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GUJRAT TECHNOLOGICAL **UNIVERSITY**

DESIGN AND DEVELOPMENT **OF AUTOMATED STORAGE &** **RETRIEVAL SYSTEM (ASRS)**



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PROJECT BACKGROUND

- It is an automatic setup for warehouse storage system.
- It is also used car parking in skyscrapers.
- As we know now a day in industry floor space is less but need of floor space is increase.
- So, industry build large warehouse to store their product/raw material. But the handling in large warehouse is difficult by manually.

Continue...

- By using automation we remove this difficulty.
- PLC or Microcontroller is used to automated storage and retrieval system. Here also require crane and conveyer arrangement.
- By giving command we load or unload the pallet/container.
- So, this is optimize the time and also increase material handling quality. This system also reduce human effort.

OBJECTIVE

- To reduce cost of system.
- To reduce human effort.
- To reduce material handling time.
- Increase quality of material handling.

PROJECT OVERVIEW

- Our AS/RS project based on mechanical and PLC.
- Our project is divided into 2 parts.
 - 1.mechanical structure &
 - 2.Programming
- Our mechanical structure further divided into 3 parts
 - 1.Horizontal structure
 - 2.Vertical structure
 - 3.Fork lift structure
- In programming we use timer function in PLC.

Mechanical Structure

- This fig shows the assembly of three structure.
 1. Horizontal structure
 2. Vertical structure
 3. Forklift
- The brief description of every component is given below.



1.Horizontal Structure

1.Lead Screw

- Quantity-1
- Length- 28 inch = 700mm
- Diameter- 25mm
- Thread– Single start
V-thread
8 TPI
- Material– M.S(Mild Steel)



2. Guide Rod

- Quantity-2
- Length-28inch=700mm
- Dia-16mm
- Thread at the both end
2 inch V-thread
12 TPI
- Material-M.S



3. Supporting Plate

- Quantity-2
- Size-250*100*10mm
- Hole-2 hole(16mm)&1 hole(52mm)
- Material-M.S



4. Work Table

- Quantity-1
- Size-180*200*8mm
- Material-M.S



5. Nut

- Quantity-1
- Length-2 inch
- Diameter- inner 25mm,
outer 50 mm
- Internal Thread- V thread
single start
8 TPI
- Material-M.S



6. Bearing

1) Shaft bearing

- Quantity-2
- Code- 6205
- Bore diameter- 25 mm
- Outer diameter- 52 mm



2) Linear motion bearing

- Quantity-4
- Code- LME16
- Bore diameter- 16 mm
- Outer diameter- 26 mm



Assembly of Horizontal Structure



2.Vertical Structure

1.Lead Screw

- Quntity-1
- Length- 30 inch = 760mm
- Diameter- 25mm
- Thread– Single start
V-thread
8 TPI
- Material– M.S(Mild Steel)



2. Guide Rod

- Quantity-2
- Length-30 inch=760mm
- Dia-16mm
- Thread at the both end
2 inch V-thread
12 TPI
- Material-M.S



3. Supporting Plate

- Quantity-2
- Size-150*150*6mm
- Hole-2 hole(16mm)&1 hole(52mm)
- Material-M.S



4. Work Table

- Quantity-1
- Size-178*76*5mm
- Material-M.S



5. Nut

- Quantity-1
- Length-2 inch
- Diameter- inner 25mm,
outer 50 mm
- Internal Thread- V thread
single start
8 TPI
- Material-M.S



6. Bearing

1) Shaft bearing

- Quantity-2
- Code- 6205
- Bore diameter- 25 mm
- Outer diameter- 52 mm



2) Linear motion bearing

- Quantity-2
- Code- LME16
- Bore diameter- 16 mm
- Outer diameter- 26 mm



Assembly of Vertical Structure



3.Fork Lift Structure

1.Base Plate

- Quantity-1
- Size-146*90*4mm
- Material-M.S



2.Round bar

- Quantity-2
- Length- 6 inch
- Dia-10mm
- Material-M.S



3. Pipe

- Quantity-2
- Length- 6 inch
- Dia-14mm
- Material-Steel



4. Nut & Bolt

- Quantity-1
- Bolt Dia-14mm
- Bolt & Nut are standard.
- Thread- 12 TPI



Assembly of Fork Lift Structure



General

1.Nut

- Quantity-16
- Dia-16mm
- These nut are use to connect guide rod with plate.
- Nut are standard.



