

## Low Cost Online Automated IOT Shopping List Processing Mechatronic System for a Super Market

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**Abstract:** “Robota” which is a Czech word translated as "forced labor" designed for heavy, repetitive manufacturing work. They handle tasks that are difficult, dangerous or boring to human beings. Especially military purposes, Space Shuttle Remote Manipulator Systems etc. The most common manufacturing robot is the robotic arm, which is made up of seven metal segments controlled by rotating individual stepper motors connected to each joint. This accuracy allows the computer to move the arm very precisely, repeating exactly the same movement repeatedly. An industrial robot closely resembles a human arm it has the equivalent of a shoulder, an elbow and a wrist. As a part of long project involving industry and academic collaboration, we have to develop an automatic shopping cart handling system for a super market. The basic idea of our project was to pick up selected object from the shelf and drop it to the shopping cart, to handle online customer orders, by offering customers the very best in service, selection, convenience, and value. This is a system which can successfully manipulate and handle a shopping cart, by adding all the items according to an online item list which has been ordered by an online customer. For this process we have utilized a “Web Site” as the customer interface, a “Company System”, considering the convenience of the company tasks and finally, a “Robot System” to manipulate and handle the shopping carts based on an online item list. The overall objective of this Software-Mechatronic combined IOT system is to successfully automate the series of tasks from the “customer ordering” process to the “shopping cart handling” process. The fully implemented system will be beneficial to customers, supermarkets and various marketing agents for different products. OASP will make shopping more convenient by cutting down time. Furthermore it will slash away the unwanted wasteful spending which takes place while shopping. For the super market by making shopping a more convenient experience will mean that customers will be more likely to visit the super market. It will also make it easier to for the super market to keep track of its regular customer base. At present there are systems which assist shoppers and high-end retail supermarket chains but the difference with OASP is it automatically prepare online request for customers behalf of shopping customers.

**Keywords:** OASP -Online Automated Shopping Partner, B2C - Business To consume, Software-Mechatronic combined IOT system

### I. INTRODUCTION

This software-Mechatronics combined IOT system which manipulates and handles the shopping carts by adding the ordered items one by one to the shopping cart, according to an online item list which is ordered by a customer via internet or through so called IOT process.

Mainly, this overall software-Mechatronics combined IOT system process was carried out using three sub systems.

1. Web site as the customer interface.
2. Company System for handling tasks of the Company.
3. Mechatronic-Robot System for preparing item lists.



Fig. 1: Overall view of the software-Mechatronics combined IOT system.

Considering the Website of the system, customer is allowed to prepare the item list by considering the qualities of the various types of items from the shopping mole store. At first, it considers the place where the customer is required to get the order. According to his place, he can view the details of the items of a nearest shopping mole. After creating the item list, he/she is also able to make further changes to their item lists.

Finally, he/she can make the payments for their list of ordered items from the shopping mole.

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- Customer is able to check the list of the ordered items by log in to the web site, also after his order has received.
- The Administrator of the company can also check the details of the items of the shopping mole store, details of the daily handling orders via the web site at any time.
- 24/7 availability

The next step of this entire process is the company system. With this company system, the employers of the company can fill the details of the items, change the item details as well as they can view various types of reports according to their requirement. As an example, they can view item details, order details, invoices, expired items etc. Moreover, the configurations and data tuning processes for the Mechatronic-Robot system is also performed by utilizing this company system.

This system is very specific because, we can prepare item lists automatically and manually by using the Mechatronic-Robot System. And also we can view all the tasks carried out during this process, by viewing the videos which are been captured by the cameras located in various angles.

The third sub system is the Hardware portion of the entire system. Hardware portion of the system includes the Mechatronic-Robot System. This Mechatronic-Robot system successfully handles and prepares the shopping cart by adding items one by one to the shopping cart, after the order details are been received. Therefore, this Mechatronic-Robot system can successfully handles the online orders according the priority of the orders. While adding ordered items to the shopping cart, then this Mechatronic-Robot system checks the expiry dates of each item and then it decides whether to add each item to the shopping cart or to the expired cart.

