

# MSE12: THE LOADING AND UNLOADING ROBOTS IN CAR WHEEL INDUSTRY

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## ABSTRACT

Robots are increasingly used by the industries especially, in the loading and unloading operations. This research concentrates on the loading and unloading operations of car wheels using an industrial robot arm. The concept operation of the industrial robot arm is discussed thoroughly. This research showed the advantages and disadvantages of using robot arm to handle loading and unloading operation for car wheels. In manufacturing operations, the geometry and the weight of a car wheels makes it difficult to be handle using manual labor. This research uplifts the potential advantages of using robot arm in dealing with these problems. This in-turn can increase the productivity of the car wheels manufacturing industries.

## Keywords

Robots, Loading and Unloading, Car Wheels, Manufacturing Operations, Manual Labor

## 1.0 INTRODUCTION

Wheel is a mechanical device. It provides rotary motion by means of a disk or circular frame revolving on an axis. It can be used in heavy load and traction services. However, car wheel is used to propel the car. A good rim actually makes the wheel grip better and make it much easier to balance the wheel. Eventually, it improves traction and cornering performance. Therefore, the production line of car wheels must be careful and caution, so that the high quality wheels can be produced. Thus, it is very importance to involve the loading and unloading robots in the wheels industry.

This study is to examine about loading and unloading robotic in car wheel industry. The main purpose of loading and unloading robot is to transfer parts into or out of a production machine. The loading and unloading robot is being program to carry out a process of the moving production line of car wheel manufacturing which are forging,

machining, and general processing of steel car wheel (Figure 1).

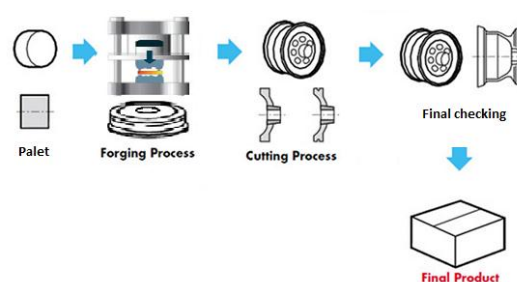


Figure 1: The process of produce car wheels

Using a manual worker system in the production line, the industrial company may face many problems, such as risk of injury of labor, impossible to be done manually and to develop the quality standard of the products, (Mikell, P. G., Mitchell, W., Roger, N. N., & Nicholas, G. O, 1986). A robot arm with a gripper on the end can reproduce many of the same movements as a human arm and hand. Therefore, manual labor system is replaced by robotic system.

The main objectives in this study:

- i. To overcome the task that difficult to be done by manual workers
- ii. To help the wheel industry in saving times in production cycle
- iii. To reduce the mistakes or errors as human do during the production line

## 2.0 LITERATURE REVIEW

Journal 1: An Autonomous Restaurant Service Robot with High Positioning Accuracy

This journal is discussed about the usage of robot in a restaurant that applicable for service, cooking, fetching and sending food. Loading and unloading robotics systems have been applied by the owner of restaurant especially through fetching and sending food for customer. Stereo images and biologically inspired algorithm are used with high

accuracy to pose, size and shape to grasp the object. The body of robots consist of clamp and have a claw that act as a finger. In order to ensure the plate is completely grasped by the claw, serrated groove is place in line form in the claw and plate.

According to (Borenstein et al. 1996) the outcome problem in positioning and navigation of object by robot is to keeping track of robot pose and the way for estimate global pose. Therefore, segmented positioning method was applied to provide different accurate coordinates at different stages. At a same time, the vision-based tracking method was used to give a command to robot for move toward object and perform load and unload activities.

#### Journal 2: A flexible Joint Micro Assembly Robot with Metamorphic Gripper

This journal discuss about the design of robot with a high accuracy and high operative flexibility. In manufacturing industry, the robots have been design to full fill the requirement during operation. The design of robotic hand is manufacture for grasping all basic shapes such as rectangular and triangular prisms, spheres and cylinder.

According to Hirose and Umetani (1997) in Japan, they developed “soft gripper” which is able to conform to the outer contour of objects of irregular shape and hold with uniform pressure.

