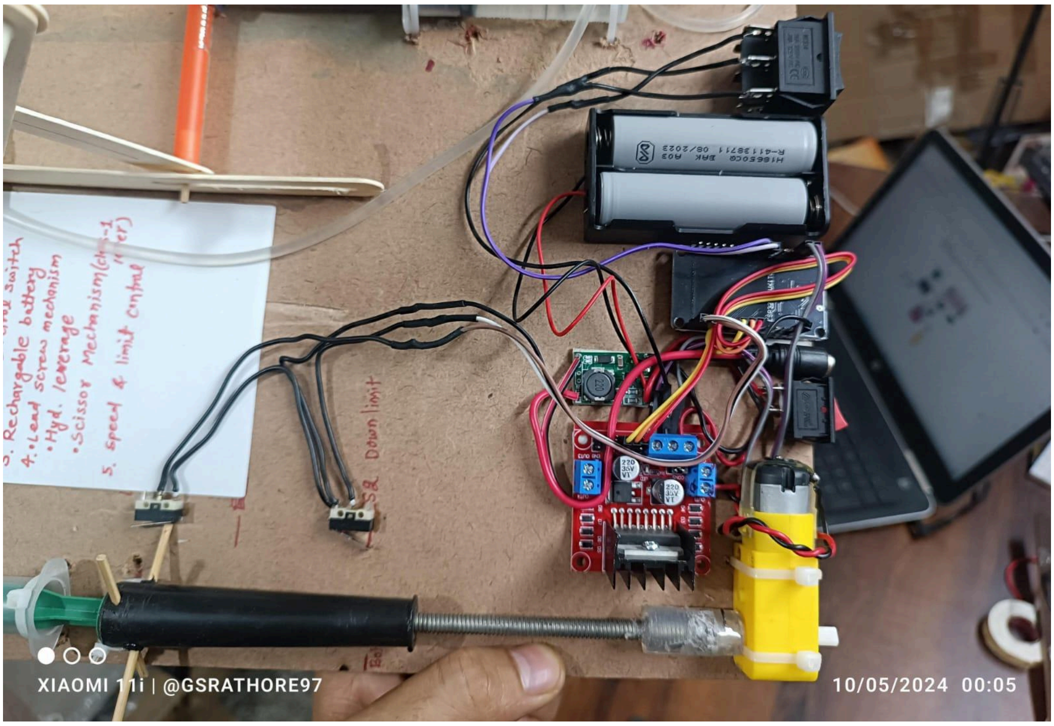


**Circuit assembly-**

Make the circuit connection according to the following Circuit diagram with wires and soldering or use jumper wires.