2.Coupler

- Quantity-2
- Dia-40mm
- Length-6 inch
- To couple lead screw shaft with motor shaft.
- Material-Nylon



3.Motor

- Quantity-1
- Johnson gear motor- 1000 rpm
12 volt, 5 amp

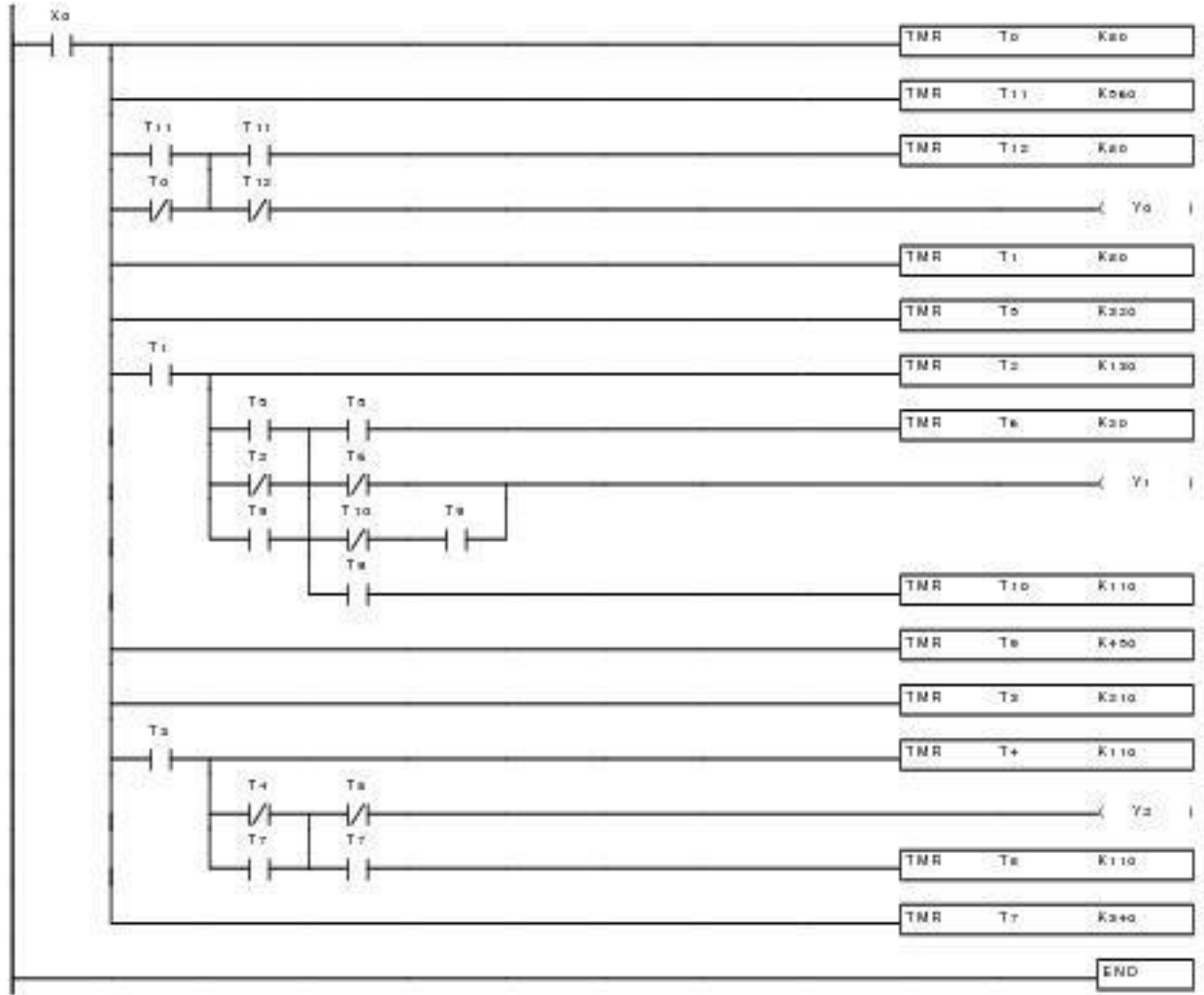


Programming

- Our project is based on PLC and automation so, we have to use programmed for automation. In our project first we prepared the mechanical structure. In mechanical structure we used D.C motor for lead screw rotation.
- In PLC we have couple of way for programmed a structure to run. First is pulse output to control motor and second is timer based programming. In both of the way we choose timer based programming, because D.C motor cannot take pulse input.
- Our programmed is mainly prepared by timer, NO (Normally Open) switch, NC (Normally Close) switch, etc. Below programmed is based on timer which controls three directional motion of mechanical structure.
- By above programmed we store the pallet according to the calculations of the time travel for each position. Above programmed shows the position of pallet store or for one particular position.

