

AUTOMATED GUIDED VEHICLE

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in Auto mobile Engineering

BY

ANTOGIXSON.D (3880002)

HARI HARAN.B (38860005)

DEPARTMENT OF AUTOMOBILE ENGINEERING



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

JEPPIAAR NAGAR, RAJIV GANDHI SALAI,

CHENNAI – 600119, TAMILNADU

MAY 2022



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Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600119
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DEPARTMENT OF AUTOMOBILE ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of ANTO GIXSON D (38860002). HARI HARAN B (38860005). Who carried out the **project entitled AUTOMATED GUIDED VEHICLE** under my/our supervision from Dec 2021 to May 2022

Internal Guide

Dr.A.KARTHIKEYEN M.E.,Ph.D.,

Head of the Department

Dr. V.K. BUPESH RAJA. M.E., Ph.D.,

Submitted for Viva voce Examination held on_____

Internal Examiner

External Examiner

DECLARATION

I **ANTO GIXSON D (38860002)**, **HARI HARAN B (38860005)** hereby Declare that the Project Report *entitled* **“AUTOMATED GUIDED VEHICLE”** done by me under the guidance of **Dr.A.KARTHIKEYEN M.E.,Ph.D.** at Satyabhama Institute of Science and Technology is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Automobile Engineering.

DATE : 30.04.2022

PLACE : CHENNAI

1. **ANTO GIXSON D** _____



2. **HARI HARAN B** _____



SIGNATURE OF THE CANDIDATE

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ABSTRACT

Currently, companies have increasingly needed to improve and develop their processes to flexible the production in order to reduce man power and increase productivity through smaller time intervals. To achieve these objectives, efficient and automated transport and handling material systems are required. Therefore, the AGV systems (Automated Guided Vehicle) are often used to optimize the flow of materials within the production systems. In this paper, the authors evaluate the usage of an AGV system in an industrial environment and analyse the advantages and disadvantages of the project. Furthermore, based on data collected from real production system, in order to analyse and optimize the use of AGVs. Throughout this paper, problems are identified as well as and the results obtained.

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CHAPTER 1

INTRODUCTION

Introducing worker robots into warehouses has the potential to increase the standards currently held by the industry. The autonomous machines have the capability of dynamically storing pallets, lowering labor and insurance rates, and reducing the risk of personal injury. To approach these goals, the Automated Guided Vehicle, AGV was designed.

This chapter talks more about the AGV and its uses over manual mode of transportation of equipment from one work station to another.

1.1 AGV Automated Guided Vehicle

A self-driving car can analyse surrounding without any human interactions and take decisions accordingly without any human interactions. A number of sensors are combined and are used to identify the pathway and road signal from the surroundings. An autonomous car is having reduced costs due to less wastage of fuel, increased safety, increased mobility, increased customer satisfaction and that's why it has more advantage than traditional cars. The biggest benefit of using a self-driving car is significantly fewer traffic accidents. More than 90% of all accidents are caused by some degree of human error, including distraction, impaired driving, or poor decision making. With self-driving cars making decisions and communicating with one another, the number of accidents should reduce.

The AGV has the function to ensure efficient flow of materials within the production system. Production systems must be flexible and must allow the dynamic reconfiguration of the system. The AGV is a key component to achieve the objectives of an FMS (JOSHI and SMITH, 1994). This means that the AGV should provide the required materials to the appropriate workstation, at the right time and in the right amount, otherwise the production system will not perform well, making it less efficient, generating less profit or increasing the operating costs. In an FMS system, the AGV has the following advantages:

- Driverless operation;
- More efficient control of the production; Diminishing of the damages caused by manual

material handling; There are several topologies of AGVs when considering the positioning system. It can be quoted the inductive system, the magnetic system and the laser guided system, among others. However, those systems have high cost and are difficult to maintain according to changes of the environment, and it can drive only the designated path by sensors which are placed or embedded in. To overcome those weaknesses. The factory of the case study of this work uses the laser guided vehicle (LGV) (FERRARA; GEBENNINI; GRASSI, 2014). The LGV systems have the advantage of the absence of physical components related to the route. It is guided by microcontroller that senses obstacle by IR sensors.