XIAOMI 11i | @GSRATHORE97
04/05/2024 01:37


XIAOMI 11i | @GSRATHORE97
10/05/2024 00:05

**Final Assembly-**

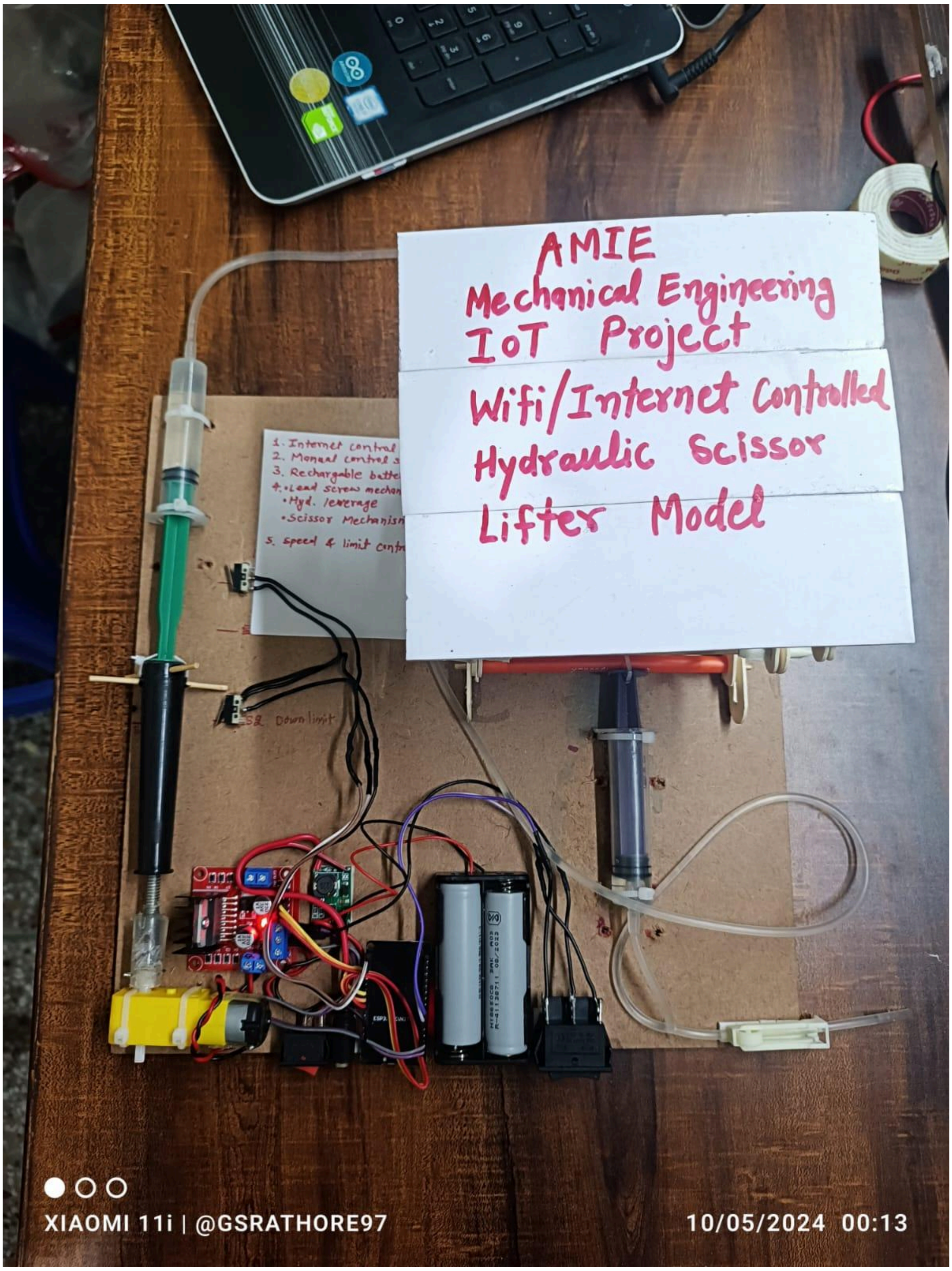
Fix all the Systems on the MDF board with Double sided tape, Cable tie, Hot glue,etc

Demo Video- https://youtube.com/shorts/fzsYE_GAf8o?si=ks7uHJ8k_gQkhhBd

Full Video-https://youtu.be/STk515_Xuog?si=TMUwp9zekl8JLXCP

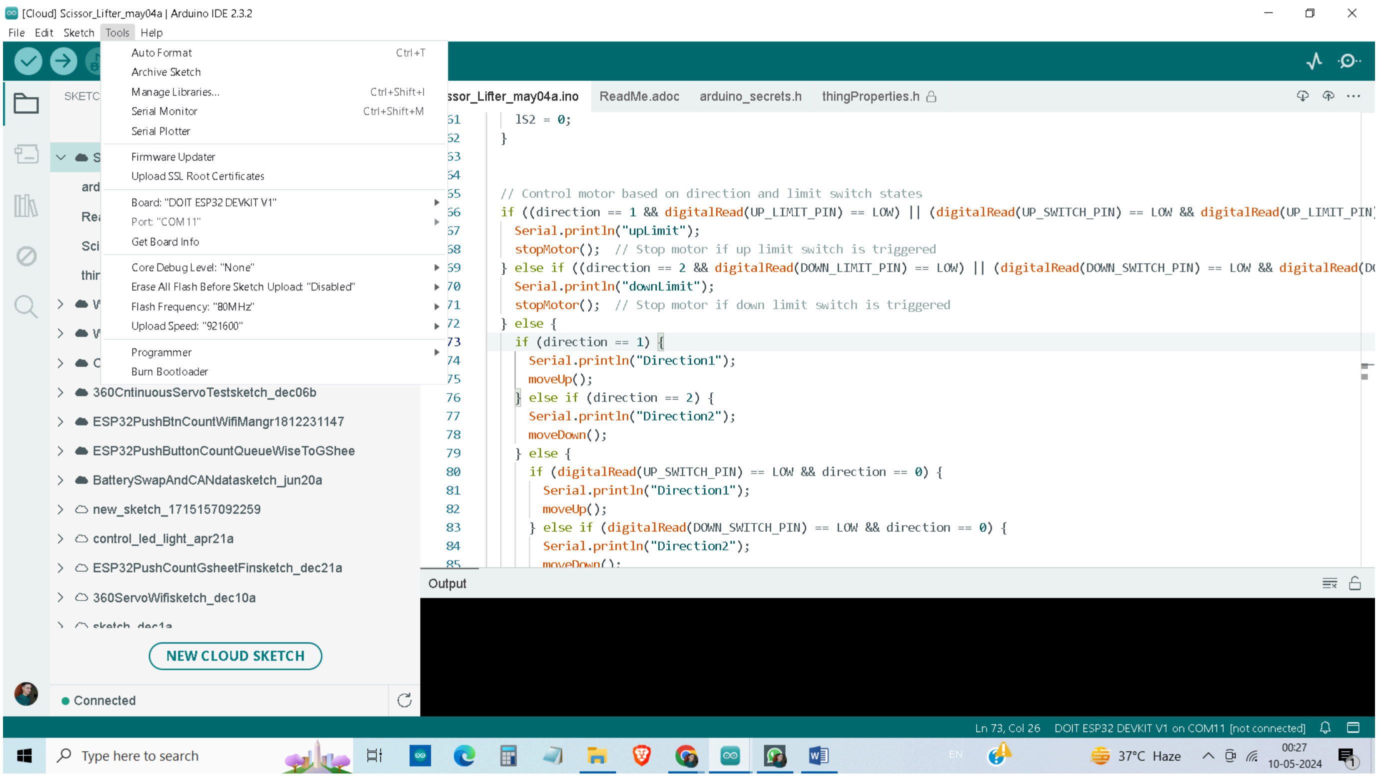
Project & Code- https://github.com/gsrathore97/iot_Scissor_lifter_AMIE_Project_2024