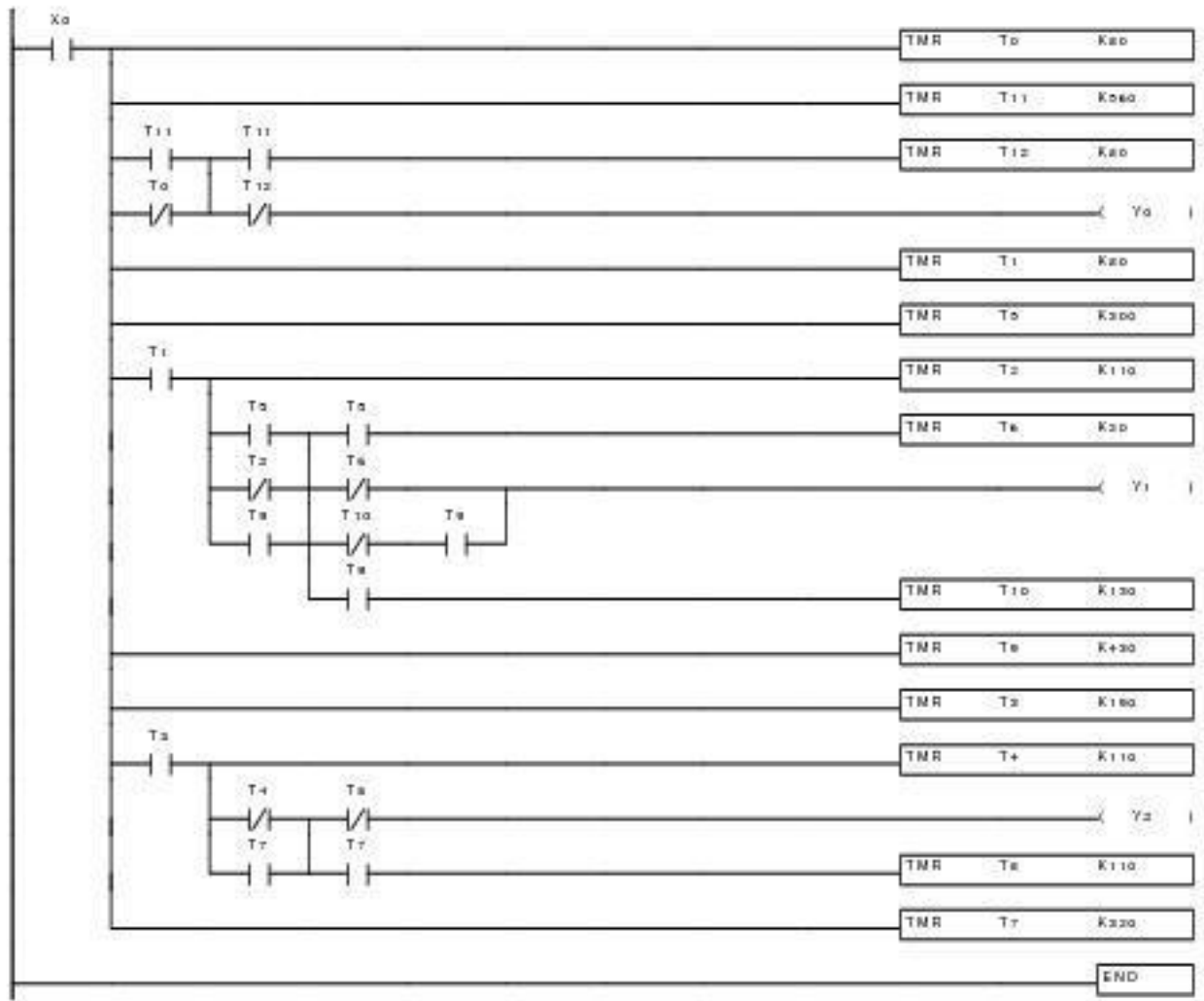
- First we have to give some information about switch, timer function and output.
- In this programme the X0 is the completely independent switch, when we wish we open or close this switch. The other NO and NC switch which are completely depend on timer. In this programme we have T1, T3, T5, T7, T9 and T11 are the NO switches and T0, T2, T4, T6, T8, T10 and T12 are the NC switches. In programme the Y0, Y1, and Y2 shows the D.C motor. Y0 stands for X-axis motor, Y1 stands for Y-axis motor and Y2 stands for Z-axis motor.
- The whole process is done by in this manner that, first when we close the X0 switch which is NO switch current is passed through it. Due current pass through the X0 the timer TMR0, TMR1, TMR3, TMR5, TMR7, TMR9 and TMR11 start and their set time is 8s, 8s, 21s, 32s, 34s, 45s and 56s respectively.
- When X0 close timer T0 as well as T1 start and also Y0 start due to T0 is in close condition. After 8s the timer TMR0 and TMR1 done their task and open the T0 and close the T1, which result in the Y0 now has been stop and the TMR2 and the Y1 now start their function. After 13s T2 now in open condition so the supply is cut and Y1 is now stop.

