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ROBOT TRUCK LOADING BY UNIQUE MATRIX ROUTINE

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Abstract– *This paper deals with the development of Unique Matrix Routine so that any truck can be loaded in Automatic Mode through Kawasaki Robot- ZX165U. Currently, human loading system of truck is difficult and also the trucks are not standardized and made in different sizes and capacities. The project involves the development of Sensing and Control system to allow the Robot to move around and perform Pick & Place operation and detect the Unique Matrix locations on the truck body for onward loading of finished packages to tuck as per pre-determined loads and truck identification.The system consists of a Robot, a Gripper, a simple sensor mechanism with VFD for the roller conveyor. The Robot is kept well within its work envelope and within the reach of the maximum truck width. The work envelope of the Robot is within the reach to load the entire matrix into the truck. The starting point of the loading will be identified by an "Index Sensor" and hence ZX165U Robot will be able to load any truck irrespective of its size and shape.*

Keywords: *Truck Loading system, Kawasaki robot ZX165U,pneumatic pusher,conveyor,Index sensor,Teach Pendant*

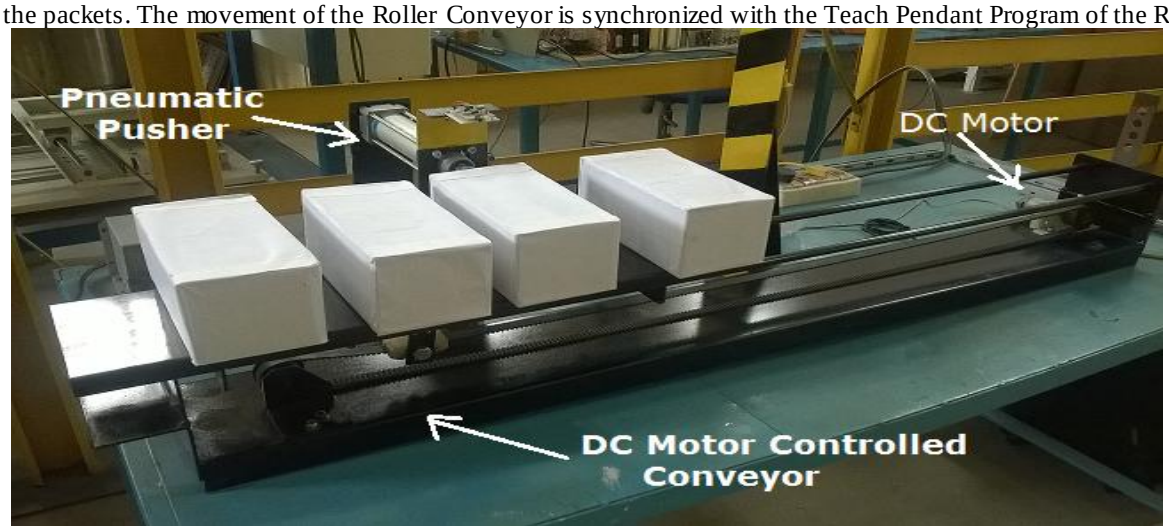
I. INTRODUCTION

This paper deals with the development of a Robotic Truck Loading System by the Unique Matrix Routine for use in Indian factories to load dissimilar non-standard Indian Trucks through Kawasaki Robot – ZX165U. This paper deals with the development of Unique Matrix Routine so that any Indian Truck can be loaded in Automatic Mode through Robot. It also deals with the development of Sensing and Control system to allow the Robot to move around and perform Pick & Place operation and detect the Unique Matrix locations on the truck body for onward loading of finished packages to truck as per pre-determined loads and truck identification. Post packaging inspection was also taken care of to facilitate the robot picks only the correct packages for onward truck loading.