Project Folder-
https://drive.google.com/drive/folders/1Q-h4NLbMkmBsdpBlGQFpYtT1N3Pb2OyV?usp=sharing



## (iv) Integration of IoT-

Let's Program the microcontroller to communicate with a designated IoT platform. Connect the ESP32 to the Laptop via USB and write code in Arduino IDE or Use Arduino Web editor. Test all components one by one and then start integrating code as required in the device. Upload code to ESP32 and test working as coded and expected.



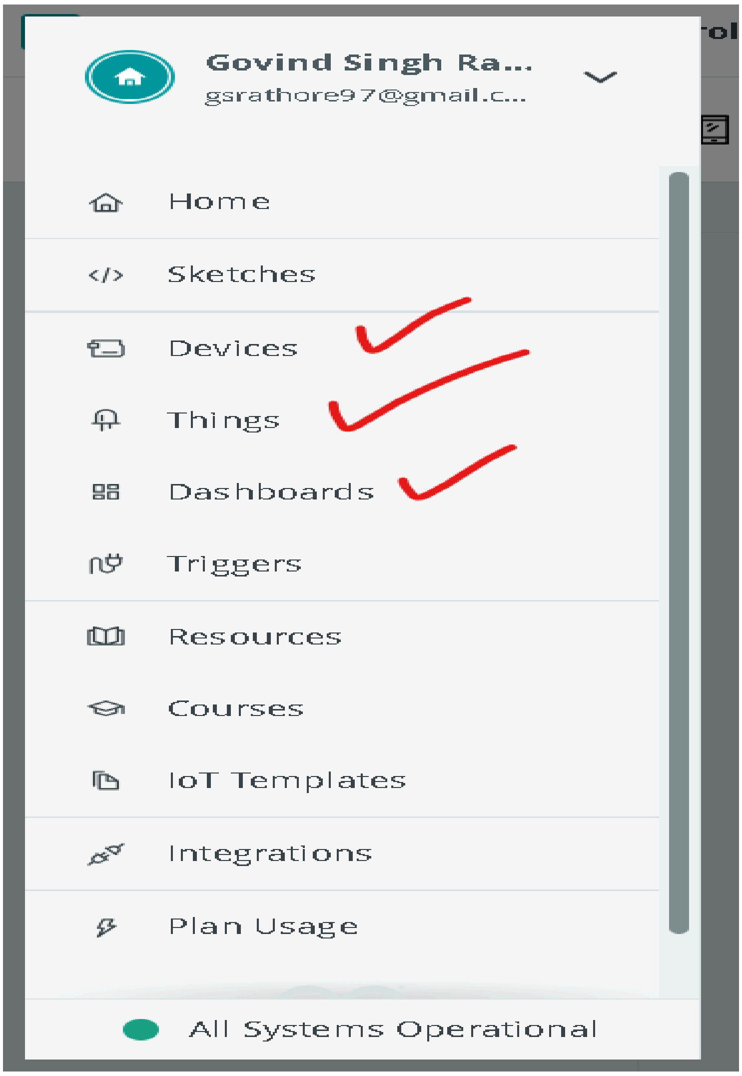

```
#include "arduino_secrets.h"
#include "thingProperties.h"
#include <Wire.h>

#define ENA_PIN 5            // PWM pin for motor speed control
#define IN1_PIN 18           // Motor direction control pin 1
#define IN2_PIN 19           // Motor direction control pin 2
#define UP_LIMIT_PIN 22      // Up limit switch pin
#define DOWN_LIMIT_PIN 23    // Down limit switch pin
#define UP_SWITCH_PIN 27     // Up switch pin
#define DOWN_SWITCH_PIN 26   // Down switch pin
#define RAMP_INTERVAL 20     // Time interval between speed increments (in
milliseconds)

int speedValue;         // Variable to store the motor speed
```

