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AUTOMATED STORAGE AND RETRIEVAL SYSTEM

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Abstract:

This paper presents the design and implementation of an Automated Shelves system for efficient material handling in organizations, focusing on optimizing vertical space utilization. The system utilizes a vertical conveyor with shelves, driven by a stepper motor and controlled by an Arduino-based system. The design ensures maximum storage capacity while minimizing floor space consumption. The system's components, including the frame, motor, shelves, and control system, are detailed, highlighting their roles in enhancing operational efficiency. The system's functionality and reliability are validated through testing, demonstrating its potential for various material handling applications in both industrial and commercial settings.

1. Introduction:

The automated shelving system is designed for efficient storage and retrieval of files, books, and other documents at SGBIT. It optimizes space utilization by capitalizing on existing space, accommodating maximum items. The system is intended for use in organizations to enhance storage efficiency, which is beneficial for NBA compliance. This project aims to design and fabricate an automated vertical files handling system to simplify the process of storing and accessing files at elevated heights. Additionally, it can be utilized to transport books across multiple shelves in a library.

Fig. 1

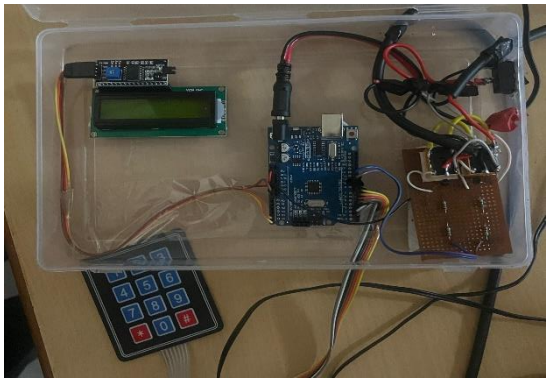

Fig.2

2. literature Survey:

The research on Automated Storage & Retrieval Systems (ASRS) underscores their vital role in optimizing space

utilization and streamlining files and book handling processes across institutes. ASRS, exemplified by systems like "Automated Shelves," eliminates manual labour, enhances efficiency, and minimizes space consumption. Literature highlights ASRS applications in manufacturing, warehousing, and retail, emphasizing their versatility and impact on operational efficiency. Studies delve into component functionalities, such as stepper motors and control systems, to ensure seamless operation and reliability

3. Objectives

- To maximize space use, these files are stored on several racks.
- In order to hold the most data possible, SGBIT makes an effort to maximize our current space.
- The system is made to store files in organizations with NBA assistance.
- One piece of material handling (files) equipment are automated shelves. There are several racks used for different types of store files.
- When used in a library, the suggested system's capabilities extend beyond file storage and include the ability to transport books and other items of a similar size.

4. Methodology:

Figure 3 shows the Methodology used for Automated shelves. The automated shelves consists of following components:

1) Main Frame
2) D C Motor
3) Chain drive
4) Transmission Shaft
5) Shelf to Chain Attachment
6) Shelves
7) Control System