## II. METHODOLOGY

“Online automated shopping list handling system” project aims at the development of a new generation low cost shopping list handling system for a super market. This Software-Mechatronic-Robot based IOT total system was developed in project has 3 steps.

1. Web application to place orders for customers.(Web site/ Customer interface)
2. System to handle super market inventory.(Company System)
3. System to control Automatic process.(Mechatronic-Robot System)

### 2.1 THE WEB SITE FOR IOT ACTION OFMECHATRONIC-ROBOT SYSTEM

Online shopping is a form of electronic commerce (e-commerce) whereby consumers directly buy goods or services from a seller over the Internet without an intermediary service. An online shop, e-shop, e-store, Internet shop, web shop, web store, online store, or virtual store evokes the physical analogy of buying products or services at a bricks-and-mortar retailer or shopping Centre. The process is called business-to-consumer (B2C) online shopping. When a business buys from another business it is called business-to-business (B2B) online shopping

The following Software was used here:

- To build Web sites and online applications: “Joomla” content management system
- To create databases: “MySQL”
- Shopping cart script like AceShop, HikaShop
- CSS, Html, PHP, Java script, Adobe Flash are also used for the web site development.

## 2.2 COMPANY SYSTEM.

This system controls and manipulates overall software functionalities of the Mechatronic-Robot system and the company system. Such as, Item filling, Searching, Update, Delete, Store details, report generating, and filling, deleting and updating rack details etc.

Moreover, it uses queues to prepare the order according to the priority and then it feeds these orders to the Mechatronic-Robot system via the parallel port. While handling these orders, the cameras will provide the videos to the window of the application system.

Furthermore, the instructions of the processes of preparing orders automatically, finishing the orders, emptying the carts are being fed to the parallel port.

Objective of the project is to provide better inventory management system to the supermarket manager. By providing the current stock details, employee details, new items to be added, transactions as well as reports.

Used Software:

- To build the applications: visual studio 2008 by using c#
- To create databases: “mysql”

## 2.3 THE MECHATRONIC-ROBOT SYSTEM.

Basically, the overall goal of this Mechatronic-Robot system was to grabbing item from the shelf and adds each item to the shopping cart or to the expiry cart based on item's expiry date. This process was carried out until the items of the order are completed. After that, it gets ready to an upcoming new order by releasing the shopping cart which is already completed.

For all these received orders are to be handled,

1. A Mechatronic-Robot frame structure to move along each axis (X, Y, and Z).
2. Mechanical grabbing part for grabbing items
3. A sensor system to identify the decided place and the Maximum movement limitation.
4. A system for data transition (Encoders & Decoders).
5. A system for power supply.
6. Motor driven circuits.
7. Rotary encoders for DC motors

In order to reach the decided place, this Mechatronic-Robot arm should control its movements basically in three directions.

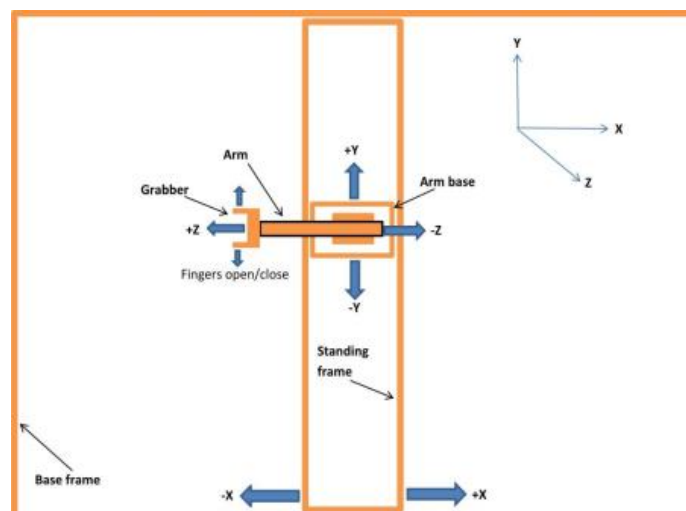


Fig. 3: Basic Movements of the Mechatronic-Robot arm

According to the above diagram, the “Base frame” bears all the components of the Mechatronic-Robot arm and it also aids for the movement of the Robot arm.

