

# Automatic Ream Handling System for AS/RS Conveyer

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**Abstract**— In TNPL finishing house area, the reams are packed manually by using brown sheet and being sent to the shrink wrapping machine. In which reams are packed by polythene cover. A single ream contains 500 sheets and 4 or 5 reams are sent for shrink packing operation. From shrink wrapping machine the packed reams are collected manually and fed in to the AS/RS input conveyor. In our project the system eliminates manual handling and will be controlled with automation and manual control. By extending the output conveyor from shrink wrapping machine reams are pushed to the next perpendicular conveyor using hydraulic pusher and collected by input conveyor of AS/RS. The system also comprises storage conveyor to control the ream flow during maximum production. This system increases speed of operation and reduces time, manual power, loss or damage during handling.

## I. INTRODUCTION

Tamil Nadu Newsprint and Papers Limited (TNPL) produces sheet bundle which is called ream can be stored in AS/RS (Automatic Storage and Retrieval System) of 7500 tons capacity. Reams which are stored in AS/RS can be retrieved and ready for loading point at any time. AS/RS system process is controlled manually and automatically as well.

TNPL, which commenced its operation in the year 1984, has completed 26 years of operation. The company has grown from the initial capacity of 90000 tonnes per to the present level of 400000 tonnes per annum. Under the mill expansion plan, TNPL installed a new state of the art paper machine (Paper machine-3) at a capital outlay of Rs.1000 crore. The machine-3 has 5.45M deckle, operating at 1100 meter per minute speed and is capable of producing high quality pigmented and surface sized papers. The annual production capacity of the machine is 155,000 MT. It has the advantage of low specific water consumption to reduce overall fresh water requirement and lower specific energy consumption. The backward integration of Chemical Bagasse pulping line completed simultaneously as part of the mill expansion plan, will increase chemical bagasse pulp production from 400 tonnes per day to 500 tonnes per day. A multi fuel high pressure boiler has been installed with steam generation capacity of 125 tph to take care of the additional steam requirement. As a part of company's Corporate Social Responsibility initiatives, for which TNPL has set apart 3% of its previous year net profit amounting to Rs.3.78 crore. TNPL's forward thinking policies have led to consistent growth from the initial capacity of 90,000tpa to the present capacity of 400000 tpa. The continuous growth has made TNPL to emerge a significant

player in the Indian paper industry with the credit of being the second largest producer of writing paper in the country.

A large portion of the equipment installed in TNPL is the first of its in the Indian paper industry. TNPL's operational and financial performance is one of the best in the Indian paper industry.

In TNPL finishing house area, the reams are packed manually by using brown sheet and being sent to the shrink wrapping machine. In which reams are packed by polythene cover. A single ream contains 500 sheets and 4 or 5 reams are sent for shrink packing operation. From shrink wrapping machine the packed reams are collected manually and fed in to the AS/RS input conveyor.

Shrink machine and storage are not interlinked so the polythene wrapped reams are handled manually from shrink machine and loaded to the ASRS manually. Barcode is being pasted manually. This increases the time and cost. By manual handling the reams causes damage to the reams and huge man power is needed.

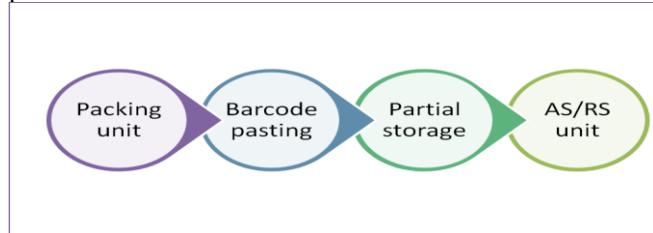


Fig. 1. Block Diagram of the System

## II. SYSTEM MODEL

A conveyor is used to interconnect the shrink wrapping machine and storage handling conveyor. In our system the barcode is being pasted automatically before entering into the storage conveyor. A partial storage is being installed for reducing the ream jamming. This will protect the reams and conveyors from causing damage. This will also reduce the man power and cost.

There are different conveyor designs in this project the conveyors are connected as a double 'I' beam. By using the double 'I' beam the reams can make travel through the traffic free route and easily reach the conveyors of the storage area from shrink machine.