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- Now the TMR3 has done their function due complete 21s. So, the T3 now in close condition which start the TMR4 and Y2. After 11s the T4 is open so Y2 is stop.
- After 32s the TMR5 has done their function and close the T5 so current is pass through T6 which in close condition also TMR6 start at that time and after 2s its open the T6 which result in Y1 stop.
- Till this programme the storage function is perform by software as well as hardware. Now we further discuss about retrieval of forklift.
- This is the second phase of programme now TMR7 has done 34s which will result in start TMR8 and start Y2 after 11s the TMR8 open the T8 which stop the Y2.
- Now TMR9 has done 45s its close the T9 and result in start TMR10 and Y1 after 11s the TMR10 open the T10 which stop the supply to the Y1 and Y1 stop. At the end of this step Y1 is now at its initial position.
- Now TMR11 has done 56s which results in start TMR12 and Y0. After the 8s TMR12 open the T12 and stop Y0. At the end of this step Y0 is now at its initial position. By above programme we store the material. This programme is for storage of material.



- Above programme stands for storage of material now we discuss about the retrieval of material. Below image is retrieval programme.
- By above programme we retrieve the pallet according to the calculations of the time travel for each position. Above programme shows the position of pallet retrieve or for one particular position.
- First we have to give some information about switch, timer function and output.
- In this programme the X0 is the completely independent switch, when we wish we open or close this switch. The other NO and NC switch which are completely depend on timer. In this programme we have T1, T3, T5, T7, T9 and T11 are the NO switches and T0, T2, T4, T6, T8, T10 and T12 are the NC switches. In programme the Y0, Y1, and Y2 shows the D.C motor. Y0 stands for X-axis motor, Y1 stands for Y-axis motor and Y2 stands for Z-axis motor.
- The whole process is done by in this manner that, first when we close the X0 switch which is NO switch current is passed through it. Due current pass through the X0 the timer TMR0, TMR1, TMR3, TMR5, TMR7, TMR9 and TMR11 start and their set time is 8s, 8s, 21s, 32s, 34s, 45s and 56s respectively.
- When X0 close timer T0 as well as T1 start and also Y0 start due to T0 is in close condition. After 8s the timer TMR0 and TMR1 done their task and open the T0 and close the T1, which result in the Y0 now has been stop and the TMR2 and the Y1 now start their function. After 11s T2 now in open condition so the supply is cut and Y1 is now stop.

- Now the TMR3 has done their function due complete 19s. So, the T3 now in close condition which start the TMR4 and Y2. After 11s the T4 is open so Y2 is stop.
- After 30s the TMR5 has done their function and close the T5 so current is pass through T6 which in close condition also TMR6 start at that time and after 2s its open the T6 which result in Y1 stop.
- This is the second phase of programme now TMR7 has done 32s which will result in start TMR8 and start Y2 after 11s the TMR8 open the T8 which stop the Y2.
- Now TMR9 has done 43s its close the T9 and result in start TMR10 and Y1 after 13s the TMR10 open the T10 which stop the supply to the Y1 and Y1 stop. At the end of this step Y1 is now at its initial position.
- Now TMR11 has done 56s which results in start TMR12 and Y0. After the 8s TMR12 open the T12 and stop Y0. At the end of this step Y0 is now at its initial position.
- By above programme we retrieve the material. This programme is for retrieval of material.
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LITERATURE REVIEW

1. AN RFID-ENABLED AUTOMATED WAREHOUSING SYSTEM

Journal Name	International Journal of Materials, Mechanics and Manufacturing
Year	2013
Author	Qian Wang, Saleh Alyahya, Nick Bennett, and Hom Dhakal
Code	DOI: 10.7763
Remark	In this system RFID tag is used for allot unique no to pellet and RFID reader is used to read the tag. By scanning the tag system load or unload the pellet.

