AUTOMATION OF SUPERMARKET IN SUPPLY OF ASSEMBLY LINES

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Abstract: *With the competitive environment that makes companies have increasingly an ongoing commitment to create procedures to improve their processes, the high volume of production, the maintenance of inventory becoming smaller, the reduced supply stimulated in times the concepts of factory clean and lean production, increasing the need to computerize the Assembly lines. Given this scenario, this article presents an approach to the use of neural networks with Matlab software tool, allowing an application in supermarket supply inputs to occur efficiently and synchronously in a real situation through projecting a virtual situation. Automate logistics management system of supply was an option controlled by AGV (Automated Guided Vehicle), integrated platform of PLC networks industrial floor. This approach was capable of integrating and measuring results generating economies visible in assembly line feed with inventory reduction, improved storage of materials, reduced response in mounting parts. Another goal achieved by the work was to stimulate research on Enterprise logistics system, whose domain is essential to competitiveness in the automotive sector.*

Keywords: supply of production, automation of transporter, neural networks, Matlab simulation.

1. INTRODUCTION

From the globalization world, the automotive industry is gearing up for the improvement of their processes on the factory floor. The high production volumes and reduce inventory, with the lead-time every time smaller and with improved quality, avoiding production delays, the attendance of inputs efficiently in assembly lines and diversity of products, among others, are important factors for the excellence of performance of industries in competitive market, no longer tolerate the breaches and losses of production, and the focus turned to the lean production system. Second Tompkins et al. (1996), significant changes are happening in the design of manufacturing system, motivated by continuous improvement in production processes. Costs, quality and flexibility have become decisive factors in the survival and success of business organizations. As Tompkins et al. (1996), new trends of the market require the enterprise response types discussed below, in its manufacturing system. In this process, the stockpile management is critical to reducing costs.

The project is so audacious and innovative because it introduces a number of new concepts in manufacturing process already dominated and successful. The new trend of course already has been tested and is part of a process of change within the company. The challenge is to join a series of projects that unify small to a large process of changes in the supply of parts of a supermarket to the line assembling engines.

The company is the automotive industry study and, in the area of subassembly, has several assemblies that must be prepared before you even brought to line. The site has also been the target of several Kaizens, that generated actions that improved the physical arrangement, creating modular line concepts, which significantly improved the original design.

The concept of modular responsible pre-assembly line aims to provide an assembly line shorter and more synergy between competences for modules, reduction in the use and number of tools to mount the main line, among other benefits. In this context, in the Assembly, the operator performs the transport of pieces using forklifts, minitratores, handcarts and hydraulic. This supply system was accomplished through programmed parts collection, and any cost delivery would be made, in order not to compromise the final assembly.

This concept of mounting the main critical points were identified, because the transport of such items should always be in sync with the type of product that was being assembled, to avoid excessive inventories between them. One problem identified was the mounting of the volume to satisfy the diversity of existing engines.

This article identifies a potential savings to adapt this line of pre-Assembly parts, with the inclusion of carrier kits mounts until it reaches its final destination, which is the main assembly line.

Therefore, the study had to verify the sensitivity of the algorithms in quality moving robots and analyzing dynamic behavior of subsets in subassembly engines, in order to identify the maximum capacity of production and timing of this line with the main line, always with the goal of minimizing stocks finished engines or awaiting release.

2. CHANGES AND CONCEPTS OF ASSEMBLY LINE

It is proposed to maintain the Assembly as a new concept. The engine is mounted atop a device shaped carousel, being accompanied by a pair of assemblers since the beginning until the end of the line, moving along with it which has constant speed. Mounting kits are used poka-yoke, which are supplied through inputs on time and in the necessary amount. With this, the duo assemblers is responsible for the engine from the beginning until its release for testing.

The kits and finished pieces are in the proximity position of the line, facilitating and promoting the use of the tool to control just-in-time. Some products are mounted in parallel on a workstation called pre-Assembly of sets, because they must be well next line avoiding inadequate logistics, however not all inputs could be organized in this concept, necessitating a fitness area and a way to transport the closest possible mounting.