Meanwhile the conveyor routes have hydraulic push pull cylinders to divert the directions of the reams and made to reach the ASRS conveyors. The hydraulic cylinders are given inputs from the solenoid valves and these solenoid valves coils are energized through the reference values of sensors. The proximity sensors are used here to sense the presence of reams and give the reference values to the solenoid valves.

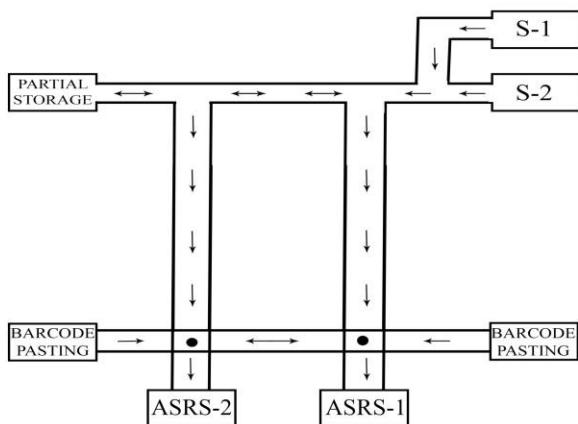


Fig. 2. Conveyor Routes of the System

A conveyor system is a common piece of mechanical handling equipment that moves material from one location to another. Conveyors are especially useful in applications like transportation of heavy or bulky materials. Conveyor system allows quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kind of conveying systems are available and are used according to the various needs of different industries.

There are roller conveyors, chain conveyor or bucket conveyor (floor and overhead), belt conveyor, slot conveyor as well. Chain conveyors consist of enclosed tracks, I-Beam, towline, power free and hand pushed trolleys. Conveyors are able to safely transport the materials from one level to another, which when done by human labour would be strenuous and expensive. They can be installed almost anywhere, and are much safer than using a forklift or other machine to move materials. They can move loads of all shapes, sizes and weights.

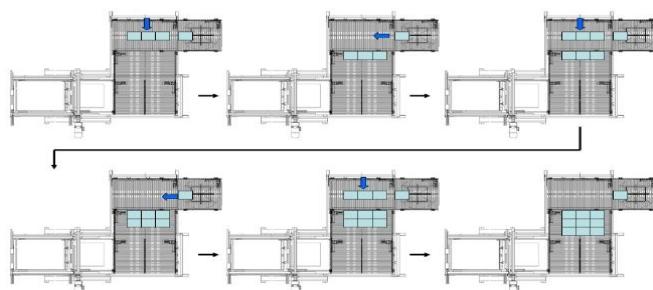


Fig. 3. Conveyor Working

#### A. Roller Conveyor

Roller conveyors are, as their title suggests, powered via a shaft beneath the rollers. These conveyors are suitable for light applications up to 20 kg such as cardboard boxes and tote boxes. A single shaft runs below the rollers running the length of the conveyor. On the shaft there are a series of spools; one spool for each roller.

When there is a bundle waiting at the end of the feeding roller conveyor, it is moved on roller conveyor. If it needs to be turned according to the pallet pattern the bundle is stopped in the middle of the turning device.

Tuning device is then lifted up, turned 90 degree and then laid down. After the bundle is moved to end of roller conveyor. If roller conveyor at palletizer is ready to receive, the bundle moves straight away on it. When the bundle is moving to roller conveyor 1, next bundle is moved to roller conveyor 2 at the same time.

One gear motors with contactor control to one direction for conveyor movement. One pneumatically actuated turning device for turning the bundle if needed. One Sick Absolute encoder, with profibus interface for bundle positioning. Photocells for bundle detecting. Conveyor movement speed: 0,30m/s



Fig. 4. Roller Conveyor

#### B. Indicator

In On-Line mode the trigger led corresponds to the active reading phase signaled by the Presence Sensor. In Automatic and Continuous modes the trigger led is always on indicating that the reader is ready to read a code. When connected to a Field bus network through the CBX500, the com led is always active, even in the absence of data transmission, because of polling activity on the Field bus network. During the reader startup (reset or restart phase), all the LEDs blink for one second. On the back of the reader near the cable, the "POWER ON" LED indicates the laser scanner is correctly powered. Red LED refers to the STATUS, this LED refers to the NO READ data in the system. READY LED refers to the system that is ready to operate and the green colour light glows for indicating that the system is ready. COM LED with yellow colour light refers to the active communication on main serial port.

