

This project has successfully addressed the design and optimization of critical components for automated systems, focusing on bearing wheels, caster wheels, and their integration into advanced material handling solutions such as AGVs (Automated Guided Vehicles). The study employed a systematic approach to ensure structural integrity, operational efficiency, and compliance with industry standards. Key achievements include the validation of the single-level scissor lift mechanism for a load capacity of 200 kg, the development of a robust chassis structure capable of supporting up to 300 kg (2943N), and the selection of the NSK 6201 bearing for its high performance and reliability in handling both radial and axial loads. SolidWorks was utilized for 3D modeling and finite element analysis (FEA), enabling accurate identification of potential failure points and enhancing structural integrity while minimizing prototyping costs. Through careful consideration of material properties, mechanical constraints, and environmental factors, the final designs demonstrate excellent durability, efficiency, and compliance with ISO 3691-4:2020 guidelines.

0.1 METHODOLOGY AND DESIGN APPROACH

The design process adopted a comprehensive methodology that combined theoretical calculations, empirical analysis, and digital tools. Extensive structural analysis and stress testing were conducted to validate the performance of the scissor lift mechanism and chassis, ensuring that the designs met specified operational requirements while maintaining necessary safety margins. SolidWorks simulations played a pivotal role in refining the design. FEA helped identify weak points in the assemblies, allowing for iterative improvements before physical prototyping. This approach not only enhanced the efficiency of the design process but also reduced costs significantly. Adherence to ISO 3691-4:2020 guidelines ensured that the bearing and caster wheels met stringent safety requirements, including braking systems, speed control, load handling, and stability. Compliance with these standards guarantees safe and efficient operation in industrial environments.

0.2 CONTRIBUTIONS TO INDUSTRIAL APPLICATIONS

The successful development of these components represents a significant advancement in automated material handling solutions. By integrating advanced safety features, control systems, and predictive maintenance capabilities, the system demonstrates improved reliability and functionality. Enhanced operational stability and structural integrity were achieved through meticulous load distribution and stress analysis. Improved load-handling capabilities for industrial trucks were realized, aligning with modern trends toward automation and sustainability. These contributions position the system as a reliable solution for industrial ap-

plications, addressing the growing demand for efficient and durable material handling equipment.

0.3 FUTURE DIRECTIONS

While the current project lays a strong foundation, several areas have been identified for future development to further enhance performance, safety, and sustainability. Future work will focus on optimizing the weight and strength of components by exploring lightweight materials. Modular attachment systems and enhanced payload configurations will also be investigated to improve versatility. The integration of smart sensors for real-time load monitoring and predictive maintenance is a priority, enabling proactive maintenance, reducing downtime, and extending the service life of components. Advanced emergency stop systems and collision avoidance capabilities will be developed to ensure the AGV system adapts to complex industrial environments while maintaining high safety standards. Exploring eco-friendly material alternatives aligns with global environmental regulations and industry trends, reducing the carbon footprint while enhancing durability and recyclability. Experimental testing and field applications are essential to validate the proposed designs in real-world scenarios, providing valuable insights into performance under varying conditions and helping refine the system further.

0.4 CONCLUSION

In conclusion, this project has demonstrated a structured and comprehensive approach to the design and analysis of bearing wheels, caster wheels, and AGV systems. By leveraging advanced tools like SolidWorks for simulation and adhering to industry standards such as ISO 3691-4:2020, the study provides a robust framework for developing high-performance, durable components. The successful implementation of the proposed designs marks a significant step forward in automated material handling solutions. With continued advancements in materials, smart technologies, and sustainable practices, these systems will evolve to meet emerging industrial demands, offering greater efficiency, versatility, and safety. Ultimately, this project paves the way for more reliable and innovative solutions in industrial automation and material transport.

0.5 COST


Table 1: here is the list of components

Components	Quantity	Price(per Unit)	ref
Raspberry Pi 4 8GB RAM	1	3127.03 ₺	
ESP32-S3-DevKitC-1-N8R8 - ESP32-S3-WROOM-1	2	1220 ₺	
Closed Loop Stepper Driver V4.1 0-8.0A 24-48VDC CL57T	2	1186 ₺	
Motorbit Weight Sensor 120 kg	2	768.2 ₺	
Weight Sensor - Load Sensor 50Kg.	4	29.7 ₺	
Load Cell Amplifier - HX711	4	27.3 ₺	
BTS7960B 40 Amp Motor Driver Board	1	188.82 ₺	
Barcode Scanner Module 1D/2D Codes Reader	1	1261.83 ₺	
QTRXL-MD-01A Re- flectance Sensor Array	4	90.57 ₺	
Gravity: HUSKYLENS	1	1723.14 ₺	

IMU Sensor / 9 Axis MPU9255 IMU and Barometric Sensor (Low Power)	1	1058.31 ₪	
RPLIDAR - 360 degree Laser Scanner Development Kit	1	5029.72 ₪	
TXS0108E 8 Channel Voltage Level Transducer	4	40 ₪	
The VL53L0X is a time-of-flight (ToF) distance sensor	10	101.76 ₪	
UV Solder Mask	3	180.78 ₪	
LM2596HV/LM2576 Voltage Regulator for Multiple power supply	4	36.09 ₪	
Aluminum heatsink	2	439 ₪	
5V 8 Channel Relay Card	1	154.68 ₪	
P Series Nema 23 Closed Loop Stepper Motor 2Nm(283.28oz.in) with Electromagnetic Brake	2	2971.78 ₪	
EG Series Planetary Gear-box Gear Ratio 20:1 Backlash 20arc-min for 10mm Shaft Nema 23 Stepper Motor	2	1642 ₪	

Shaft Sleeve Adaptor 11mm to 8mm for NMRV30 Worm Gearbox	4	35 ₺	
Single Output Shaft for NMRV30 Worm Gearbox	4	121.37 ₺	
Double Output Shaft for NMRV30 Worm Gearbox	4	121.37 ₺	
NEMA 23 Stepper Motor Vibration Damper	4	243.74 ₺	
Nema 23 Bracket for Stepper Motor	4	243.74 ₺	
Nema 23 Flange for ISC And ISD Series Drivers	3	175.28 ₺	
AWG 20 High-flexible with Shield Layer Stepper Motor Cable	2	43.25 ₺	
TP-Link TL-WR840N	1	569 ₺	
Raspberry Pi 4.3 Inch Capacitive Touch Screen DSI Interface 800"480	1	1750.28 ₺	
Nema 8R 5W 87dB 90X39mm Speaker	1	108.11 ₺	

Nema RS232 to Bluetooth Series Adapter	2	455 ₺	
12V 70 AH AGM BATTERY	1	5000 ₺	
Battery Chargers 6V/2A 12V/2A Full Automatic Smart Battery	1	642.99 ₺	
RS232 Adapter Cable to USB 2.0	2	453.65 ₺	
Motor and encoder extension cable kit	2	351 ₺	
DC 12V Electric Linear Actuator Force 6000N	1	2479 ₺	
WM-045 DC-DC 150W Voltage Booster	1	521.04 ₺	
Motorbit DC-DC 1500W 30A Voltage Boost Module	1	881.76 ₺	
TCA9548A I2C Çoklayıcı / Multiplexer Kartı	1	40.66 ₺	
3B Printer Limit Switch	2	37.07 ₺	

Drn956 16mm Acil - Stop Switch (Kafa 27mm)	1	145.08 ₺	
---	---	----------	---