A Robotic Truck Loading System in which there is no requirement of Moving Gantry for the Robot is difficult to achieve. Indian trucks are not standardized and made in different sizes and capacities. This challenge in Indian Truck loading is solved by an Unique individual matrix designed for each variety (there may be more than 7/8 varieties) of truck. The system will be highly economic, as we need a Robot, a Gripper, a simple sensor mechanism with VFD for the roller conveyor. To avail best possible use of the available work area, the Robot is kept well within its work envelope and within the reach of the maximum truck width. The work envelope of the Robot is well within the reach to load the entire matrix into the truck. We have designed the Unique Truck Loading Matrix in which the starting point of the loading will be identified by an "Index Sensor" and hence ZX165U Robot will be able to load any truck irrespective of its size and shape.

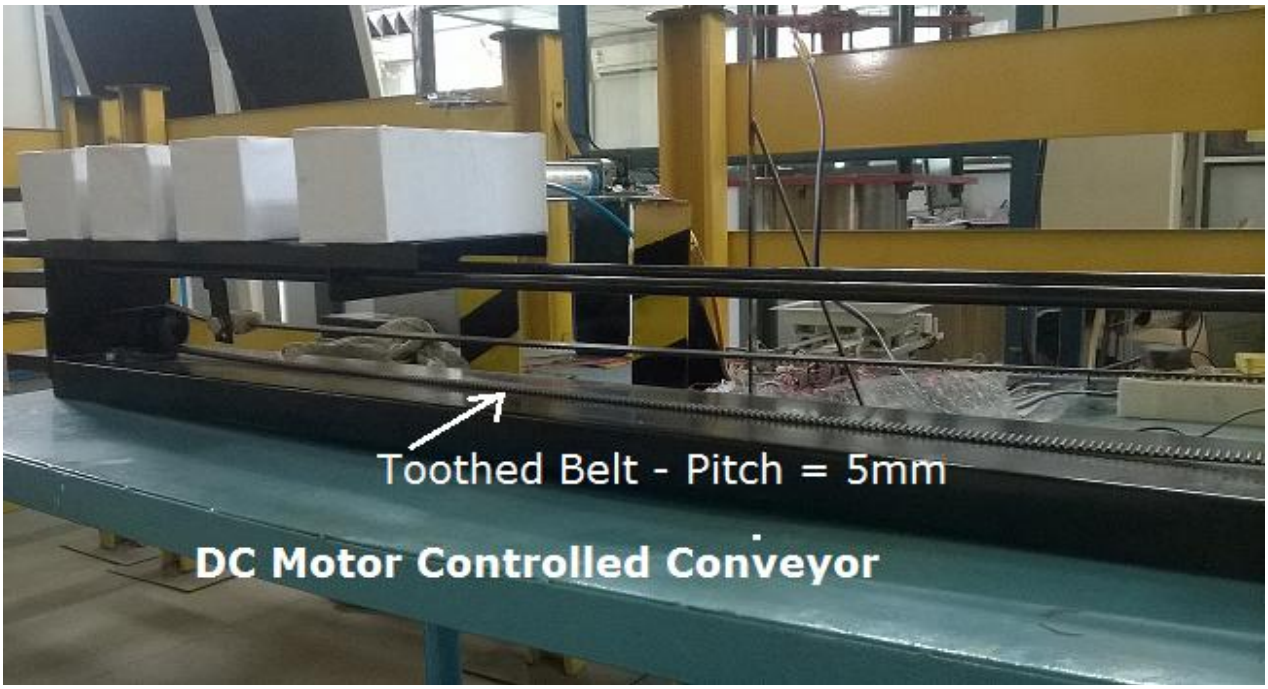
II. DC MOTOR CONTROLLED CONVEYOR

This DC Motor Driven Roller Conveyor is Micro-processor driven to facilitate exact movement during robot pick and place of the packets. The movement of the Roller Conveyor is synchronized with the Teach Pendant Program of the Robot.



DC Geared Motor Conveyor roller set is driven by a planetary geared motor multistage integrated inside the roller by a system 'shock-absorbing' that softens and protects the assembly in sudden movements with accelerations and violent stops.