MIT hand is a type of claw robot and has been designed and (Allen et al., 1990) built a system for programming and controlling. The hand is capable to locating and picking up moving objects. (Wright (1985) initial development of hand designed for manufacturing work. The robotic system especially in locating and load and unload work part is done by eyesight to estimate positioning hand and grasp the work part. Other than that, beak movement, bite movement and parallel movement is a different clamping movement when jaws move towards work part for grasping.

At a same time, it discussed about force and position control. Two methods is identified as a impendence control and hybrid control which mechanical impendence of gripper is adjusting to external forces, whereas hybrid control is using two feedback space by incorporating the kinematics control and dynamics limitation of robotic manipulator.

#### Journal 3: A neural network approach for a robot task sequencing problem

After reading this journal we learn that developing alternative neural network approaches and an understanding of the dynamics of networks is very essential to improve the robot task-sequencing problem.

This journal presents a neural network which can minimize a weighted objective of the total robot travel time for a set of tasks and the tardiness of the tasks being sequenced. According to this journal the robot task-sequencing problems under consideration are robot task sequencing in a Flexible Manufacturing System (FMS), the amount of time a task has been waiting for to be completed by the robot, the material flow in an automated printed circuit board assembling environment, the manufacturing environment that include material handling devices (e.g. AGV), and multi-robot assembly cell that has to perform some given tasks.

In this journal, the solution for these problems has been attempted using Hopfield Neural Networks. Hopfield’s model has been proven successful in rapidly generating good solutions to NP-complete problems, and is readily amenable to parallel and distributed computation. Parallelism results in a large reduction in the computation time, a property required in a real-time decision making environment. This neural network approach is successful in coping with both these impediments. It offers a worthy method for large scale FMS, successfully implemented for asymmetric networks, and large reduction in computation time, a property required in a real-time decision making environment.

### 3.0 METHODOLOGY

The type of robot being use in this study is polar coordinate robot and it has a work volume that is a partial sphere which illustrate in Figure 2. The robot arm with a gripper on the end can reproduce many of the same movements as a human arm and hand. Moreover, it can work with much variety task compare to human, such as it can pick up the heavy objects, contact with high temperature object, and so on. In wheel industry, the robot that involved must have the ability to pick up the object with maximum 20kg because the weight of car wheel is between 5-12kg. Therefore, the robot has overcome the problem which heavy and high temperature object that difficult to be transfer by manual workers.

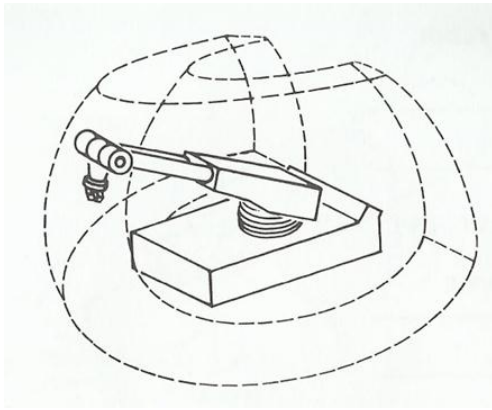


Figure 2: Polar coordinate robot and it has a work volume.

The robots enable to move its body, arm and wrist through a series of motions and positions. Attached to the wrist is the end effectors which is double gripper that has been chosen to use by the first loading and unloading robot to grasp and hold parts (Figure 3). A double gripper has been chosen in first robot because it has gripping devices attached to the wrist and is used to handle two separate objects. Double grippers can help the wheel manufacturing industry in saving times because it is used to grasp a heated pallet to unload from heating furnace and load another work part into the heating furnace (Refer to figure 4). But the robot with only a gripper would have to unload the finished part before picking up the raw part. Using single gripper would consume valuable time in the production because the robot will have to run two cycles during these handling motions. Besides, the speed of robot is faster as compared to human. Therefore, robot arm will help the wheel industry in saving times in production cycle.