Table. 1. Indicators Colour and Description

LED	Colour	Description
READY	Green	Ready to operate.
GOOD	Green	Confirms successful reading.
TRIGGER	Yellow	Status of the reading phase.
COM	Yellow	Active communication on main serial port.
STATUS	Red	NO READ result.

### C. Programmable Logic Controller

A Programmable Logic Controller (PLC) is a solid state device that uses soft wired logic contained in the controller's memory to duplicate the functions of relays and hardwired solid state control devices. In operation, the memory unit sequentially scans inputs are (sensors, limit switches, push buttons, photocells) in cyclic fashion to determine which output (contacts, motor starters, solenoids, pilot lights, converters, etc.) should be turned on or off.

It uses a programmable memory to store instructions and execute specific functions that include ON/OFF control, timing, counting, sequencing, arithmetic, and data handling.

### III. SYSTEM OPERATION

#### A. System Layout Operation

Initially assume that all devices are in automated view. Reams are being loaded in conveyor. The bundle which is called Reams are output of the shrink wrapping machine are collected by the extended conveyor. Prescribed load withstanding limit of ream is say approximately 60- 70Kg. When the start is "ON" the ream which is from the Shrink Wrapping Machine moved to the Extended Conveyor.

The reams moved are sensed by the "OBJECT SENSOR" and moved to the perpendicular conveyors by the use of hydraulic pusher. Immediately after reaching the ream to the respected area it will sense by the sensor and pushed by another hydraulic pusher. The reams pushed by the hydraulic pusher are loaded to the pallet which is capable of loading capacity of 3.5tonnes. The reams loaded in the pallet are lifted by the "LIFTER" and which are to be taken to the "TRAVELSCAR".

The pallet loaded in the travelscar are travelled to the Storage Area and stored in the respected area with respect to the barcode. If the Storage Area is completely full, immediately it will indicate and "ALARM" is "ON" the reams are moved to the manual storage. The above process is handled by PLC (programmable logic circuit) programming language through the automation. This operation makes the reams to travel without any delay to the storage conveyor from the shrink machine conveyor.

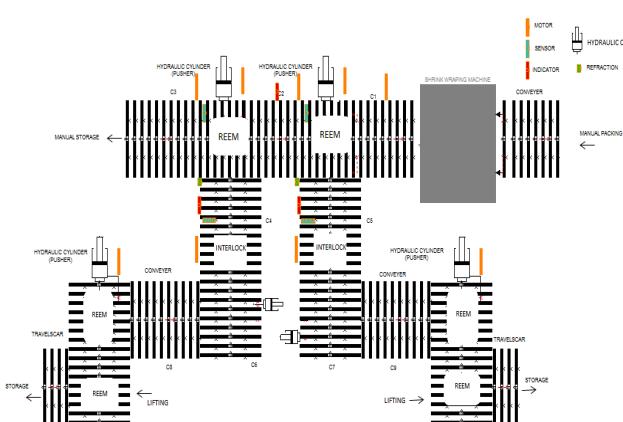


Fig. 5. System Operation Layout

#### B. System Simulation Operation

The System simulation is basically programmable Logic circuit's simulation. There are various types of programs but the common way is Ladder Logic Diagram. This Ladder Logic diagram is basically works on the normally open and normally close operation.