The “Standing frame” aids for the Mechatronic-Robot arm in order to move horizontal manner. And also the “Arm base” helps to move in vertical manner. Moreover, the Robot arm can move forward and backward and also it can open and close the grabber fingers too.

Therefore, this system can move to all the decided places by using the movements of X, Y, and Z axis in a three dimensional system inside a limited range.

## 2.4 The Importance of the “Movement” process of the Mechatronic-Robot System

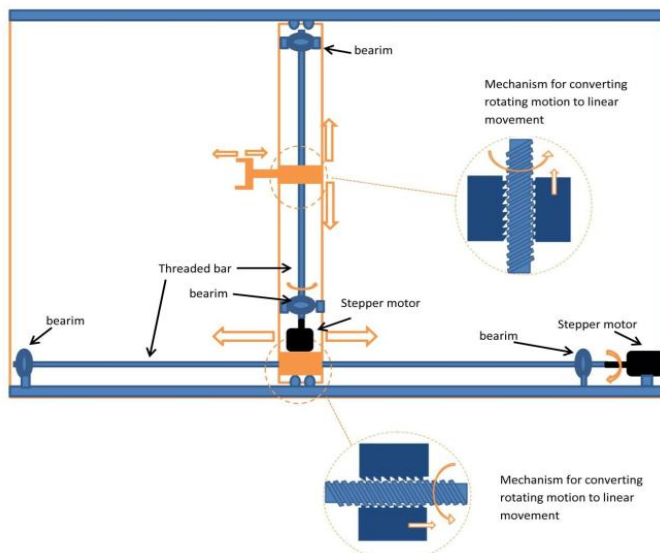


Fig. 4: Full frame of the Mechatronic-Robot system

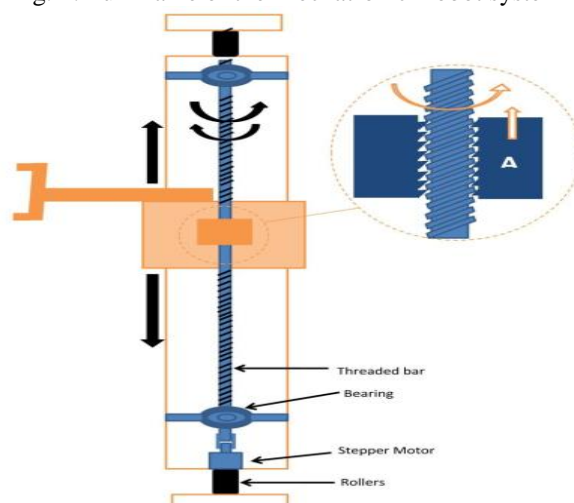


Fig.5: Vertical Bar of the Mechatronic-Robot System.

The stepper motor generates a circular motion. But, in this system we need to have a linear motion. For this motion transition, here we have used a “Threaded Bar” attached to the axis in which the stepper motor is rotated. This “Threaded Bar” also rotates with the motor too. It is pivoted in to the exact part of the A portion. Now, when the bar is rotating, A portion also moves upward and downward. Moreover, this Mechatronic-Robot Arm is made to be fixed with the A portion. Therefore, the Arm base moves upwards and downwards when the threaded bar is rotated, due to the rotation generated by the stepper motor.

The most specific feature of the stepper motors is the ability to move an exact amount of degrees according to the number of pulse cycles we provided. Therefore, we can control the number of rotations of the stepper motor accurately. So that, we can successfully move the Arm to a distance as we required in a smooth manner.

**2.5 The Functionality of the Mechatronic-Robot Arm.**

By utilizing the mechanisms as described above, now the arm can move and stay face to face with the item accurately. Now the arm should add the item to the shopping mole cart.

When system want to get an item, arm move to right corner of rack section. Then it move to left side till meet the item. When it found the item again it move to forward as shown in figure 06

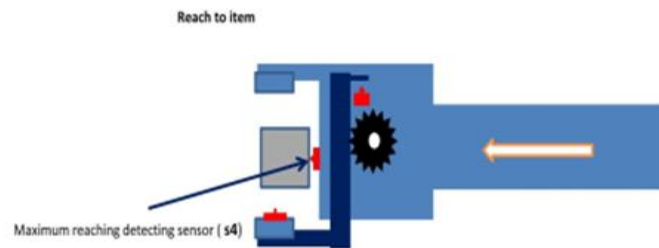


Fig.6: The Grabber is moved to forward then it closed its fingers to able to pick the item.