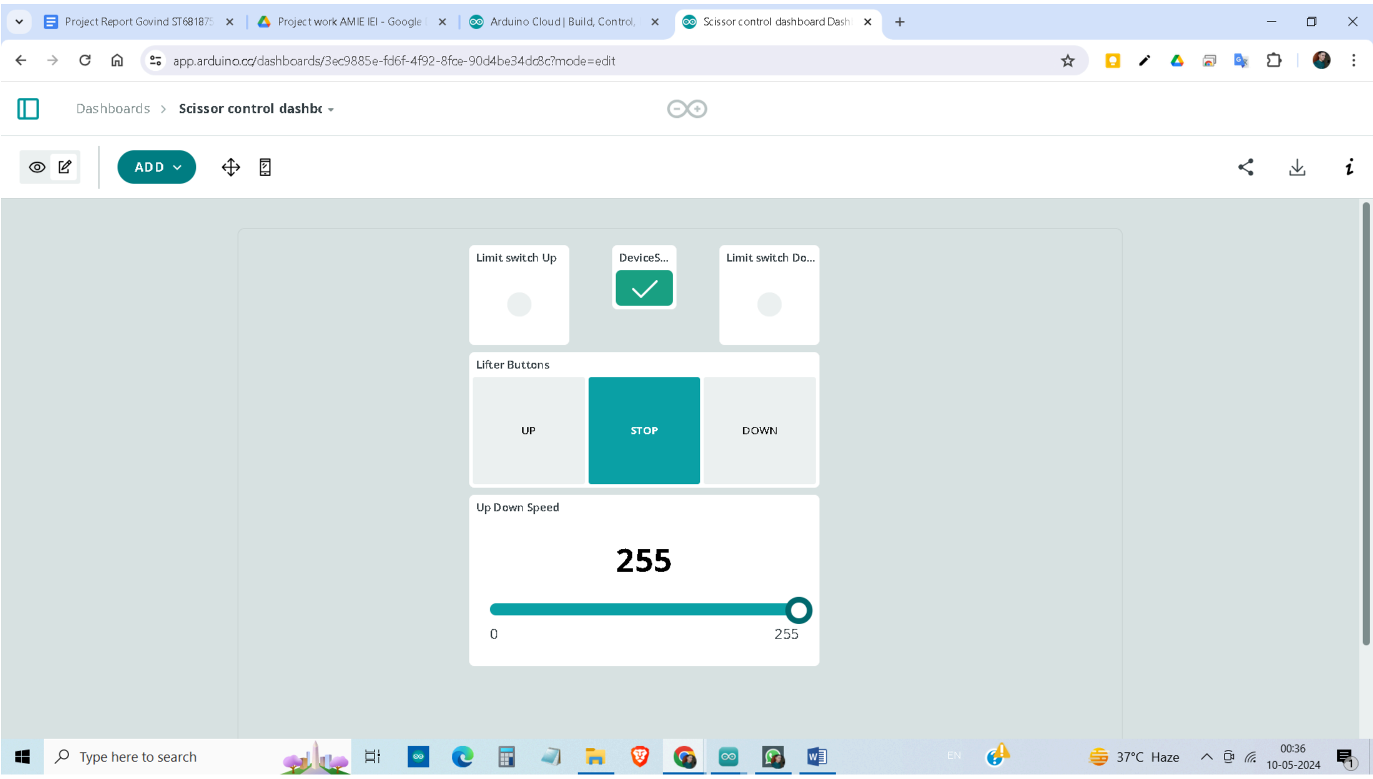
```
int direction;         // Variable to store the motor direction (0 - stop, 
1 - up, 2 - down)
int currentSpeed = 0;  // Variable to store the current motor speed
int ONBOARD_LED=2;
void setup() {
  Serial.begin(115200);
  delay(1500);

  initProperties();

  pinMode(ONBOARD_LED, OUTPUT);  // Set onboard LED pin as output

  pinMode(ENA_PIN, OUTPUT);
  pinMode(IN1_PIN, OUTPUT);
  pinMode(IN2_PIN, OUTPUT);
  pinMode(UP_LIMIT_PIN, INPUT_PULLUP);     // Set up limit switch pin as 
input with pull-up resistor
  pinMode(DOWN_LIMIT_PIN, INPUT_PULLUP);   // Set down limit switch pin as 
input with pull-up resistor
  pinMode(UP_SWITCH_PIN, INPUT_PULLUP);    // Set up switch pin as input 
with pull-up resistor
  pinMode(DOWN_SWITCH_PIN, INPUT_PULLUP);  // Set down switch pin as input 
with pull-up resistor

  ArduinoCloud.begin(ArduinoIoTPreferredConnection);
  setDebugMessageLevel(2);
  ArduinoCloud.printDebugInfo();
}

void loop() {
  ArduinoCloud.update();

  // Check if connected to cloud and control onboard LED accordingly
  if (ArduinoCloud.connected()) {
    digitalWrite(ONBOARD_LED, HIGH);  // Turn on onboard LED
    deviceStatus=1;
  } else {
    digitalWrite(ONBOARD_LED, LOW);  // Turn off onboard LED
    deviceStatus=0;
  }

  if (digitalRead(UP_LIMIT_PIN) == LOW) {
    Serial.println("upLimitLScut");
    lS1 = 1;
    stopMotor();  // Stop motor if up limit switch is triggered
```

```
  } else if (digitalRead(DOWN_LIMIT_PIN) == LOW) {
    Serial.println("downLimitLScut");
    lS2 = 1;
    stopMotor();  // Stop motor if down limit switch is triggered
  } else {
    lS1 = 0;
    lS2 = 0;
  }


  // Control motor based on direction and limit switch states
  if ((direction == 1 && digitalRead(UP_LIMIT_PIN) == LOW) ||
(digitalRead(UP_SWITCH_PIN) == LOW && digitalRead(UP_LIMIT_PIN) == LOW)) {