The electronics includes a driver phase, and with brake brushless which develops power from 13.5 to 60 W and peripheral speeds of from 0.06 to 76 m / min. The tube in normal or stainless steel can be coated with rubber, polyurethane or other product and has diameter of 38-89 mm, with lengths between 200 and 1,500 mm. The cylindrical or conical rollers can support up to 1500 Kg static load.The motorized rollers is noted for their high performance torque to be transmitted and high cadences with low power consumption and the use of low voltage that ensures security and simplicity of installation. Moreover, they are compatible with control networks; simplify wiring and control and integration of intelligence in conjunction with automation. Its quiet, clean and small size improves working conditions environmental performance.



III. CONTROL SYSTEM

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively.ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD.ATmega16 has various in-built peripherals like USART, ADC etc. Each I/O pin has an alternative task related to in-built peripherals. The following table shows the pin description of ATmega16.

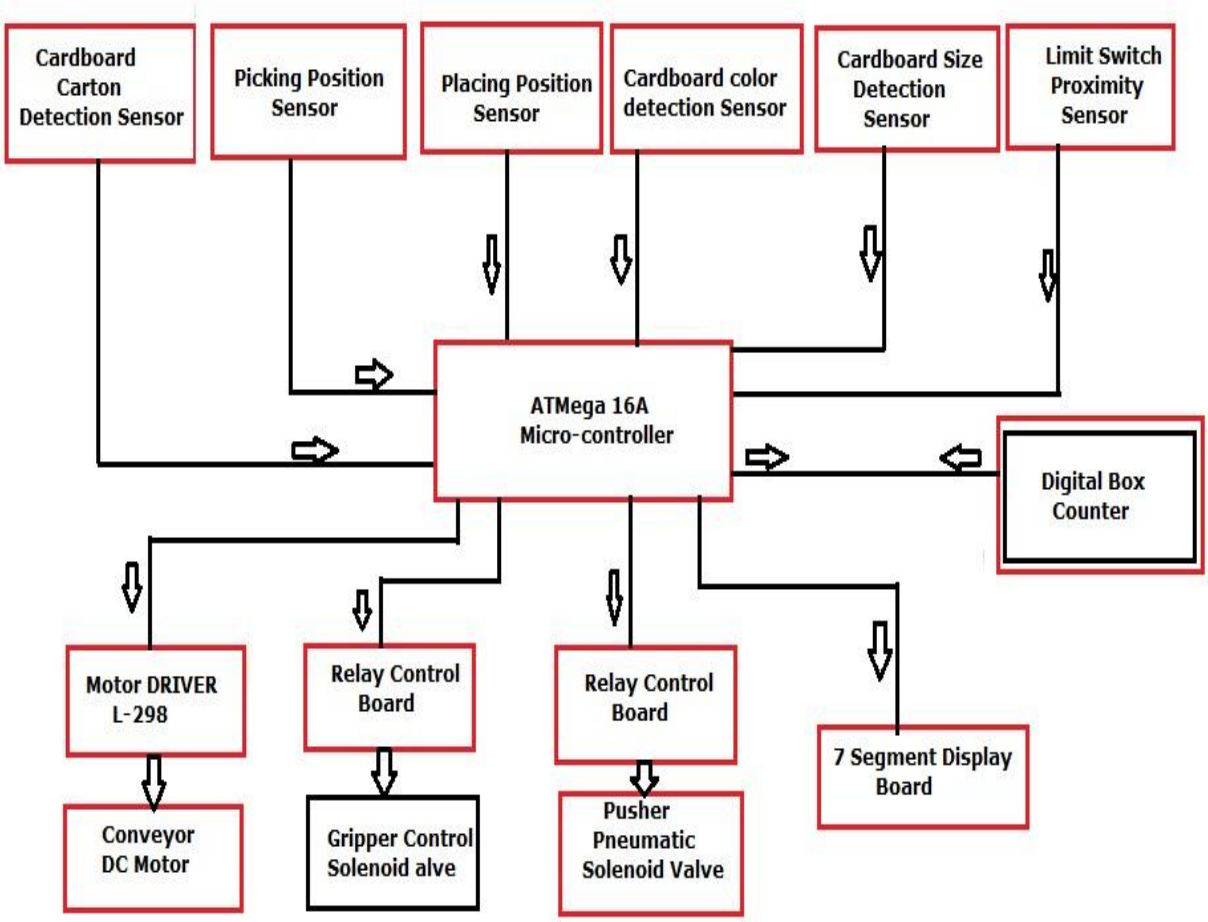


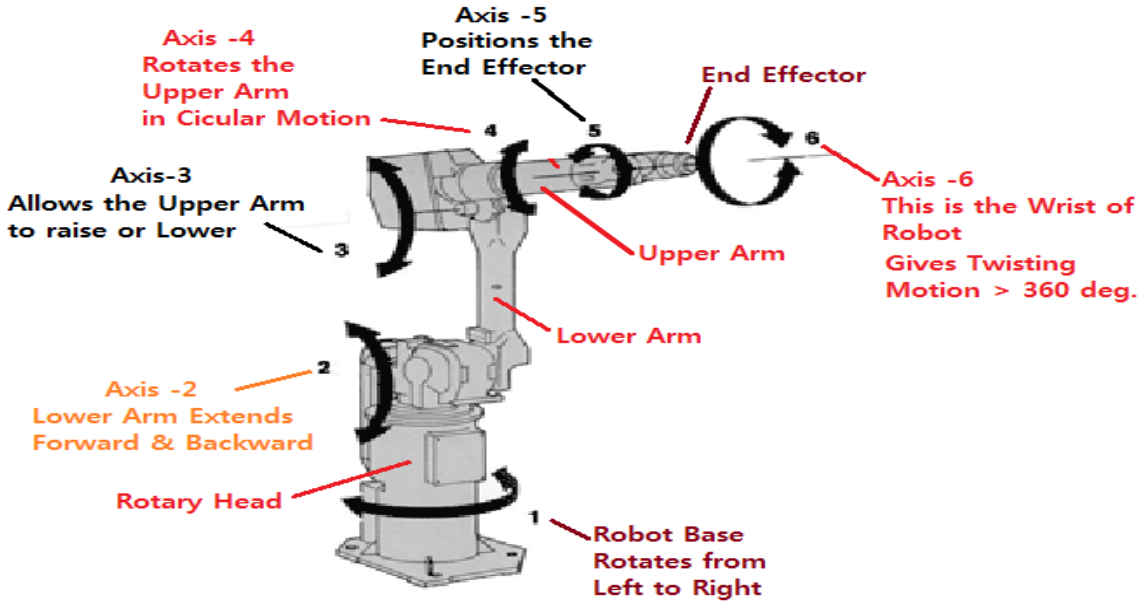
Fig.1 Overall Block Diagram

Fig2.Fabricated Atmega microcontroller

IV. ROBOTIC SYSTEM

Industrial Robots are mostly Six Axis Robots. The Mechanics of ZX165U Robot is explained below.

Degrees of freedom - 6 Axis, Pay Load -165Kg, Max. Speed - 110-250 degrees/second, Weight - 1350Kg, Linear Speed - 2.5mm/sec, Controller - E-42



ROBOT CONTROLLER

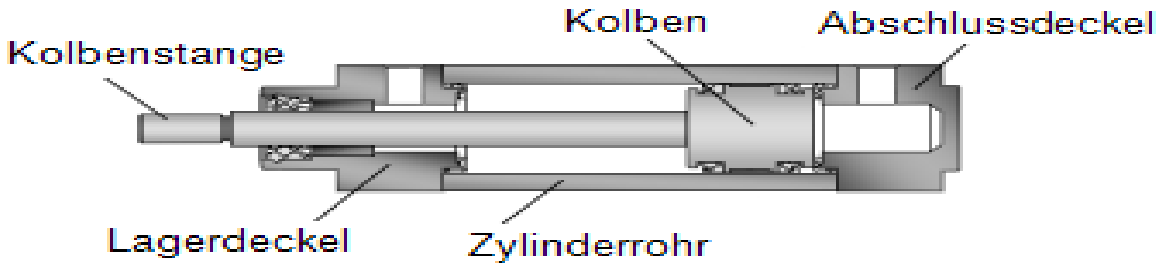
The e-controller as consistent further development of the existing control concept has been developed in close cooperation with Kawasaki's customers. In this way, a state-of-the-art high-end product has been created - offering the familiar ease of operation and exceptionally high power. A maximum of 10 external axes may be integrated, up to three of which in the controller housing (e4x). All established bus systems (interbus, profibus, profinet…) are supported. The integrated soft plc may be edited via teach pendant or even more comfortably at the pc. Custom-tailored user inter- faces may be programmed and used for the simplified control of the robot and also peripheral devices