For this synergy, the supply was organized in mounting kits are packed into trays with docking, preformed etc. The kits are transported to the line, which fit with all the pieces, so that the assembler, equipped with a tool, will be able to do their work. There are also electronic powered screwdrivers that lower physical effort in finalizing the Assembly station with torques controlled by computers. The delivery of these pieces and mounting kits is done manually and trolleys, which, life-long mounting, feed supply, causing a movement of excess carriers in the vicinity of the line.

The so-called supermarket works like an centrally near the line where is made the pre-Assembly of sets, counting with the storage of small pieces packed in boxes, baskets and shelves, inclined at an angle, to facilitate access of operators who will prepare supply kits for line.

This line, where they are produced diesel engines, brings an innovation: the use of a cart of 360 degrees, which serves as a device to meet the supply from the beginning to the end of the line, an idea already utilized in companies with the same activity representing an evolution of the system that had already been used in European countries, being an adaptation of an idea developed by Toyota of Japan. On the Assembly line, there are ten mount points with capacity for two shifts, producing on average 50 units/day, with a goal to produce 60 to 80 units/day.

With this Automation, aims to reach 80 units/day, with the lowest index in the reduction of quality testing in each unit produced. The project aims to deploy an industrial automation system in the supply of assembly line aimed at continuous improvement of processes, avoiding mistakes, pre-Assembly and mounting, in organizing kits, enabling processes and costs for the plant. In-process automation set up a management system with move equipment, hardware and accessories specifically deploying AGV's (*automated guide vehicle*), a system-integrated automation and networks deployed to the production floor.

3 . COMPUTERIZED PRODUCTION

The process of internal logistics supply assembly line was modified due to the continuous flow of production to keep inventories low, the factory introduced the moving parts during the Assembly process with the AGA's (*automated guided vehicles*), automatically guided vehicles with ability to move up to 10 ton. This carrier, also known the harvester, is distributed along the route of the area, always on the same trajectory, being guided by magnetic induction cables embedded in the floor, moving in a fixed route and fueling the 10 jobs (Figure 1). Figure 1 and 3 shows a proposed layout of the problem as an example of the project outlining the problem and used as a template to apply in the software simulation data and compare the number of input-output study, which used as physically isolated interpretation

Thus, the major sets produced in the pre-assembly line are routed to their destination or, where offices, along with the kits from the packaging of the supermarket.

The success of this transporter installed on floors with a kind of carpet belt has its problems, not exerting any autonomous role, despite having sensors that can help you stop and resume its movement to find an obstacle in front of you. It is stocked with short battery life and low speed. The reasons that led to research this project boil down to do these carriers assume a position of control and roam alone, without the electronic rug installed on floors, the probability of wear with time.

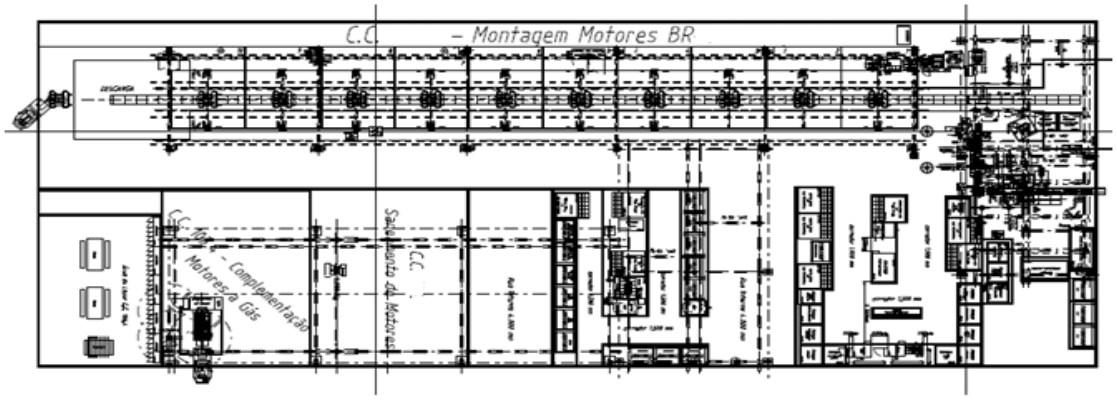

Figure 1 – Map of the actual situation.