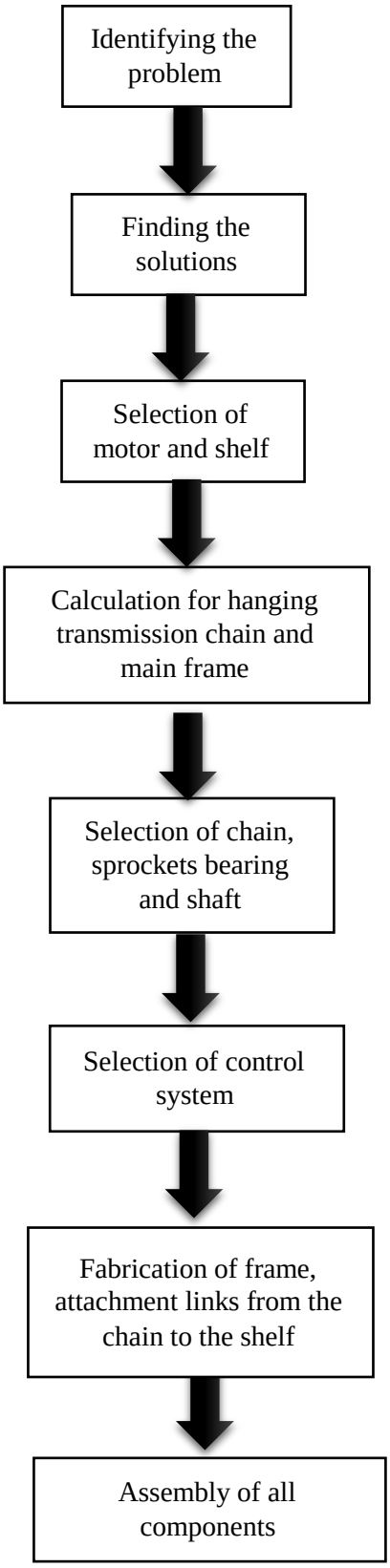

Fig.3 Methodology for Automated shelve

5. Components:

I. D C Motor

The main function of the motor is to drive and stop the whole vertical conveyer system according to the user requirement. If the motor requires to be stopped instantaneously. Since the electromagnetic brakes exert holding power even while the power is off, they are ideal for use as emergency brakes and in vertical load applications. The electromagnetic brake motor is employed if the load should be maintained.

Specifications of motor selected:

- Motor type: D C motor
- Power: 100watts
- Motor RPM: 76 rpm

II. Metallic Frame:

The metallic frame supports all the elements of the system. The sprockets of the chain drive are to be mounted on the frame. Material Used for the shelf is MS Hollow Square Tubing. Frame Dimensions after the design calculations are as follows:

i. Breadth = 600 mm
ii. Width = 700 mm
iii. Height = 1200 mm

III. Shelves:

The shelves will be carrying the load i.e. all the books will be stored in them. Material selected for shelf is plastic so as to make the shelf lighter. The base of the shelves is 600 x200 mm2. The height of the shelf is 400mm.

IV. Control System:

The control system facilitates automation to the material handling system. It consists of a microcontroller (Arduino UNO Board), a and an input module. The control system comprises of four main components:

1) Arduino microcontroller and interface
2) Sensors
3) Arduino Board ATmega328P
4) Input Module

V. Chain Drive.

Chain drives are the most important drives for power transfer. It is a positive drives mechanism as opposed to self-drives. The chain drive velocity ratio, or the ratio of the angular velocity of the driving sprocket wheel, stays constant in the absence of slip or creep. The velocity ratio can get as high as eight in this case. Every now and then, the chain can be turned to produce power that can be used to move or raise objects. To regain the power, it is sometimes necessary to position a second gear and fasten shafts or hubs to it. Even though drive chains are often merely simple circular loops, they can be made to bend around obstacles by adding more than two gears along the chain.

VI. Arduino Keypad

Keypads enable data entry by users even when a program is operating. This tutorial demonstrates how to utilize the library keypad and connect a twelve-button keypad to an Arduino. An Arduino system frequently requires an input keypad, and membrane-type keypads provide a cost-effective solution for a variety of use cases. Since they are rather thin, mounting them wherever they are needed is simple. to operate a 12-button numeric keypad that resembles a phone keypad. There are three columns and four rows on a 12-button keypad. One of the row outputs can be shorted to a column output by pressing a button.

VII. Alpha Numerical Display:

Numerous devices, such as cell phones, word processors, photocopiers, point-of-sale terminals, palmtop computers, and medical equipment, use alphanumeric displays. There are 224 distinct characters and symbols that can be displayed on the 16 x 2 intelligent alphanumeric dot matrix displays. Pages 7–8 contain a comprehensive list of the characters and symbols (notice that these symbols can vary depending on the manufacturer of LCD used). All the technical details needed to connect the device—which needs a single power source of +5V—are provided in this brochure.

The Serial LCD Firmware, which enables serial control of the display, is an optional addition. The LCD module may be connected and used considerably more easily with this option. Microcontrollers (and microcontroller-based devices like the PICAXE) are made possible by the firmware.

VIII. Transmission Shaft:

Because of their high specific stiffness and high specific strength, carbon fiber-epoxy composite materials have been employed in advanced engineering constructions like spacecraft, aircraft, car transmission shafts, and robot structures. In contrast to advanced composite materials, conventional metal alloys are more frequently utilized in engineering structures; therefore, linking polymeric composite materials to metal alloy is highly beneficial for the production of a variety of engineering structures. Generally speaking, the joint that is utilized, not the structure itself, determines how efficient the composite constructions are. Since the curing and joining processes for the composite structures may be completed concurrently, the co-cured joining method—also known as an adhesively bonded joining method—is a productive joining approach.