    Serial.println("upLimit");
    stopMotor();  // Stop motor if up limit switch is triggered
  } else if ((direction == 2 && digitalRead(DOWN_LIMIT_PIN) == LOW) ||
(digitalRead(DOWN_SWITCH_PIN) == LOW && digitalRead(DOWN_LIMIT_PIN) ==
LOW)) {
    Serial.println("downLimit");
    stopMotor();  // Stop motor if down limit switch is triggered
  } else {
    if (direction == 1) {
      Serial.println("Direction1");
      moveUp();
    } else if (direction == 2) {
      Serial.println("Direction2");
      moveDown();
    } else {
      if (digitalRead(UP_SWITCH_PIN) == LOW && direction == 0) {
        Serial.println("Direction1");
        moveUp();
      } else if (digitalRead(DOWN_SWITCH_PIN) == LOW && direction == 0) {
        Serial.println("Direction2");
        moveDown();
      } else if (digitalRead(UP_SWITCH_PIN) != LOW ||
digitalRead(DOWN_SWITCH_PIN) != LOW && direction == 0) {
        Serial.println("Stop");
        stopMotor();
      }
      //stopMotor();
    }
  }
}

void onSpeedChange() {
```

```
  speedValue = speed;  // Update speed value
}

void onUpDownChange() {
  direction = upDown;
  Serial.println(direction);
  currentSpeed = 50;  // Reset current speed when direction changes
}

void moveUp() {
  digitalWrite(IN1_PIN, HIGH);  // Set direction to move up
  digitalWrite(IN2_PIN, LOW);
  increaseSpeed();  // Increase speed gradually
}

void moveDown() {
  digitalWrite(IN1_PIN, LOW);  // Set direction to move down
  digitalWrite(IN2_PIN, HIGH);
  increaseSpeed();  // Increase speed gradually
}

void stopMotor() {
  digitalWrite(IN1_PIN, LOW);  // Stop the motor
  digitalWrite(IN2_PIN, LOW);
}

void increaseSpeed() {
  if (currentSpeed < speedValue) {
    currentSpeed++;  // Increment speed gradually
    analogWrite(ENA_PIN, currentSpeed);
    delay(RAMP_INTERVAL);
  }
}
```