4 . MOTIVATION FOR USING NEURAL NETWORKS

Utilization and motivation for a computational model of neural network aims to extract knowledge from actually executing the processing networks in parallel, which is not the case when using a conventional computer for robot movement between spaces through a location map.

Neural computing model complements with conventional computation by means of a model based on human brain, which is able to handle tasks that require parallelism. The model is formed with a simple processing structure, called neurons, which are interconnected. According to Haykin (2001), an artificial neural network (RNA) resembles the human brain in two aspects:

• Learning: process used by RNA to obtain knowledge from their environment;

• weights synaptic contacts: connection forces between neurons used to store the knowledge acquired.

Neural computing differs from conventional computing by method used to determine the best outcome generated by the system used. In the case study, the computers are programmed with software Matlab 7.6, with instructions, which together form a program which will perform a task that generates results. The RNA, rather than be scheduled is trained during the process of learning to recognize patterns and abstract knowledge and, from it, generate results.

There is need to develop a machine with neurons interconnected neural computing for programming. On the contrary, a neuron can be represented by a mathematical rendering template that can be implemented in a conventional computer, being able to implement several neurons interconnected to form an RNA (Figure 2).

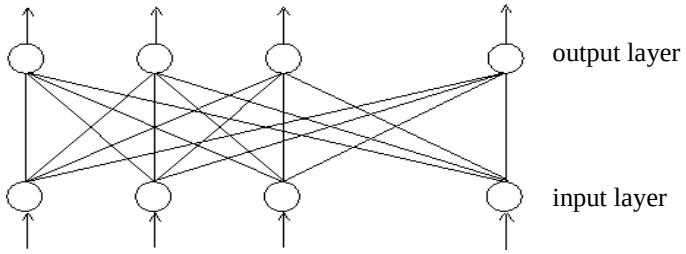

Figure 2 – network of perceptrons proposal by Frank Rosenblatt (1958).

There are numerous architectures of multilayer neural network architecture was used in this project, particularly described in great detail the scheduling algorithm used in thisstudy of multilayer neural networks. For this was used as a beacon of decisions neural network system to integrate the model of moving parts kits to supply the assembly line.

The artificial neuron is a simplified mathematical model. Is the fundamental unit of processing information of an RNA. Figure 2 shows a model of a neuron. He has entries that perform the weighted sum of the inputs and one output. Each input signal has an associated weight, which is used in the weighted sum. In the same way as a biological neuron emits a signal by the axon by a stimulus.

According to Gomes and elder (1994), the goal of computer vision is "to obtain, from a picture, topological or geometric information, about the physical landscape that gave rise to this image." Second Fairhurst (1988), computer vision can be divided into two interrelated areas: image processing and pattern recognition.

In this context, many methods for recognition of location, location and navigation of mobile robots have been developed, which uses computational vision to increase the autonomy with which the robots perform their tasks (RAO et al. 2002; ANDREASSON, 2004; MARTINEZ, 2005; CHEN and the DELAWARE RIVER, 2006).

5 . THEORETICAL FOUNDATIONS FOR LOCATION MAPS

For the successful implementation in a local supermarket, mobile carriers must have the ability to self localization precisely, using a map of the area to be deployed. The location via maps is a technique in which a carrier uses its sensors to perceive the environment and use this information to build the site map, which is compared with the global environment already stored in its memory. If the comparison result is positive, then a match for the test will have been achieved and the carrier parts can thus calculate its position within the environment (Figure 3).