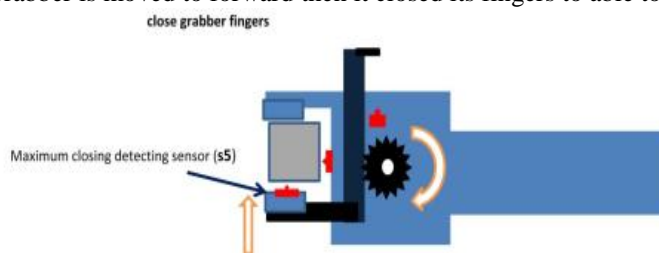


Fig. 7: The Grabber is closed its fingers

Then the Mechatronic-Robot arm should add the grabbed items to the shopping cart or to the expiry cart, based on the expiry dates of each items.

**2.6 The Sensor Circuits for manipulating and reaching to item.**

The “Rack configuration” table of the database, provides the width and height of the section of rack. In addition, the “Store” table provides the width, height and the position (at what section of rack).

According to these details and sensor array values, system drive arm to the item for grabbing process.

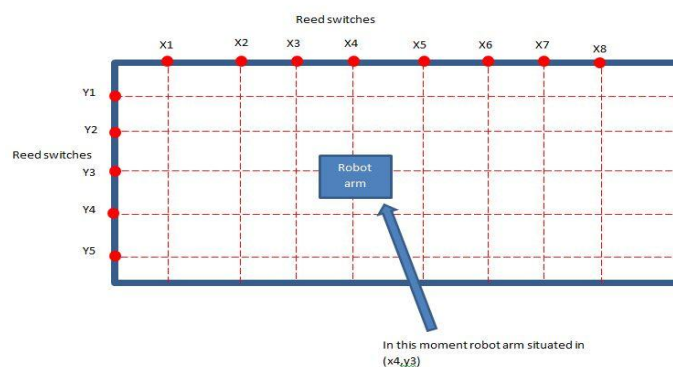


Fig. 8: the proposed sensor array mechanism

As shown in the diagram, the Mechatronic-Robot arm gets the vertical and horizontal position. All the above mentioned sensors are been connected to the computer by the encoder circuits via the parallel Port circuit. Therefore, the signals needed for the company system can be obtained. By using these signals and the other needed information, the system can be automatically controlled by the company system. Instruction fetching is done through the decoder circuit.

