Using New Techniques and Devices within the Set of Tiba Body Roller Hamming Robots

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Abstract

In this article, new techniques and technologies have been tried and tested in the installation and commissioning of Roller Home industrial robots, in order to produce a Tiba car with a focus on cost reduction. Due to the fact that press equipment for automobile parts requires a lot of expenses, it was decided to use robots with the same function of roller to reduce costs and increase the quality and increase the product variety. The Hamming roller robot can flexure the single-layer and multi-layer sheets, according to its structure and advantages, and then with a suitable and variable pressure at any point. To reduce the cost using the Devicenet network of Hamming roller robots in The production of the TB vehicle as a carrier carrier has also been used, which has reduced the cable, connectible equipment and carrier robots.

Keywords: Roller Hemming, DeviceNet, Robot, Carrier, Peres

1- Introduction

The creation of new Tiba door hamming production lines in Saipa corporation is deemed necessary due to the production of Tiba 211 automobile production in the site of Saipa automobile Corporation and the supply of the peripheral doors of it through Kashan Saipa Corporation and regarding the production of Tiba 212 in Saipa Corporation which needs the production line of rear doors of Tiba and also the goals and advantages intended. [1]

After analyses and assessments of the advantages of projects such as utilizing hamming presses and through the use of roller hamming, it was decided to use hamming roller robots instead of press equipments. Following this decision, using control modules with the help of the advantages of DeviceNet industrial network, it was made possible to exploit a robot with the two devices required. Thus, a considerable reduction of expenses in installation and start, the purchase of pieces, and preservation, and fixture of the devices was achieved.

Another advantage of using DeviceNet industrial networks in this project was the omission of robots' interlock panel part which in its turn resulted in the reduction of a considerable amount of expenses and also

the utilization of modern technologies. The control panel of robots previously used in different production saloons contained two distinct parts, one for robot control and the other interlock. In interlock part, the panel uses PLC controllers. Through the use of DeviceNet industrial networks, we could use EmbeddedPLC modules and roller hamming robots have had a control panel unit for the robots. [1]

2- The Process of Roller Hamming Robots

Time is considered as a very important item in the process of roller hamming of the doors in Tiba automobile. [4]. All processes related to the production of Tiba doors' manufacturing should be done within the time span of 90 seconds. This includes the loading of outer layer of the doors onto the internal frames, transferring from the primary production fixture to the hamming fixture by using a robot through a gripper device, changing the gripper device into hamming devices, and finally the roller hamming action carried out.

According to figure 1, hamming roller robots and gripper were installed next to each other and hamming and transfer are done between the fixtures. The arrangement of the robots has been carried out based on the time predetermined for the production time (90 seconds) [1] and everything has been installed and launched accordingly.