Motor power on and program start may be activated directly via the manual control unit. The parallel display of two information screens (e.g. Position and signal data) facilitates the process control. Integrated software functions support the most various applications. Through individual combination and programming, highly complex systems may be designed and realized. (e.g. Soft absorber, collision detection, conveyor tracking and many more).

Ultra-fast execution of programs, loading and storing processes as well as a precise continuous- path control and much more thanks to the up-to- date processor design and powerful components. 8 Mb ram (80,000 steps) and USB interface as standard. Simple and friendly due to the optimized modular configuration of the Kawasaki control, maintenance work is exceptionally user-friendly. Furthermore, integrated service and diagnosis tools guarantee increased safety in operation. Remote diagnosis via Ethernet is also included in the standard package

V. MECHANICAL SYSTEM

The double-acting cylinder requires compressed air for every direction of movement. On this type of cylinder, the force both the advancing and retracting direction is built up using compressed air. The simplest way of actuating a double-acting cylinder is by using a 5/2 valve.



Of course, that's usually not everything that makes up a cylinder. There are also various smaller components such as seals, bearings, guiding band, permanent magnets, etc. But these parts are all included in the above-mentioned five parts which make up a standard cylinder (cylinder with single-ended piston rod).

The Pneumatic gripper is specially made for picking cardboard carton from the conveyor line is made.

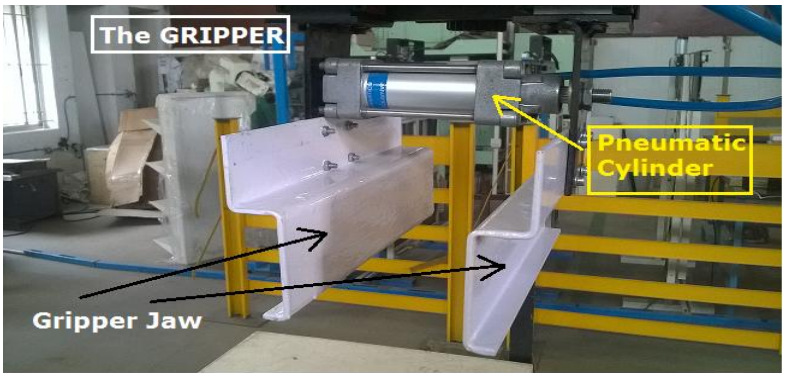


Fig.3 Pneumatic gripper

The Pneumatic pusher is specially made for rejecting unsized cardboard carton from the conveyor line is made.