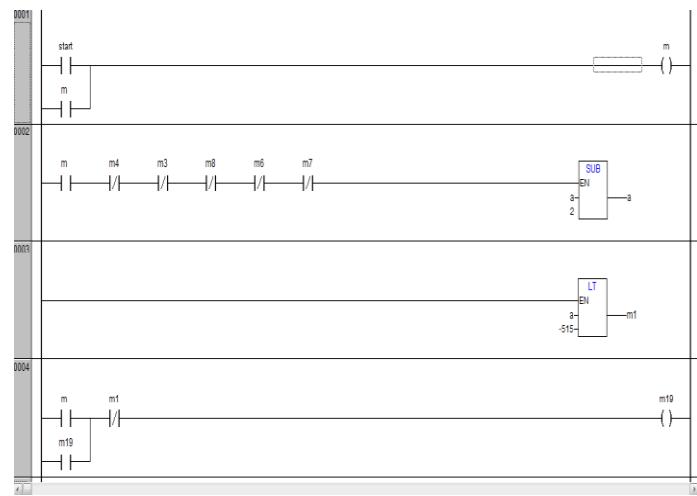


Fig. 6. Ladder logic diagram simulation 1

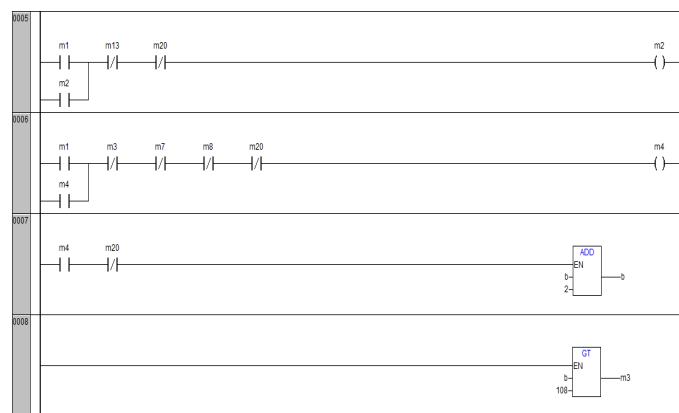


Fig. 7. Ladder logic diagram simulation 2

### IV. CONCLUSION

The PLC being an effective tool in automation can automate any process logically along with the usage of I/O's. Even if one PLC fails, another PLC connected in the same network will retake the process without causing any interruption or malfunction. This kind of Cheaper and well efficient design if installed can create a perfect sequence of operation. The main Moto is to provide smooth and precise handling of paper storage. Since everything is automated the storage and retrieval process with quick and more efficient then input to the system requires more consistent. Our project ensures the same. Similarly in case of production expansion the system needs some small changes in program generally in timer circuits. Thus a separate setup is not required such that the existing system itself will be well sufficient to meet maximum production.