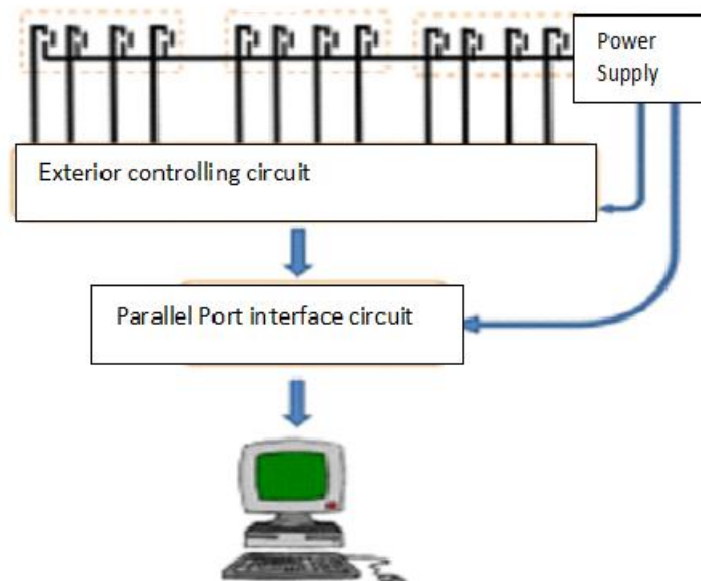


Fig 9: The proposed system gets signals from sensors through the encoder circuit

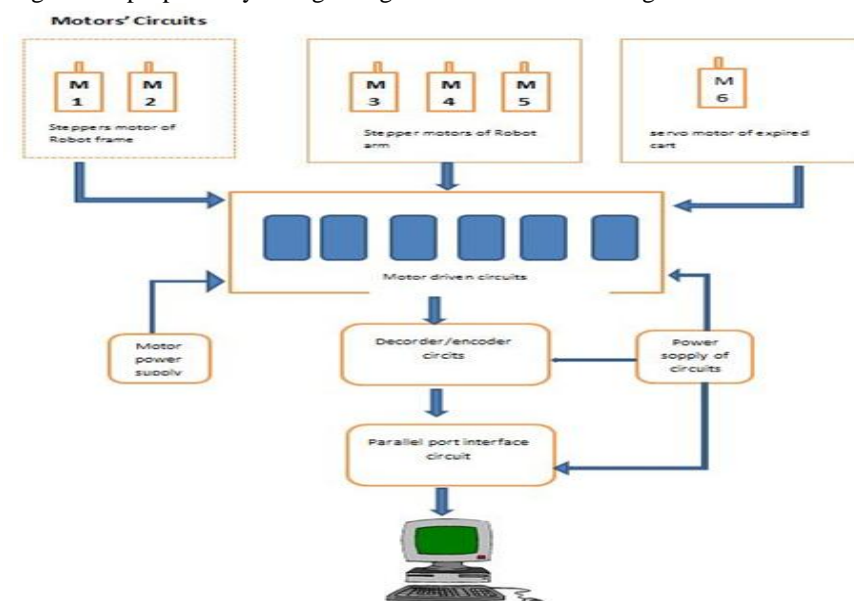


Figure 10: system fetches signals to circuit through the decoder circuit

### III. RESULTS AND DISCUSSIONS

The research was conducted to make huge impact on implementing this kind of a shopping technique without sophisticated expensive imported readymade parts/ system. To address a real world problem from our research is not an easy task. The implementation stage faced difficulties were useful for future developments in this low cost system. As our research focused on introducing such kind of a web based shopping planning and guidance method which automatically reporting the functionality to supermarket management. Remarkable amount of literature survey was done using techniques like research papers, relevant books, web resources, expert human resources.

### IV. CONCLUSION AND FUTURE WORK

The presented system has some drawbacks as the mechanical robotic system processing time is somewhat higher than that type of expensive imported readymade systems. The proposed Software-Mechatronic-Robotic system can be improved in following ways.

- Increase system speed by adding timing belt rather than using threaded bars.
- Arrange items automatically using robot system.
- Analyze, identify, grab ordered items and from image processing.
- Check QR code using image processing for getting item details
- After packed the order , print delivery information on the box
- Packed orders automatically carry to store using convey belts
- Using vehicle arranging system for loading boxes into vehicle

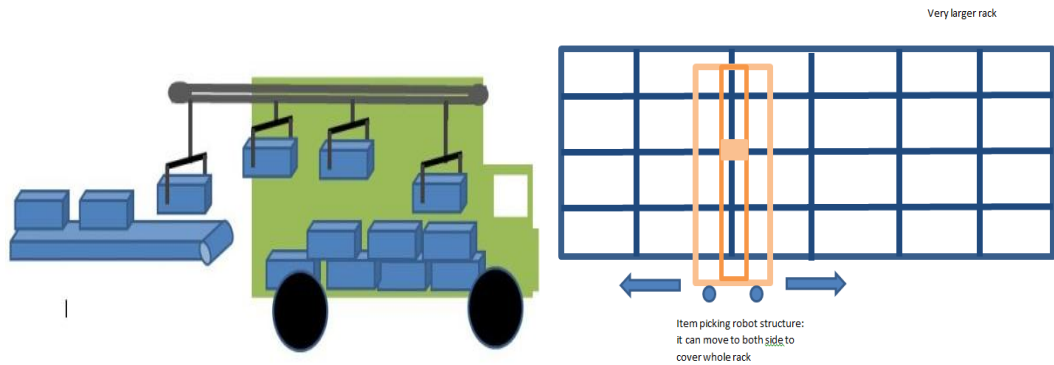


Figure 10: The proposed future enhancement

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