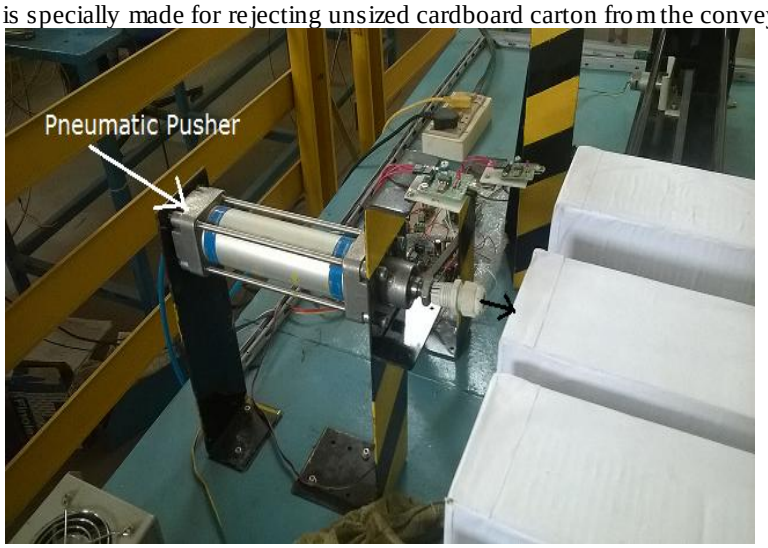


Fig .4 Pneumatic pusher

VI. PROGRAMMING SYSTEM

The selection of a new program name is at the discretion of the programmer. Program name should be consistent with company practices and the name of other programs that are in system memory. The multifunction panel must be in the teaching display to name a new program. To name a new program, press the PROGRAM KEY to display the PROGRAM SELECT screen.

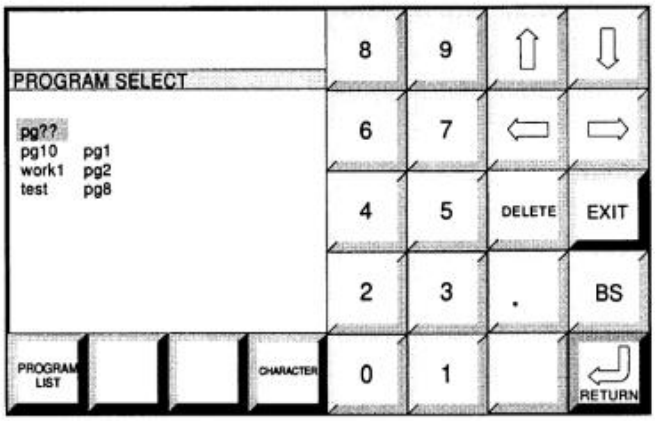


Fig .5 Teach Block

Select the desired character names for the program name. After the desired characters for the program name have been selected, the ENTER key is pressed to enter the new program name.

8.1.2 Recording program steps:

Fig.6Record and Teach key

Using the jogging methods position the robot tool in the location to record a position. The method that was used to that was used to jog the robot into position for the recording of a point will not be a part of the program, the auxiliary interpolation data will control the play back path. When the RECORD key is pressed, the location will be entered into memory, the step display of the teaching display will be incremented by one and the comment area of the screen will display the message the "position recorded". The key to the right of the RECORD key will display the TEACH new to identify that the step indicated has not yet been entered into memory. The Robot can now be jogged to the next location and process repeated.The project involves the programming of the robot using the teach pendant by following the above methods and the joint angles for each and every step of the program is recorded and tabulated.

Step No.	Joint 1	Joint 2	Joint 3	Joint 4	Joint 5	Joint 6	Joint 7
1	21.975	43.322	-20.527	0.096	-70.651	-322.944	-1999.979
2	21.995	52.943	-33.363	0.107	-57.184	322.970	-1999.979
3	12.440	24.479	-31.740	0.321	-59.410	-313.825	-1999.979
4	-27.791	38.144	-23.204	1.029	-67.677	-273.331	-1999.979
5	-18.968	40.408	-27.605	0.929	-63.233	-282.621	-1999.979
6	-18.864	28.607	-36.261	1.024	-54.587	-282.953	-1999.979
7	-18.864	34.503	-43.093	1.123	-47.755	-283.117	-1999.979
8	-18.715	25.755	-32.548	0.973	-58.301	-283.017	-1999.979
9	21.715	44.702	-23.664	0.097	-67.513	-322.949	-1999.979
10	21.975	53.161	-33.562	0.106	-57.615	-322.969	-1999.979
11	13.042	32.926	-37.398	0.323	-53.747	-314.431	-1999.979
12	-27.630	47.976	-23.109	1.028	-67.599	-273.985	-1999.979
13	-18.918	39.205	33.395	0.990	-57.435	-282.837	-1999.979
14	-18.918	39.205	33.395	0.990	-57.435	-282.837	-1999.979
15	-18.911	33.616	-26.002	0.919	-64.839	-282.704	-1999.979
16	21.715	44.262	-22.997	0.097	-68.183	-322.949	-1999.979
17	21.715	53.093	-33.501	0.107	-57.678	-322.969	-1999.979
18	16.571	31.273	-41.500	0.237	-49.658	-317.972	-1999.979
19	-27.566	47.909	-23.182	1.027	-67.525	-274.052	-1999.979
20	-26.169	45.155	-26.661	1.043	-64.068	-275.508	-1999.979
21	-28.283	38.304	-39.950	1.239	-50.742	-273.722	-1999.979
22	-27.789	29.856	-29.458	1.082	-61.246	-273.938	-1999.979
23	21.715	45.788	-24.928	0.098	-66.258	-322.951	-1999.979
24	21.646	52.445	-33.373	0.108	-57.804	-322.901	-1999.979
25	15.743	22.922	-32.687	0.239	-58.429	-317.121	-1999.979
26	-26.979	47.405	-23.505	1.021	-67.212	-274.630	-1999.979
27	-25.370	46.240	-28.264	1.043	-62.452	-276.333	-1999.979
28	-26.071	47.041	-34.075	1.116	-56.654	-275.764	-1999.979