6. Working:

1. Mechanism that drives a vertical carousel is similar to the mechanism that drives a Ferris

wheel. However, rather than rotating on a circular path, as a Ferris wheel would, the shelving units move up and down vertically, following an elongated oval path.

2. The rotation is driven by a motor that spins a drive chain, which is attached to a torque tube extending across the interior of the carousel. This creates what is called a "drive side" and an "idle side." But because the torque tube on the drive shaft is synced with the drive side, when the drive side spins, the idle side spins, generating the vertical motion up and around, over and the over.
3. The internal mechanism of a vertical carousel is integrated with computer software, and when a certain product needs to be picked, it is the software that directs the carousel to the correct level.
4. Once that signal is received, the motor spins the drive chain attached to the torque tube, and the vertical carousel turns to present the right shelf at the counter.

7. Advantages And Disadvantages

ADVANTAGES

- More Accurate when compare to other circuit
- Faster response
- As we said earlier it is easy to control the devices by setting password.
- This project provides another facility to change the password.
- Easy to setting/resetting password.

DISADVANTAGES

- The initial cost of installation and maintenance can be expensive, and ongoing upgrades and repairs may also add to the cost over time.
- ASRS systems can be complex and require skilled personnel to design, install, and operate them.
- ASRS systems require regular maintenance and repairs, which can be time-consuming and expensive.

8. Calculations:

DESIGN OF WELDED JOINT

To ensure the safety of the welded joints, the strength of the transverse fillet weld connecting the side plate and the edge stiffness plates must be checked. The maximum load the plate can carry for this weld is calculated using the formula:

P = 0.707 x S x L x ft

Where, S = factor of safety,

L = contact length = 35mm

Given that the load of shear along with friction is 500N (50 kg),

we can calculate the safe value of 'ft' as follows:

ft = 500 / (0.707 x 3 x 35) = 6.73536 N/mm^2.

Since the calculated value of the tensile load is very smaller than the permissible value as ft=56 N/mm^2. Hence welded joint is safe.

D C MOTOR

The motor is being used of 12 volts and 100 watts.

Since the motor is of 100 watts and from battery it requires the power of 100watts

Motor speed=N=76rpm

Power=100watts

$P=2\pi NT/60$

$T=P*60/2\pi N$

$= (100 \times 60) / (2 \times \pi \times 76)$

$T = 12.56$ N-m

T= 12.56 x 103 N-mm

The material being used for the shaft is mild steel

Yield stress σy= 380 Mpa for M S Material

Shear stress $fs = \sigma y / (2 \times FOS)$ (FOS=factor of safety)

$=380/2*2$

$= 95$Mpa

$T / J = G\theta/L = fS/ R$

$T / J == fS / R$

$T = (\pi/16) \times fS \times d3$

$12.56 \times 103 = (\pi/16) \times 95x\ d3$

d= 8.76 mm

d= 18 mm

Taking diameter of shaft as 18mm for the motor Hence the design of the motor shaft is safe.

9. Result and Conclusion

Comparing the suggested automated shelving system to manual material handling procedures, a major improvement is seen. Utilizing state-of-the-art technology such as DC motors and Arduino controls, the system improves efficiency and precision in file storage and retrieval. The capacity to optimize space use, which is crucial for companies like SGBIT that want to maximize storage capacity while abiding by legal requirements like NBA compliance, is where this improvement is most noticeable. Furthermore, the system's flexibility goes beyond file storage; it may also be used to manage books in library environments. This flexibility highlights the system's scalability and environment-suitability.

Additionally, through the resolution of typical industrial issues such as ineffective material handling, imprecise inventory control, and restricted warehouse area, the automated shelves system enhances efficiency and streamlines operations. The system exhibits a dedication to dependability and performance through careful design

considerations and exacting calculations guaranteeing structural integrity and safety. The installation of this novel solution is justified by the long-term benefits of increased production and operational efficiency, even though the initial investment and maintenance costs may present challenges.

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