## REFERENCES

- [1] Y. Suzuki, K. Koyama, A. Ming, M. Shimojo, "Grasping Strategy for Moving Object using Net-Structure Proximity Sensor and Vision Sensor", IEEE International Conference on Robotics and Automation (ICRA), pp. 1403-1409, 2015
- [2] R. Sekar, S. J. Hsieh, and Z. H. Wu, "Remote diagnosis design for a PLC-based automated system: 1-Implementation of three levels of architectures", Int. J. Adv. Manuf. Technol., vol. 57, no. 5-8, pp. 683-700, 2011.
- [3] A. T. Almeida, F. J. T. E. Ferreira, D. Both, "Technical and economical considerations in the application of variable-speed drives with electric motor systems", *Industry Applications*, vol. 44, pp. 188-199, 2005.
- [4] S. R. Zhang, X. H. Xia, "Optimal control of operation efficiency of belt conveyor systems", *Applied Energy*, vol. 87, pp. 1929-1937, 2010.
- [5] S. R. Zhang, X. H. Xia, "Modeling and energy efficiency optimization of belt conveyors", *Applied Energy*, vol. 88, pp. 3061-3071, 2011.
- [6] M. Thirugnanasambandam, M. Hasanuzzaman, R. Saidur, M.B. Ali, S. Rajakarunakaran, D. Devaraj, N.A. Rahim, "Analysis of electrical motors load factors and energy savings in an Indian cement industry", *Energy*, vol. 36, pp. 4307-4314, July 2011.
- [7] Ali, A. Nazar. "Cascaded Multilevel Inverters for Reduce Harmonic Distortions in Solar PV Applications." *Asian Journal of Research in Social Sciences and Humanities* 6.Issue : 11 (2016): 703-715.
- [8] Ali, A. Nazar. "A Single phase Five level Inverter for Grid Connected Photovoltaic System by employing PID Controller." *African journal of Research* 6.1 (2011): 306-315.
- [9] ali, A.Nazar. "A SINGLE PHASE HIGH EFFICIENT TRANSFORMERLESSINVERTER FOR PV GRID CONNECTED POWER SYSTEM USING ISPWM TECHNIQUE." *International Journal of Applied Engineering Research* 10.ISSN 0973-4562 (2015): 7489-7496.
- [10] Ali, A. Nazar. "Performance Enhancement of Hybrid Wind/Photo Voltaic System Using Z Source Inverter with Cuk-sepic Fused Converter." *Research Journal of Applied Sciences, Engineering and Technology* 7.ISSN: 2040-7459; (2014): 3964-3970.
- [11] Ali, A. Nazar. "Ride through Strategy for a Three-Level Dual Z-Source Inverter Using TRIAC." *Scientific Research publication* 7.ISSN Online: 2153-1293 (2016): 3911-3921.
- [12] Ali, A. Nazar. "An ANFIS Based Advanced MPPT Control of a Wind-Solar Hybrid Power Generation System." *International Review on Modelling and Simulations* 7.ISSN 1974-9821 (2014): 638-643.
- [13] Nazar Ali, A. "Performance Analysis of Switched Capacitor Multilevel DC/AC Inverter using Solar PV Cells." *International Journal for Modern Trends in Science and Technology* 3.05 (2017): 104-109.
- [14] Ali, A.Nazar. "FPGA UTILISATION FOR HIGH LEVELPOWER CONSUMPTION DRIVES BASEDONTREE PHASE SINUSOIDAL PWM -VVVF CONTROLLER." *International Journal of Communications and Engineering* 4.Issue: 02 (2012): 25-30.
- [15] ali, A.Nazar. "A SINGLE PHASE HIGH EFFICIENT TRANSFORMERLESS INVERTER FOR PV GRID CONNECTED POWER SYSTEM USING ISPWM TECHNIQUE." *International Journal of Applied Engineering Research* 10.ISSN 0973-4562 (2015): 7489-7496.
- [16] JAIGANESH, R. "Smart Grid System for Water Pumping and Domestic Application using Arduino Controller." *International Journal of Engineering Research & Technology (IJERT)* 5.13 (2017): 583-588.
- [17] Pau11, M. Mano Raja, R. Mahalakshmi, M. Karuppasamypandiyan, A. Bhuvanesh, and R. Jai Ganesh."Classification and Detection of Faults in Grid Connected Photovoltaic System."
- [18] Ganesh, Rajendran Jai, et al. "Fault Identification and Islanding in DC Grid Connected PV System." *Scientific Research Publishing* 7.Circuits and Systems, 7, 2904-2915. (2016): 2904-2915.
- [19] Jaiganesh, R., et al. "Smart Grid System for Water Pumping and Domestic Application Using Arduino Controller." *International Journal for Modern Trends in Science and Technology* 3.05 (2017): 385-390.
- [20] Kalavalli,C., et al. "Single Phase Bidirectional PWM Converter for Microgrid System." *International Journal of Engineering and Technology (IJET)* ISSN : 0975-4024 Vol 5 No 3 Jun-Jul 2013.
- [21] Lilly Renuka, R., et al. "Power Quality Enhancement Using VSI Based STATCOM for SEIG Feeding Non Linear Loads." *International Journal of Engineering and Applied Sciences (IJEAS)* ISSN: 2394-3661, Volume-2, Issue-5, May 2015.
- [22] Karthikeyan,B. JEBASALMA. "RESONANT PWM ZVZCS DC TO DC CONVERTERS FOR RENEWABLE ENERGY APPLICATIONS ." *International Journal of Power Control and Computation(IJPCSC)Vol 6. No.2 – Jan-March 2014 Pp. 82-89@gopalax Journals, Singaporeavailable at :www.ijcns.comISSN: 0976-268X.*
- [23] Gowri,N, et al. "Power Factor Correction Based BridgelessSingle Switch SEPIC Converter Fed BLDC Motor." *ADVANCES in NATURAL and APPLIED SCIENCES*. ISSN: 1995-0772 AENSI PublicationEISSN: 1998-1090 <http://www.aensiweb.com/ANAS2016> March 10(3): pages 190-197.
- [24] Ramkumar,R., et al." A Novel Low Cost Three Arm Ac AutomaticVoltage Regulator" *ADVANCES in NATURAL and APPLIED SCIENCESISSN: 1995-0772 AENSI PublicationEISSN: 1998-1090* <http://www.aensiweb.com/ANAS2016> March 10(3): pages 142-151.
- [25] Kodeeswaran, S., T. Ramkumar, and R. Jai Ganesh. "Precise temperature control using reverse seebeck effect." In *Power and Embedded Drive Control (ICPEDC)*, 2017 International Conference on, pp. 398-404. IEEE, 2017.
- [26] Subramanian, AT Sankara, P. Sabarish, and R. Jai Ganesh. "An Improved Voltage follower Canonical Switching Cell Converter with PFC for VSI Fed BLDC Motor." *Journal of Science and Technology (JST)* 2, no. 10 (2017): 01-11.
- [27] Murugesan,S, R. Senthilkumar."DESIGN OF SINGLE PHASE SEVEN LEVEL PV INVERTER USING FPGA." *International Journal of Emerging Technology in Computer Science & Electronics*, 2016, Vol.20, No.2, pp.207-2012.
- [28] S. Murugesan, C. Kalavalli, "FPGA Based Multilevel Inverter With Reduce Number of Switches For Photovoltaic System", *International Journal of Scientific Research in Science, Engineering and Technology(IJSRSET)*, Print ISSN : 2395-1990, Online ISSN : 2394-4099, Volume 3 Issue 6, pp.628-634, September-October 2017.
- [29] Vikram, A. Arun, R. Navaneeth, M. Naresh Kumar, and R. Vinoth. "Solar PV Array Fed BLDC Motor Using Zeta Converter For Water Pumping Applications." *Journal of Science and Technology (JST)* 2, no. 11 (2017): 09-20.
- [30] Nagarajan, L. Star Delta Starter using Soft Switch for Low Power Three Phase Induction Motors. *Australian Journal of Basic and Applied Sciences*, 9(21), 175-178.
- [31] Vinusha, S., & Nagarajan, L. (2015). CURRENT SOURCE INVERTER FED INDUCTION MOTOR DRIVE USING MULTICELL CONVERTER WITH ANFIS CONTROL.
- [32] Nagarajan, L., & Nandhini, S. (2015). AN EFFICIENT SOLAR/WIND/BATTERY HYBRID SYSTEM WITH HIGH POWER CONVERTER USING PSO.