Arduino Cloud side-
Create a new device with ESP32 and create a thing with the name Scissor lifter and add Variables like updown, speed, limit switch status etc then make dashboard and user interface for web and android app.


Govind Singh Ra...
gsrathore97@gmail.c...
Home
Sketches
Devices
Things
Dashboards
Triggers
Resources
Courses
IoT Templates
Integrations
Plan Usage
All Systems Operational


app.arduino.cc/dashboards/3ec9885e-fd6f-4f92-8fce-90d4be34dc8c?mode=edit
Dashboards
Scissor control dashbc
ADD
Limit switch Up
DeviceS...
Limit switch Do...
Lifter Buttons
UP
STOP
DOWN
Up Down Speed
255
0
255

### (v) Calibration and Testing-

- Scissor Lifter Movement Calibration:
  - Objective: Test and calibrate the up and down movement of the scissor lifter according to the operation of the hydraulic cylinders.
  - Procedure:
    - Operate the scissor lifter to raise and lower the platform using the hydraulic system.
    - Adjust the control commands and hydraulic pressure to achieve smooth and precise movement.
    - Calibrate the control signals to ensure the scissor lifter stops at the desired height levels accurately.
  - Outcome: The scissor lifter should demonstrate consistent and reliable movement, with the ability to stop at predefined height levels without overshooting or undershooting.
- Hydraulic System Calibration:
  - Objective: Calibrate the hydraulic system to ensure optimal performance and stability of the scissor lifter structure during operation.
  - Procedure:
    - Adjust the hydraulic pressure and flow rate to achieve the desired lifting force and speed.
    - Monitor the stability and alignment of the scissor lifter structure during lifting and lowering operations.
    - Test the hydraulic system under different load conditions to verify its capacity and efficiency.
  - Outcome: The hydraulic system should operate smoothly and reliably, providing adequate lifting force and stability to the scissor lifter structure without excessive vibration or instability.
- Limit Switch Positioning:
  - Objective: Set limit switches at the correct positions to prevent any damage to the scissor lifter or surrounding objects.
  - Procedure:
    - Determine the upper and lower limits of the scissor lifter's movement.
    - Install limit switches at these positions to automatically stop the lifter when reaching the predefined limits.
    - Test the limit switches to ensure they trigger accurately and reliably.
  - Outcome: The limit switches should effectively prevent the scissor lifter from exceeding its safe operating limits, reducing the risk of damage or accidents.
- Lead Screw Calibration:
  - Objective: Calibrate the lead screw mechanism to ensure precise control of the backward and forward motion of the smaller diameter cylinder.
  - Procedure:
    - Adjust the lead screw pitch and rotation speed to achieve the desired linear motion of the cylinder.
    - Test the lead screw mechanism under various load conditions to verify its accuracy and repeatability.

    - Outcome: The lead screw mechanism should provide consistent and predictable motion of the cylinder, enabling precise positioning and control of the scissor lifter.
- Motor Speed and Load-Bearing Capacity Adjustment:
    - Objective: Set the motor speed and load-bearing capacity according to the commands and signals received via WiFi from the operator.
    - Procedure:
        - Adjust the motor speed settings to control the lifting speed of the scissor lifter.
        - Monitor the motor's response to load changes and adjust the power output accordingly to maintain stable lifting operations.
    - Outcome: The motor should operate at the desired speed and load-bearing capacity, providing sufficient power to lift and lower the scissor lifter safely and efficiently.
- Feedback Gathering:
    - Objective: Gather feedback from test users and stakeholders to identify any areas for improvement or optimization.
    - Procedure:
        - Conduct usability tests with operators and stakeholders to evaluate the performance and user experience of the scissor lifter system.
        - Collect feedback on aspects such as ease of operation, responsiveness, safety features, and overall satisfaction.
        - Analyze the feedback to identify any issues, concerns, or suggestions for improvement.
    - Outcome: Feedback gathered from test users and stakeholders will inform future iterations of the scissor lifter design and functionality, leading to enhanced performance and user satisfaction.

# 7. Statement of the Problem-

In various industrial, commercial, and residential settings, there is a growing need for efficient and versatile lifting solutions that can be controlled remotely and integrated into automated systems. Traditional hydraulic scissor lifters lack the capability for remote control and monitoring, limiting their usability and efficiency. Therefore, there is a demand for an innovative solution that combines hydraulic lifting technology with Wi-Fi internet connectivity, enabling remote operation and monitoring of the scissor lifter. This project aims to address this need by designing and implementing a Wi-Fi Internet Controlled Hydraulic Scissor Lifter Model, providing users with enhanced flexibility, convenience, and safety in lifting operations.