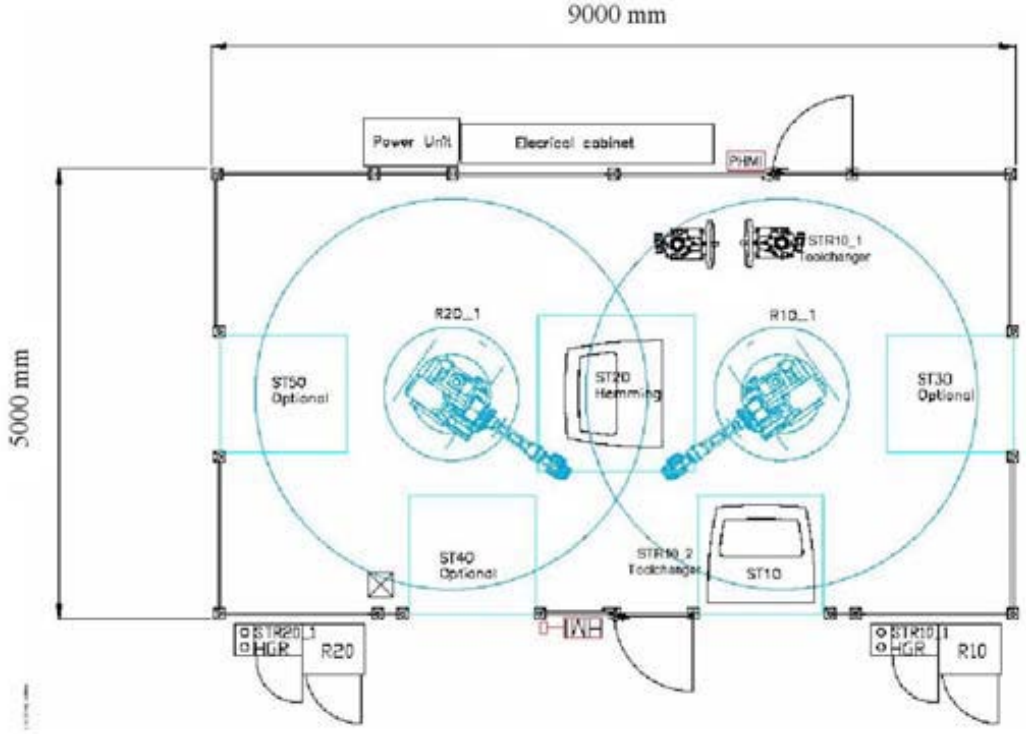

Fig.1. The process of hamming roller robots

Before the installation and launch of robots, their arrangements and their movements have been simulated through the use of Delima software to realize the time required by the manufacturing lines. The simulation part makes it possible to choose appropriate hamming devices for the sheets of Tiba, because if we use other devices there may be some bendings within the rolled sheets (Fig. 2).

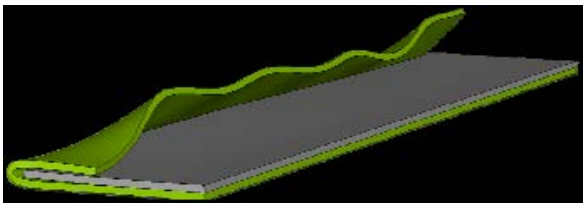

Fig.2. The simulation of hamming roller sheets using improper devices

The utilization of hamming roller robots is known as an alternate for costly systems of hamming process pressing to manufacture automobile doors including operations through which the edges of the work are dent and usually are utilized in pieces through which the internal and external parts are made in isolation and are connected afterwards (for example the outer layer and the internal parts of automobile) [4].

In the past, hamming was done using press systems or manually or using manual or electrical hammers, but recently using the robot has been utilized widely due to the cheapness and flexibility in different production stages [3].

An addition to the advantages of utilizing the robots, the utilization of roller hamming devices have had tremendous advantages and the most important advantages were lack of need to vast areas, initial capital, and the increase of automobile manufacturing quality.

To manufacture rear doors of Tiba 212 and the peripheral doors of Tiba 211 and regarding the items below, roller hamming robots were used instead of press systems.

- The accessibility of production lines of peripheral doors to control the product, recognize, trace and the removal of faults
- The application of required changes on the equipments to improve product quality [5]
- 90% reduction of the movement rate of trailer automobiles between Tehran and Kashan and the reduction of air pollution [1]
- The exploitation of local scholars in Saipa Corporation and lack of need to new human workforce to carry out complicated pressing processes [1]
- The lack of need to use a very big doper to manufacture peripheral rear and front doors for Toba 211 and Tiba 212
- Lack of need to high investments for launching, preservation, and fixtures required for press system [7]
- The possibility of automated and multi-purpose manufacturing with high precision and speed through the use of robotic systems
- The maintenance and increase of product quality using roller hamming robots
- Creating safety in workplace and the improvement of the operator's ergonomic performance through the omission of danger focal point of press system [6]

3- DeviceNet and using Connection Modules

Regarding the use of industrial robots, different devices are utilized. Each of these devices require gear cables and electric cables which pass through a route according to the fig. 3 within the robot to reach the controller. The great number of inputs and outputs of robot devices will lead to higher volumes of the cables and finding the faults and fixture and maintenance would become more difficult [5].

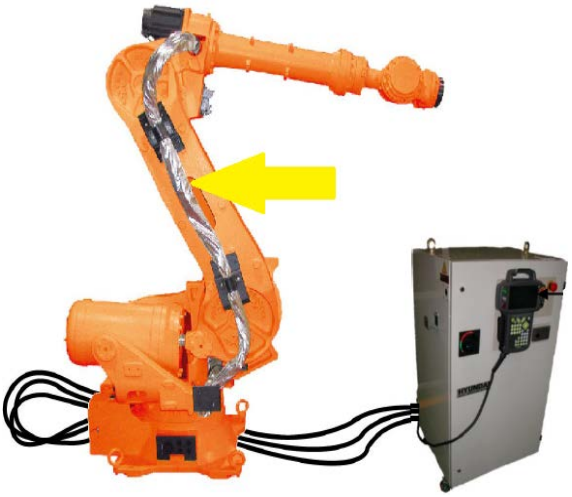

Fig.3. The passing route of robot cables

Devicenet is a network system which is used in automation industry to connect control devices in the form of internal networks and connect them to each other. Devicenet utilizes the common industrial protocols in a controller area network (CAN) and introduces a functional area to protect a range of the characteristics of device 2. The common functions of this network include the exchange of data, safety devices, and input and output controller of vast networks.