Figure 3: End effector with double grippers

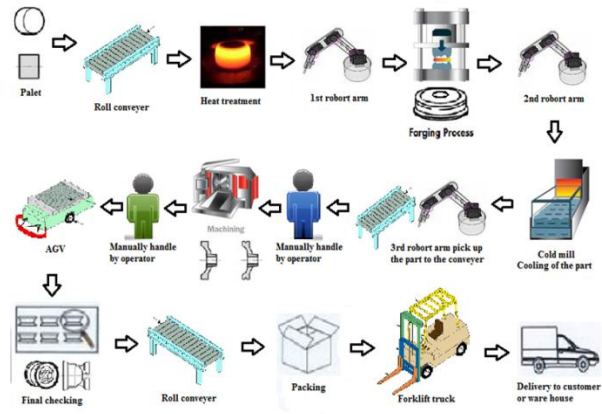


Figure 4: The process flow of wheel production

The playback robot with point-to-point control is selected because control of the sequence of positions is quite adequate for the loading and unloading system robot. It can make a record on the work cycle as a sequence of points and then playback the sequence during program execution with proper sequence. That means the desired paths are taught and been stored in the control unit memory. Therefore, it can reduce the mistakes or errors as human do in wrong sequences during the production line.

## 4.0 FINDINGS

### 4.1 Advantages of loading and unloading system in robotic.

Today the use of application of industrial robotic is in the wide range among the manufacturing industries. It is because most of the company have realized that the use of loading and unloading system in production process give a lot of advantage. Robots do not look like human and they do not behave like humans. It operates from a fixed location on the factory floor that carries out loading and unloading activities.

There are several advantages that can be taken into account. First, to finance for this kind of robotics system, it required low monthly payments compare with manual labor. In other word, the manufacturing company able to save the cost of production. The installation of program into the robot is not complicated and easy to be installed and operated by the operator. Through use of loading and unloading system in robotic, it able to reduce the risk of injury among manual labor. It is because by using a robotic to carry out loading and unloading activities, the usages of manual labor have been reduced. At same time, the company is able to reduce the expenses for salary payment towards manual labor.

By using the robotic system, it able to be used for load and unload a heavy part continuously. It also provides a higher efficiency, lower operating cost and increase equipment availability compare to manual system. Other than that, robot of loading and unloading system can have a very fast loading and unloading cycle time. It needs five seconds or slightly more for the robot to move into the machine that holds the work part. In order to transfer the work part from current station, it requires loading the work part and bringing into next station and unloading the work part for the next process.

It is able to reduce a defect on work part because the process of loading and unloading by the robot is accurate and consistent part loading. It also has a high flexibility to meet future production demand. The production can be medium or high production base on demand without include any additional cost on robotic system.

As a conclusion, the loading and unloading robotic system able to develop an improvement toward production process among manufacturing industries.

#### **4.2 Disadvantages of loading and unloading system in robotic.**

The loading and unloading system is commonly used by manufacturing industry because it has been approved that there is a lot of advantage. However, disadvantages come along with the advantages. Some people have protested the increasing use robotic for loading and unloading able to deprive people of job. Thus, it will increase the rate of unemployment. Only one operator will be needed to coordinate the system of robot for certain period in order to make the process of loading and unloading in a good condition.

Next, the loading and unloading robot needs a supply of power to operate. That might be face by user is the process of loading and unloading system must be stop in case of electricity break down and it will affect the transfer of work part from one station to the next station. The total setup time on the robotic system is able to initiate a cost to manufacturer because of production delay. However, using an industrial robot in manufacturing requires a company to have someone who is familiar with robots available. Without a good operator that familiar with the robotic system, the problem that might be occur during the process of loading and unloading unable to be solve efficiently and effectively.

Finally, the robots are only as good as its programming and they have limited duties. They only can do what they have been ordered to do by

programmer. If a programmer fails to foresee a program, a robot cannot identify it or act to fix it. So, the manufacturer must always do an improvement in system processing and capability of operator to conduct the loading and unloading system in robotic.

## **5.0 DISCUSSION & CONCLUSION**

Loading and unloading robots have developed a high improvement level to car wheel industries because it contributes advantages during manufacturing process of the product mainly in batch production. The expected result is the cycle time for a production process for each part able to be reducing because of the less time consuming for loading and unloading parts. Next, heavy and heated work part is being the transfer safely and easily from one station to another station. Lastly, the robots with point-to-point control system can make record on the work cycle as a sequence of points and the desired path has been stored in control unit memory. It allows robots to play back the proper sequence during program execution. Thus, it can reduce the error or mistake as human do because it can play back the process with proper and exactly similar sequence.

However, the disadvantages of loading and unloading robot in car wheel industry still obviously can be seen by the manufacturer, but its advantages are more than disadvantages. The loading and unloading robots still consider as very helpful in car wheel industry.

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