2. AS/RS REAL TIME SIMULATION AND CONTROL INTEGRATED SYSTEM

Journal Name	Department of Management science and Engineering Economics and Management School of Wuhan University,
Year	
Author	Xu Xusong, Xiong Hongbin
Code	
Remark	It describes some of the key features and the more significant methods utilized in the building of simulation models by using the virtual reality approach. , It provides a more flexible and less expensive method for AS/RS simulation and implement

3. AUTOMATIC CONTROL FOR STORAGE AND RETRIEVAL SYSTEM BASED ON PLC

Journal Name	International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering.
Year	2014
Author	AsaadMusaab Ali Yousif, Jiang Dening
Code	ISSN: 2278 – 8875
Remark	The implementation of this system improves the efficiency of labour and the quality of manufactured products and to create conditions for the optimum utilization of all production resources.

4. MACHINE CONTROL LEVEL SIMULATION OF AN AS/RS IN THE AUTOMOTIVE INDUSTRY

Journal Name	Proceedings of the 2010 Winter Simulation Conference
Year	2010
Author	Min S. Ko, Hye S. Shin, Sang C. Park, G.N. Wang
Code	ISBN: 978-1-4244-9864-2
Remark	Data used in this simulation is based on 3D and logical models, using actual size and PLC signals, respectively. This developed simulation environment can be used to run AS/RS systems to reduce time and cost.

5. MULTI-OBJECTIVE OPTIMIZATION OF AUTOMATED STORAGE AND RETRIEVAL SYSTEMS

Journal Name	International Journal of Engineering.
Year	2013
Author	Tone LERHER, Matjaz SRAML, Matej BOROVINSEK, Iztok POTRC
Code	ISSN: 1584-2665
Remark	The main module in the proposed model, the multi-objective optimization approach, which minimizes travel time, cost and quality, was presented. The usefulness of the proposed model was presented in a case study involving the design of a warehouse.

6. SORTING AND RETRIEVAL ROBOTIC SYSTEM CONTROLLED VIA PROGRAMMABLE LOGIC CONTROLLER FOR LIBRARY USAGE

Journal Name	International Journal of u-and e-Service, Science and Technology
Year	2014
Author	M.Z.A Rashid, H.N.M Shah, H.I Jaafar, M.S.M Aras and S.K.S Nordin
Code	ISSN: 2005-4246
Remark	The mobile robot consists of the mobile platform, vertical pneumatic cylinder and horizontal gripper to arrange the books on the shelf and the PLC controller to control the whole operation process.

RESEARCH GAP

- Future work is possible on following factors:
 - To overcome the complexity of system.
 - To reduce cost of system.
 - To improve accuracy of system.
 - Use this system in small warehouse at lowest cost by optimization.

METHODOLOGY

Selection of project Topic



Introduction about Automated Storage and Retrieval System



Introduction of components



To collect the as many as possible literature papers



Selection of components



Assembly of component



To get Experimental Results



Conclusion



End

SCOPE OF PROJECT

- This ASRS use in pallet handling, car parking, large as well as small warehouse to store or retrieve having from small floor space with accurate handling.
- It is also use in large libraries for handling book without human interference.
- We recently visited at JOHN ENERGY PVT. LTD. Warehouse and obseved that there warehouse handlling system is manually operated so, we want to implement them to automate their warehouse by our project concept.
- Here, some photographs of JOHN ENERGY PVT. LTD. warehouse



FIG. JOHN ENERGY WAREHOUSE



FIG. JOHN ENERGY WAREHOUSE

Conclusion

- Above all information and numerical calculation help in project. The overall information gives us knowledge about storage and retrieval system.
- By adopting the Automation in warehouse it reduces the labour work. In automated warehouse the utilization of floor space area is maximize. An automated warehouse not required additional equipment like crane, trolley, forklift, etc. Automation fulfills the all necessary requirement.
- Automation also increases the inventory directly and productivity indirectly of an organization. Automation also reduces the time consumption during storage and retrieval process. Due to this time saving the inventory increase directly.
- By automation the storage of material are done in perfect manner, so it reduces the searching time at retrieval stage and provide better serviceability to customer or organization.

- Above all information and programming shows that the time taken for storage and retrieval is much less than manual material handling because in manual system, operator has to achieve proper storage and retrieval position by trial and error method so it consumes more time compared to automated system.
- Due to absence of human at ground the possibility of accident reduces as well as safety standards increase.
- For applying automation in warehouse it requires foolproof planning. At the initial level it consumes more resources like money, manpower, machine, etc. but in long term it is reliable for large warehouses. It is not suitable for small scale industries as well as warehouses.

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THANK YOU