DeviceNet is a member of network created in common industrial protocol (CIP) for the higher layers. CIP entails a comprehensive set of messages and services to construct different automatic functions such as control, safety, coincidence, movement, fragmentation, the devices to recognize faults and information. DeviceNet supports 64 nodes and its speed rate is higher than 500 kbps.

To reduce the costs, we use roller hamming robots as grippers, too. The performance of robot with two devices is in a way that first the robot bends the sheets through the use of roller devices. Then, it places the roller device on proper bases. After that, it takes the gripper and after the movement of the piece (peripheral door or rear automobile door) onto the required fixtures, it puts the gripper on the intended bases. Next, it takes roller device from the bases and this process is repeated again. Figure 4 represents the devices and bases utilized in this working process [7].

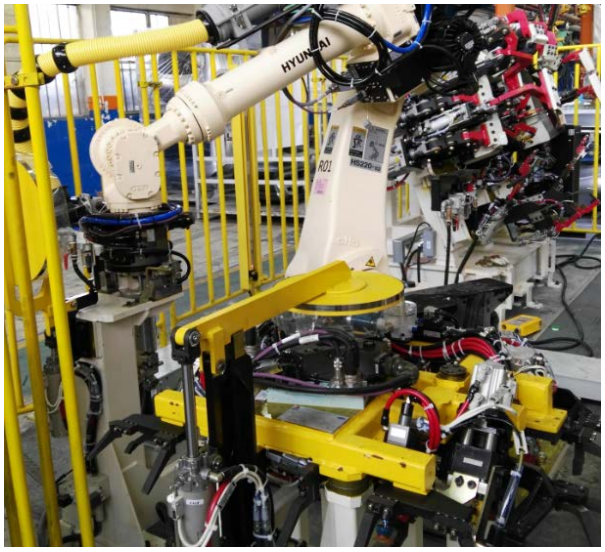

Fig.4. The devices and bases of robot

There are several sensors and electrical taps on the gripper, as shown in figure 5, to reduce the cables of the equipments to reduce the costs in fault tracing sections and the stops of production using DeviceNet. All elements installed on the gripper enter input and output modules through the cables and the data are transferred to the robot controller through a special DeviceNet cable in the modules.

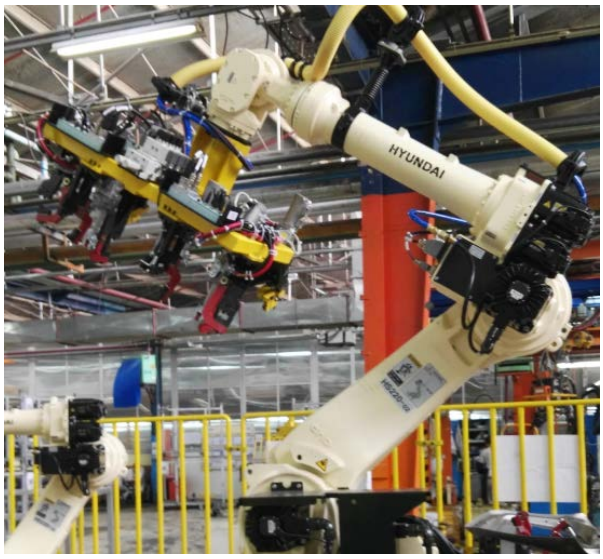

Fig.5. The gripper as robot device

Through the use of Embedded PLC and the omission of interlock panel in roller hamming robots in production lines, the robots are connected with other equipments and also the neighboring robots (if there is any) to be able to send and receive data. This connection is technically known as interlock and principally it is used to transfer data regarding the safety and location of the robots and equipments in connections such as shuttle, fixture, neighboring robot, etc. [8].

Interlock between the robots are utilized regarding the hardware (roller wheel cables), industrial network cables, and wireless systems. According to figure 6, robot controllers are divided into two sections. The upper part is known as the interlock panel and the lower part is known as robot controller panel. In robot controller section, programmable logic control (PLC) systems are used and robot data and the related equipments' data are transferred through the wheels.

4- Interlock Panel Section

This method leads to utilize Embedded PLC system to remove the faults mentioned regarding the increase of costs in control sections, increase of the volumes of equipments, higher amounts of time required for installation and launching, and the problems due to the creation of isolated hardware in the software [9].

Fig.6. Robot controllers along with interlock panel

Embedded PLC systems which are sometimes called hidden systems are hidden from the sight of others in a way that the users are not aware of their existence. Today there are embedded systems everywhere; at home, in the office, factory, etc. Most users of such systems don't know how their controlling systems are controlled. In such systems, a processor with complete facilities of a computer has been utilized. Users rarely sense such a thing because most computers recognize everything through screens, keyboards, or the mice [2], [9].