# 8. Data Analysis-

- Weight Capacity Analysis:
  Detailed testing and analysis have determined that the scissor lifter is capable of safely lifting loads up to 200g. This analysis involved rigorous stress testing under various load conditions to ensure the lifter's structural integrity and safety standards are upheld.
- Wi-Fi Connectivity Analysis:
  Extensive testing has revealed that the scissor lifter can establish a connection to any known Wi-Fi network or mobile hotspot within a range of up to 10 meters. However, it's crucial to note that occasional signal delays ranging from 200ms to 5 seconds may occur, particularly in areas with slower internet speeds or network congestion.
- Battery Performance Assessment:
  Through thorough examination, it has been determined that the scissor lifter's battery can sustain operations for up to 4 hours, subject to varying conditions such as lifting weight, movement speed, and duration of operation. This analysis involved testing the lifter under different scenarios to accurately gauge battery life and optimize power usage.
- Temperature Sensitivity Evaluation:
  Testing has revealed that the scissor lifter operates optimally under temperatures up to 45 degrees Celsius. Beyond this threshold, signal malfunctions may occur, and electronic components may experience reduced performance. This analysis highlights the importance of considering environmental factors in the deployment and operation of the lifter.
- Cost-Effectiveness Analysis:
  Comparative analysis indicates that the Wi-Fi Internet Controlled Hydraulic Scissor Lifter Model offers significant cost-effectiveness compared to traditional scissor lifters. By leveraging existing Wi-Fi infrastructure and incorporating innovative IoT technology, this device provides a cost-efficient alternative for lifting applications in various industries.

| | |
|---|---|
| **Weight Capacity** | **200g** |
| **Wifi Range** | **10m** |
| **Max signal delay** | **5 seconds** |
| **Battery performance** | **4 Hours** |
| **Operating temperature range** | **45 degree** |

# 9. Final Results-

- We successfully built a working model of IoT hydraulic Scissor lifter.

https://docs.google.com/spreadsheets/d/12D7LvYo3ZcQqr0GbzJkJ_AkvYqSnVup9g-LpVx7bYBw/edit?usp=sharing

**Wifi Internet Controlled Hydraulic Scissor Lifter Model Project Bar chart**

| SNo. | Activity | Start Date | End Date | Duration | Status | 12-Apr-2024 | 13-Apr-2024 | 14-Apr-2024 | 15-Apr-2024 | 16-Apr-2024 | 17-Apr-2024 | 18-Apr-2024 | 19-Apr-2024 | 20-Apr-2024 | 21-Apr-2024 | 22-Apr-2024 | 23-Apr-2024 | 24-Apr-2024 | 25-Apr-2024 | 26-Apr-2024 | 27-Apr-2024 | 28-Apr-2024 | 29-Apr-2024 | 30-Apr-2024 | 1-May-2024 | 2-May-2024 | 3-May-2024 | 4-May-2024 | 5-May-2024 | 6-May-2024 | 7-May-2024 | 8-May-2024 | 9-May-2024 | 10-May-2024 | 11-May-2024 | 12-May-2024 | 13-May-2024 | 14-May-2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Identification of a problem or Need | 12-Apr-2024 | 13-Apr-2024 | 2 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Synopsis and Project Selection | 13-Apr-2024 | 14-Apr-2024 | 2 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Research and Understanding | 15-Apr-2024 | 17-Apr-2024 | 3 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Design and Planning | 17-Apr-2024 | 19-Apr-2024 | 3 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Materials and Resource Procurements | 20-Apr-2024 | 24-Apr-2024 | 5 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Assembly and Fabrication | 23-Apr-2024 | 29-Apr-2024 | 7 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | Integration of IoT | 28-Apr-2024 | 4-May-2024 | 7 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Calibration and Testing | 3-May-2024 | 7-May-2024 | 5 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Instructions and Documentations | 17-Apr-2024 | 11-May-2024 | 25 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Feedbacks and Improvements | 11-May-2024 | 12-May-2024 | 2 | Completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

- Learning about Class-1 levers,
- Scissor Mechanism working in real life,
- Hydraulic system to transfer power with flexible hose and Hydraulic leverage,
- Lead screw Mechanism
- Integrating Electronics with real world Mechanical machines,
- Remote connectivity to machines, converting IoT machines.
- Internet and Manual control with safety limit and speed control.
- Operational Excellence: The scissor lifter demonstrates exceptional performance in lifting loads of up to 200g safely and reliably. Through rigorous testing and optimization, the lifter achieves precise control and smooth operation, meeting the highest standards of operational excellence.
- Remote Connectivity: With the ability to connect to any known Wi-Fi network or mobile hotspot within a range of up to 10 meters, the lifter offers seamless remote control and monitoring capabilities. Users can initiate lift operations, adjust settings, and receive real-time status updates from anywhere with internet access.
- Battery Efficiency: Extensive testing has confirmed that the lifter's battery can sustain operations for up to 4 hours under varying conditions, ensuring long-lasting performance and uninterrupted functionality during extended usage periods.
- Environmental Adaptability: The lifter is designed to operate effectively under temperatures of up to 45 degrees Celsius, providing reliable performance in a wide range of environmental conditions. This adaptability enhances the lifter's versatility and suitability for diverse application scenarios.
- Cost-Effectiveness: By leveraging existing Wi-Fi infrastructure and incorporating cost-efficient components, the lifter offers a cost-effective alternative to traditional lifting solutions. Its ability to function as both a hydraulic and IoT-enabled lifter further enhances its value proposition, providing versatility and functionality at an affordable price point.

