The Hive underground Storage

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Problem Statment

Developing an automated grid-designed warehouse system to optimize operations, reduce human intervention, and enhance efficiency and accuracy in inventory management

Target Specifications

1. Robot movement speed	0.2 - 0.5m/s
2. Maximum items dimension.	10 - 15cm3
3. Maximum items weight.	1-10kg
4. Number of battery cycles.	200 -300 cycles
5. Battery duration (run time).	3- 6 hours
6. Charging time.	6-3 hours
7. Robots communicate distance.	60 - 200 m
8. Number of robots monitored.	500 - 1000
9. Time to get an item	3- 1 mins
10. Space efficient.	18 items/m2
11. Cost of the robot.	3000 SR

Constraints

Physical Constraints:

1. **Space Limitation**: The warehouse must fit within the designated land area.
2. **Essential Facilities**: Need to include toilets, cafeteria, and resting areas in the design.
3. **Location**: Should be neither too far from the city (to ensure accessibility) nor too close (to avoid traffic issues).

Technical Constraints:

1. **Utilization of Technologies**: All components and technologies must be fully used in the warehouse.
2. **Software Compatibility**: The system should be compatible with various other systems and warehouses.
3. **System Reliability**: The system must be consistently operational with minimal downtime.
4. **Maintenance Accessibility**: The warehouse design should facilitate easy maintenance of robots and the warehouse itself.

Operational Constraints:

1. **Throughput Rates**: Measures the quantity of items processed in a given time.
2. **Order Fulfillment Timelines**: Refers to the efficiency in processing orders.
3. **Inventory Management**: Aims to enable quick access to items.

Time Constraints:

- Relates to the overall time frame required for project completion.

Financial Constraints:

- Involves budget limitations, return on investment, ongoing operational costs, and financing options.

Testing / Validation

1.Robot movement speed
RPS= 100RPM/60=5/3 RPS

The wheels circumference = $2\pi r = 2\pi(5cm) = 10\pi$ cm

Speed = 10π (5/3)= 52.36cm/s = 0.52 m/s

2. Maximum items dimension
The area in the bottom of the Robot is 18*18cm which means that the item should be less than $18cm^2$ we standerize it to be $10cm^2$

3. Maximum items weight
The linear acuator used can lift up to 3kg.

4. Number of battery cycles
The long 12V 7Ah have a cycle of 200 to 300 before it dies.

5. Battery duration (run time)
The average current consumbtion is between 1- 1.5A which means it can serve for 7-4.5 hours

6. Charging time
The charging station can provide 2A/s meaning it will charge the battery which is 12V 7Ah in 3.5 hours.

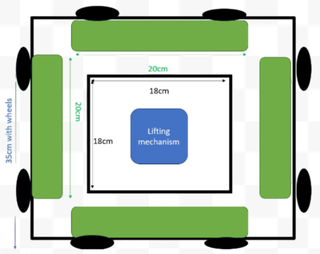
7. Robots communicate distance
The ESP32 S3 has a range communication of 200-250m

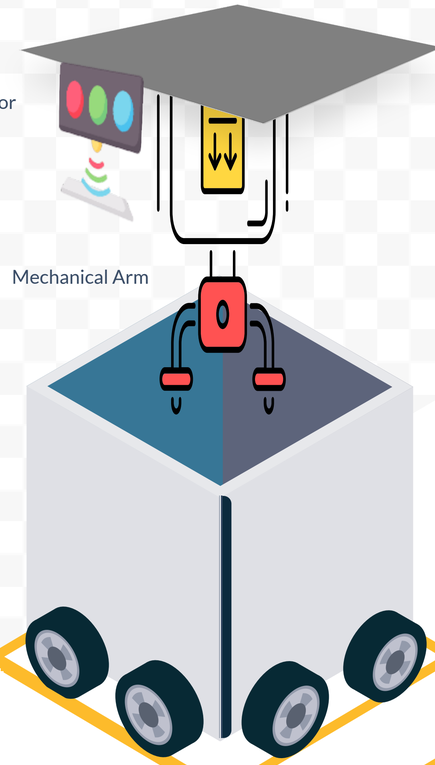
8. Number of robots monitored
Our Webserver can handle up to 1000 robots and it can control and operate them simultaneously.

9. Time to get an item
After testing, we esitmated it to be 1 min.

10. Space efficient
The squares in the storage system are 30by30cm and our prototype table has 6 items to be stored and it is 70cm by 70cm. if it was 9 item it will take 1m^2.

11. Cost of the robot
The cost of our Final Robot is 1500 SR including all componets.





Conclusion

We have designed and tested a prototype that meets our specifications. The HIVE is a groundbreaking robotics system represents the future of the warehousing industry in Saudi Arabia, signaling a transformative shift in operations and efficiency.

THE HIVE

Grid Design