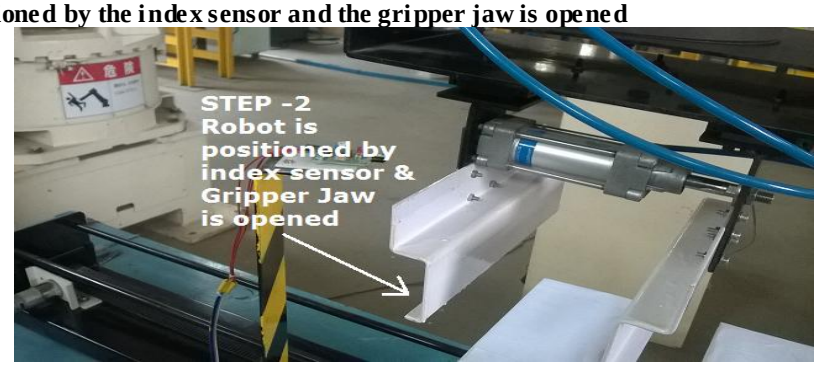
V. IMPLEMENTATION

The prototype of the robotic truck loading by unique matrix routine has been implemented at the shop floor and this chapter

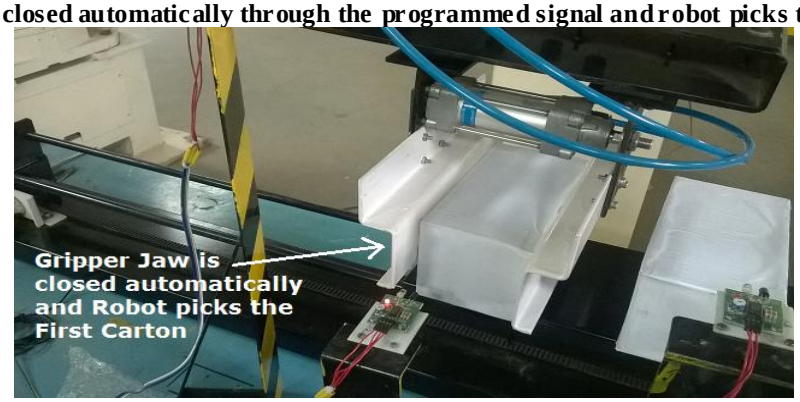
deals with the step by step operation of placing the cardboard cartons on the matrix order