The map of the area of movement of the conveyor is used in this process of comparison between two models, one created in the virtual environment in Matlab and another being built by the carrier in a navigation through a local recognition may be called operation environment to be assessed (Figure 4). There are problems in the use of models in Matlab, since in general they are complex and the time taken to access them makes their use in real time applications, reportedly also research and laboratory tests**,** Leal (2008).

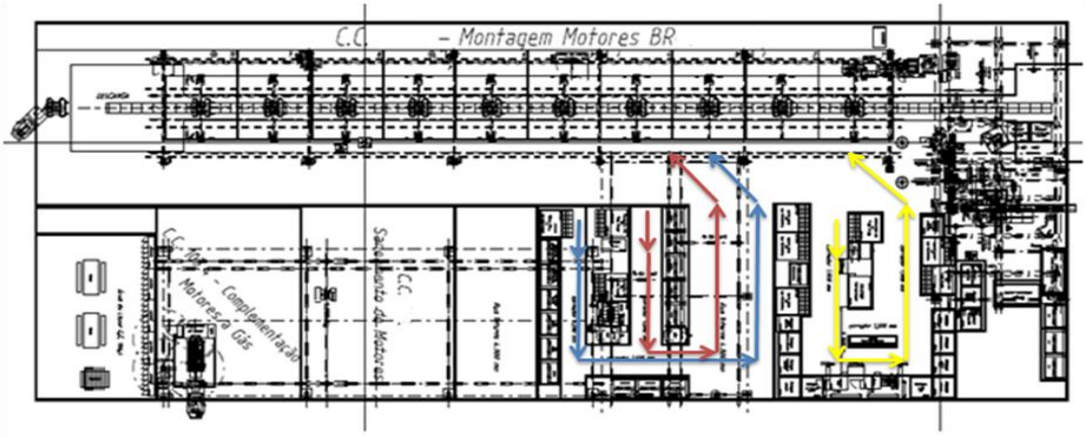

Figure 3 – path to recognition of the transporter.

Figure 4 – stream to recognition of the transporter.

For example, if a carrier robot "feel" a wall 5 meters away and move 1 meter, it can be concluded that the wall is now 4 feet away. The consequence of this action is that the relationship between the information acquired in different places can be used to evaluate consequences and lead to the conclusion that it was intended from the beginning.

To relative position, when using a type of sensor, deployed and allows to detect situations similar to those where the sensor is deployed. This way, justified the use of networks trained with different algorithms with parameters, or amount of neurons, in order to achieve the best performance in tests**.**

6 . MATLAB SIMULATION SOFTWARE AND IMPLEMENTATION.

The use of algorithms in Matlab-test decision to obtain positive results with the goal of completing the intention of working on local autonomy and conduct tests with simulation algorithms. The tests are not used for robotic real carriers. It was decided to do so because of various errors during testing. It is known that the algorithms need to interact with the real environment, performing experiments in various ways and repeatedly in real action, in order to obtain and observe a satisfactory conclusion of algorithms.

Localization systems, robotic parts conveyors are based on neural networks in operation tests, experiments were detracted the main objective of the survey, which was to verify the sensitivity of the algorithms as moving robots.

With the map of probability, the decision was taken by to programming robots to act in the way traced by maps (Figure 5).

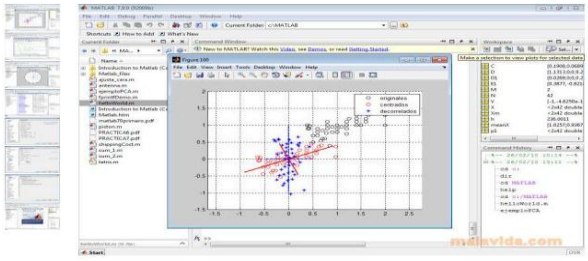

Figure 5-Matlab tool model.