According to figure 7, new generation robots can utilize Embedded PLC systems in their interlock sections.

Fig.7. Embedded PLC to interlock robots with other devices

Embedded PLC boards contain 16 inputs and 16 transistor outputs and 16 relay outputs. They also have their own processors, process the data received from other devices, and supply the required orders using HRLadder software, and send them to the outputs.

According to figure 8, new generation controller panels of robots do not have distinct interlock sections and there is an Embedded PLC board mounted onto the upper part of robot's controller panel [9].

Fig.8. Embedded PLC section to interlock new generation robots

Embedded PLC is used in digital systems and has only been designed to to do one or some limited activities and considering the structure represented in figure 9, they can only carry out one and limited numbers of actions in themselves. Also the nucleus of such systems is comprised of a micro or DSP which is used as the system brain.

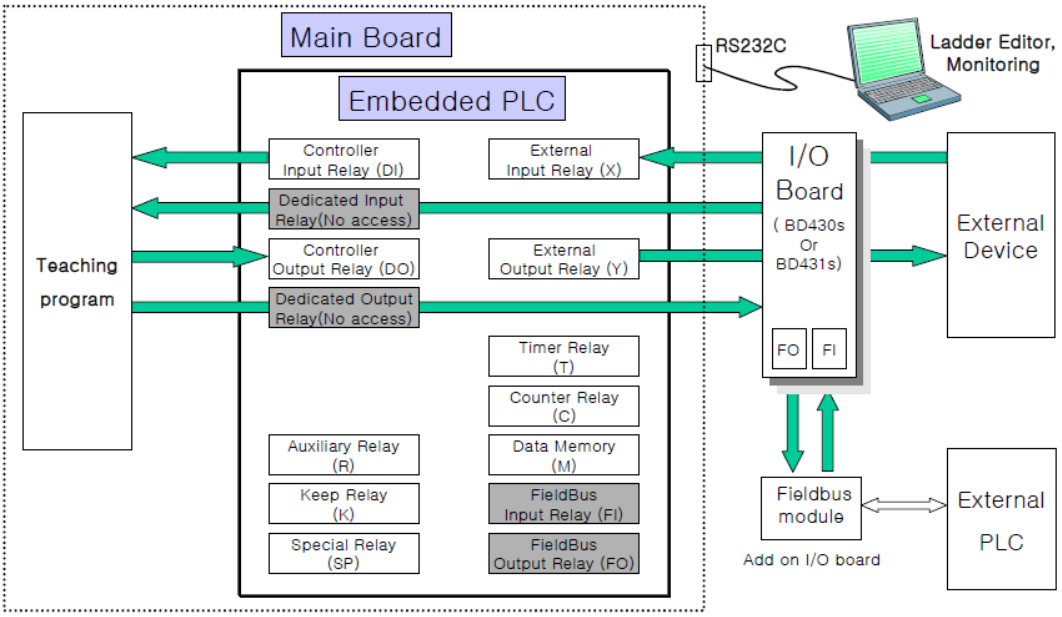

Fig.9. Interlock system diagram block of new generation robots

5- Data Reception Technique of Hamming Devices and Transfer to Robot Controller

Roller hamming robots, as shown in figure 10, have devices that could bend automobile sheets using a standard pressure [5].

Fig.10. Robot's roller hamming section

S Local Cell has been utilized to adjust standard pressure and to record it within the robot program. The standard amount has been represented through a screen as shown in figure 11 and it is connected to the device through a special cable and it is recoded on robot's program after being adjusted on automobile body. Then the cable is isolated and the robot works as start is on [7].

To adjust the required pressure it is necessary to represent 140 numerical states on the screen. It should be noted that when programming the robot, if the number is lower than the amount mentioned, the robot should be programmed in a way to get into Cartesian state in z- direction and should move with low speed to reach the predetermined amount and to reduce the pressure, the stages mentioned above should be repeated using z+ direction.

Fig.11. Load Cell section to adjust robot pressure

Conclusion

In the present study, some changes were made in manufacturing structures of peripheral doors and rear doors of Tiba 211 and Tiba 212 focusing on the reduction of costs and utilizing roller hamming robots instead of press systems to exploit robots with hamming and roller devices. Using Device Net networks and Embedded PLC controller systems, there is a possibility of cost reduction in other hardware sections, too. The use of Device Net industrial network can make it possible to create connection between devices and elements in a safer, easier, and more rapid mode. Embedded PLC controller systems also could omit robot controller panel sections and could create a better connection between the devices.

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