Step 1 – Cartons are and ready to placed move

Step 2 – Robot is positioned by the index sensor and the gripper jaw is opened

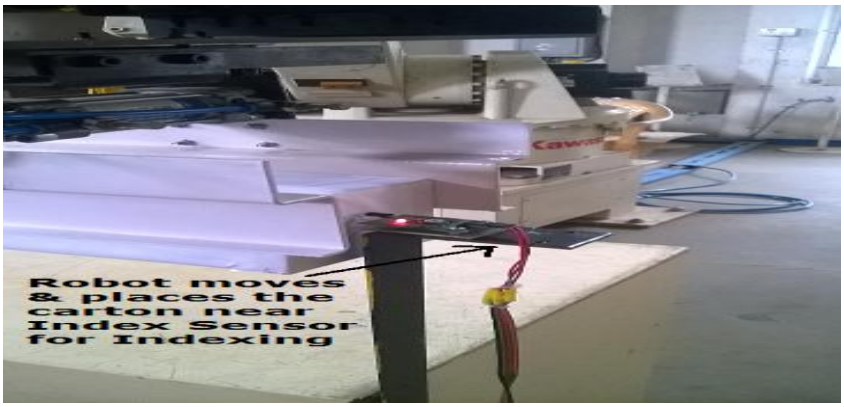


Step 3 – Gripper jaw is closed automatically through the programmed signal and robot picks the first carton

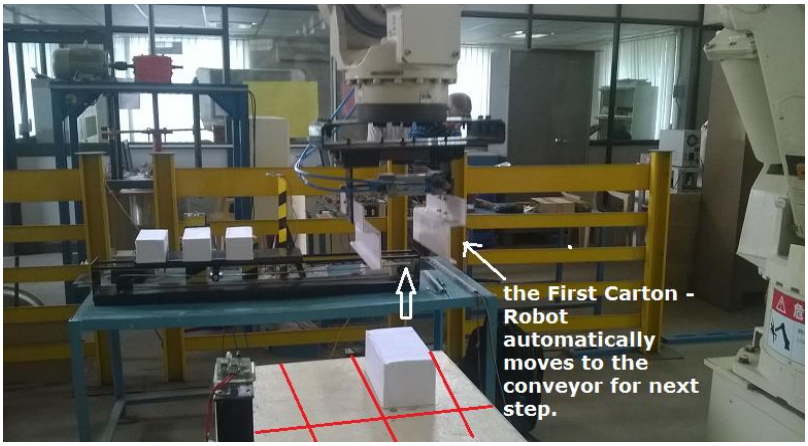


Step 4 –Robot automatically picks the first carton and moves towards the index table

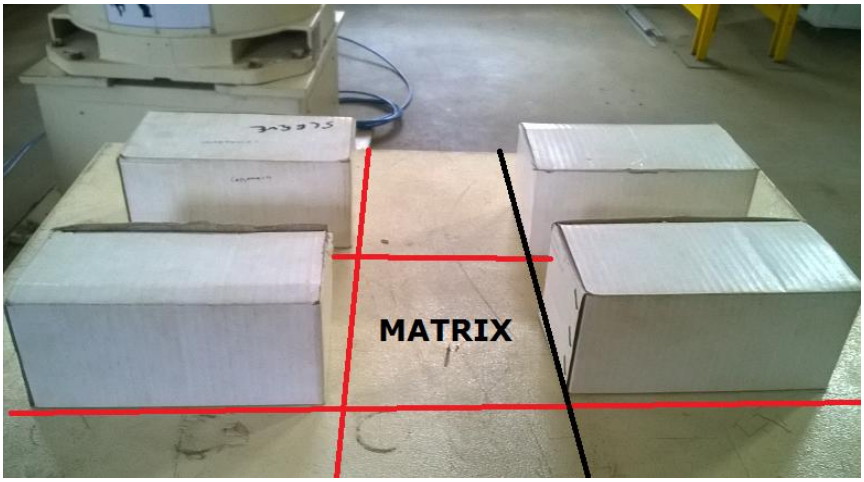
Step 5 – Robot moves with the carton automatically and places it near index sensor for ascertaining the first placement position on the matrix table



Step 6 - After placement of the first carton, the robot automatically moves towards the conveyor to pick the second carton



Step-7 – Robot automatically picks the next carton and this process is repeated till all the cartons are loaded into the matrix table.



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