The results of the algorithm were the inputs to the neural network. In the classification stage we used a probabilistic neural network, using the Matlab software. Results of pre-processed, two samples were used to train the network, and the other for the placement tests. The network correctly classified all the possibilities, if necessary, increase the number of training samples in the vector. The results of the study showed that neural networks can be used as efficient tools in the task of recognizing geometric shapes.

7. SIMULATOR

The Simulator Matlab was chosen for the test of movement in a simulation, in order to understand an application of mobile robots in a production environment, having been originally developed to allow tracking and software development for mobile robot. The factors that led to the choice of this Simulator were:

1) demonstrate to the team of planners, the results achieved;

2) change the parameters of programming to be simulated, allowing the simulation of robots with different physical characteristics.

The experiments were therefore made in Matlab Simulator, using the parameters of robot and location maps application environment. The task to be learned by the robot was approaching a target and to Dodge obstacles and walls.

To test and validate the proposed algorithm was developed a location map to simulate tests of trajectory. This map was implemented in Matlab, which is a development environment integrated Simulink, neural networks. The main advantages are:

1) platform independence;

2) dynamic loading of code over the network;

3) ease of use of the network.

Matlab portrays an environment to be exploited through a square grid of cells. Each cell represents a possible position within the space of configuration. The map was scaled to interact with the robot at the end of the search of a better way, sending the commands needed to run the route located by networks. Among several functions, Matlab has tools that let you draw obstacles of various forms, so it is a very flexible tool, allowing you to configure the search space to suit the needs of the simulation.

8 . COMPLETION

The purpose of the proposed implementation of a system simulator in Matlab computer simulation has been reached, because the neural network used correctly classified objects contained in the maps. The study showed the feasibility of using artificial neural networks in the task of classifying objects. The importance of this work is because you have filed a mapping system that can be implemented and used in real applications.

The purpose of this article was discussing the concept of supply of assembly line through a supermarket inputs to optimize assembly line of engines, in the case of the automobile industry, proposing even a discussion about the use of a computer program for the deployment of an efficient process automation.

To achieve this goal, we see continuous improvement in processes of production floor should be questioned and intended as a warning to the world economy, even when out of a period of financial crisis, because it can have an impact on the dynamics of a company's competitiveness in the market.

The importance of this approach in this academic research is that the area of automation is extremely important to the supply and logistics companies, and need to make studies of projects with computerized supervision in their processes.

Important observations were made possible with this work to prevent the factory turn a patchwork in its processes, because the market offers various patterns of automation with characteristics, realizing that there is, in this factory, different solutions to the same application, which implies differentiated maintenance tools and spare parts. In this context, the choice to automate supermarket in supply appeared for several reasons, in addition to the cost-benefit ratio:

1) bring a solution outside of small volumes;

2) automation package used smart i/o that act as mini PLCs (logical computer programmer).

In the case of assembly line, were spent on investments of $ 5 to 7 million, and rebuilds indexes work redone were very low, lower than the conventional line, occurring between 40% and 50% fewer errors in the indexes of quality. Analysis of variants between a conventional line and automated supply line, which today operates with 3 and 4 variants, it is still necessary to extend the experience with 20 variants, for example, and see if the automatic control of supply is 100% efficient.

9. SEARCH TARGETING FOR FUTURE ARTICLES

This research showed potential supply chain investigations connected to this project, highlighting the importance of reviewing all inputs are allocated in the supply of assembly line supermarket, computerized, to improve the global supply of all parts and prevent thus the possible treatment of screenings that are no longer used with the type of product or adapt engineering rapid change that affect the supply and storage of materials.

Evaluate the integration of automation of supply pieces to use an efficient system to implement the logic-fuzzy artificial neural networks in times of supply of assembly line. The work can be developed with the simulation and the use of Matlab in the laboratory, with subsequent application in real environment.

Search the integration of enterprise logistics system, the storage form of inputs, such as a vertical warehouse for optimizing physical spaces, and automation parts to eliminate transport and circulation near the Assembly area. The proposal would put a complete intelligent system causing a global project to solve the problems and justify the feasibility of reducing labor and minimum physical space required.

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