- [34] Subramanian, AT Sankara, P. Sabarish, and R. Jai Ganesh. "An Improved Voltage follower Canonical Switching Cell Converter with PFC for VSI Fed BLDC Motor." *Journal of Science and Technology (JST)* 2.10 (2017): 01-11.
- [35] Compensator, D. S. (2015). AN ADAPTIVE CONTROL AND IMPROVEMENT OF POWER QUALITY IN GRID CONNECTED SYSTEM USING POWER ELECTRONIC CONVERTERS.
- [36] Sabarish, P., Sneha, R., Vijayalakshmi, G., & Nikethan, D. (2017). Performance Analysis of PV-Based Boost Converter using PI Controller with PSO Algorithm. *Journal of Science and Technology (JST)*, 2(10), 17-24.
- [37] T.Vishnu Kumar, V. Suresh Kumar, T. Sumeet, M.Srimaha "Hybrid Front end Interface DC-DC Converter with ANFIS Based Control of EMS System". International Journal of Scientific Research in Science and Technology, Volume 3, Issue 8, Print ISSN: 2395-6011, 2017.
- [38] T. Vishnu kumar, V. Suresh Kumar, A new approach to front end interface DC-DC converter" International Journal of Multidisciplinary Research and Modern Education (IJMRME) ISSN(online): 2454-6119 Volume I, Issue II, 2015
- [39] V.Suresh kumar, T. Vishnu kumar, A certain investigation for the battery charging system" International Journal of Multidisciplinary Research and Modern Education (IJMRME) ISSN(online): 2454-6119 Vol.1 Issue.1 2015.
- [40] S. Enimai, S. Jayanthi, T. Vishnu kumar Isolated Power System Design Using Modified P&O Technique" Middle-East Journal of Scientific Research 24 (S2): 150-156, 2016, ISSN 1990-9233