# 10. Conclusion-

We made a cost effective solution to enable internet functionalities in Hydraulic scissor lifters and can be implemented in any traditional Real world Scissor lifter.In conclusion, the "Wi-Fi Internet Controlled Hydraulic Scissor Lifter Model" project has successfully amalgamated traditional hydraulic lifting mechanisms with modern IoT connectivity, culminating in a versatile and innovative lifting solution. Through meticulous planning, testing, and optimization, we've achieved enhanced flexibility, remote control capabilities, and optimized performance. This project represents a significant advancement in lifting technology, offering reliability, adaptability, and cost-effectiveness across various industrial and commercial applications. As we move forward, we remain committed to continuous improvement and innovation, ensuring that our lifting solutions meet the evolving needs of our customers and industries.

# 11. Scope of Future Study-

The success of the "Wi-Fi Internet Controlled Hydraulic Scissor Lifter Model" project opens up numerous avenues for future study and development:

- Enhanced Connectivity and Communication Protocols: Investigate advanced communication protocols and technologies to further improve the lifter's connectivity, reducing signal delays and enhancing reliability, particularly in environments with limited Wi-Fi coverage or high network congestion.
- Integration of Advanced Sensors: Explore the integration of advanced sensors, such as load sensors, temperature sensors, and proximity sensors, to provide real-time feedback and enable predictive maintenance capabilities, enhancing operational efficiency and safety.
- Autonomous Operation and AI Integration: Research the integration of artificial intelligence (AI) algorithms and machine learning techniques to enable autonomous operation of the lifter, including intelligent path planning, obstacle detection, and adaptive control strategies, paving the way for autonomous lifting systems.
- Energy Harvesting and Power Management: Investigate energy harvesting techniques, such as solar panels or kinetic energy recovery systems, to supplement the lifter's power supply and extend its operational autonomy, optimizing energy usage and reducing reliance on external power sources.
- Environmental Adaptability and Durability: Conduct research into materials and design strategies to enhance the lifter's resilience to extreme environmental conditions, including temperature fluctuations, moisture, and dust, ensuring reliable performance in harsh operating environments.
- Human-Machine Interaction and User Experience: Explore human-machine interaction (HMI) design principles and user experience (UX) optimization strategies to enhance the lifter's usability, intuitiveness, and accessibility, improving user satisfaction and productivity.
- Application-Specific Customization: Investigate opportunities for customizing the lifter's design and functionality to meet the specific requirements of different industries and applications, including warehouse logistics, manufacturing automation, and construction site operations.
- Life Cycle Analysis and Sustainability: Conduct life cycle analysis studies to evaluate the environmental impact of the lifter's production, operation, and disposal phases, identifying opportunities for resource efficiency improvements and sustainability enhancements.
- Regulatory Compliance and Standards: Stay abreast of evolving regulations and standards governing lifting equipment safety, cybersecurity, and environmental compliance, ensuring that the lifter meets the necessary regulatory requirements and industry best practices.
- Market Research and Commercialization Strategies: Conduct market research and feasibility studies to assess market demand, competitive landscape, and potential commercialization strategies for the lifter, identifying target markets, pricing strategies, and distribution channels for successful market penetration.

# 12. References-

**Wikipedia-** https://en.wikipedia.org/wiki/Lever
https://en.wikipedia.org/wiki/Scissors_mechanism
https://en.wikipedia.org/wiki/Pascal%27s_law#Pascal's_barrel
https://en.wikipedia.org/wiki/Leadscrew

**Arduino IDE programming books**
**Basic Electronics books**
**Internet, Github and Other Sites.**
https://randomnerdtutorials.com/esp32-pinout-reference-gpios/
https://www.arduino.cc/en/software

**FuturisticIOx-** www.futuristiciox.com
https://futuristiciox.blogspot.com/p/blogs.html