From the 90s, opening the domestic market to imported products and the movement of privatization promoted by the government, spurred investments in industrial automation in Brazil to compete in international industries. Currently, the need to make the industrial processes more lean and competitive is increasingly required due to globalization. For this reason, the flexibility of manufacturing through integration with automated systems and devices should be part of the strategy of industries who wish to excel in the marketplace. The Flexible Manufacturing Systems (FMS) are fundamental to face competition from competing on a global level, the constant technological advances and ever-changing consumer demand. Flexible manufacturing systems are highly computerized and automated production systems. For these reasons, mathematical programming approaches are very difficult to solve for very complex system so the simulation of FMS is widely used to analyse its performance measures. The advantages of the simulation in manufacturing systems are also stressed in. That article gathered information from 1997 to 2006 in order to map the coverage as well as the trends in the area of the simulation of the manufacturing systems. Another concept extend this definition to production computer controlled system consisting of several individual machines and workstations, material handling system, system settings and control system, which can process multiple items simultaneously in continuous operation mode for new equipment. Among these various elements and devices that make up a flexible manufacturing system, mobile robots for handling materials are a key part of the integration of stations and stages of a production process. The AGV (Automated Guided Vehicle) consists in a mobile robots used for transportation and automatic material handling, for example for finished goods, raw materials and products in process, point out that the AGV is a driverless vehicle that performs the tasks of handling of flexible materials and is therefore

considered suitable for an FMS environment. Furthermore, they define a system of autonomous vehicles (AGVS) consists of a number of AGVs operating in a facility, usually controlled by a server. The design and operation of AGV systems are highly complex due to high levels of randomness and large number of variables involved. This complexity makes simulation an extremely useful technique in modelling these systems for these reasons several works explore the FMS simulation using AGVs. From this context, this paper will focus on the use of AGVs technology in an industry of consumer goods and the development of a model of virtual simulation to explore potential improvements to the system. The objective of this work is to analyse the use of AGVs integrated into the manufacturing process in an industry of consumer goods. Furthermore, the paper proposes to develop a computer simulation model and validate it through the actual data of the case study, in order to have an additional decision tool to assess possible changes in the process. In the literature some works deal with the problem of optimizing the use of AGVs in FMS. In a simulation of a FMS production system using AGVs is presented. The authors, however, do not possessed real data for the simulation and hypothetic data were used. The authors stressed the benefits of using the software simulation tools for achieving a more efficient system. They considered the AGV not necessarily as a driverless system, demand quantity is measured by the unit of weight or volume, buffer storage does not exist in the system. They have mentioned the application of its model to the operation of delivery express. Concerning about the AGV control problem, (NISHI; ANDO; KONISHI, 2006) presented a rescheduling procedure can reduce the total computation time by 39% compared with the conventional method without lowering the performance level. A simulation model of a hypothetical system using AGV which has a job shop environment and which is based on JIT philosophy was developed in (KESEN; BAYKOÇ, 2007). In addition, a dispatching algorithm for vehicles moving through stations was presented in order to improve transportation efficiency. Several aspects of AGV systems are discussed at (VIS, 2006). Among them is the design of the system. It is clear that the design as well as the control system of the AGV is a difficult task. One important point when designing the system is the definition of the number of vehicles. In that subject the simulation helps the designers to take the best decision. The work presented by (NEGAHBAN; SMITH, 2014) provides a good review in the simulation of manufacturing systems. An important highlight is dedicated to the material handling systems where the AGV appears as an important element. The authors

mentioned that the use of the AGVs increases the productivity in manufacturing systems. However, the design and operation of AGV systems are highly complex due to high levels of randomness and large number of variable involved. For these reasons, the advantages of the computational simulation of the AGV are presented again. An AGV control system evaluation is proposed in (BERMAN; SCHECHTMAN; EDAN, 2009). Again, the benefits of the simulation of manufacturing systems with AGV are presented. The authors used laboratory hardware to validate the simulation of the control system. This paper contributes with the subject of simulating AGV systems when applies real data from a leader of market industry to do both the investigation of the actual scenario and a simulation of a new proposed scenario. First results of this work were presented in high level conference and this paper represents an extended and revised version after the conference discussions.

CHAPTER- 2

LITERATURE REVIEW

From the study of AGV from various literature modelling ,programming ,circuits assembly etc. is been studied. The program used for AGV is been developed through MP Lab platform where the working of AGV is programmed to a micro controller via PIC K150 programmer. In KENJI SAWDA's report from the year 2013 he has provided the source code for working of AGV .WEN-QIANG ZOU's report the procedure for assembling the circuit using rechargeable battery is provided and the selection of microcontroller .Material selection is done as per the reliability and cost efficiency mild steel has been selected and via arc welding the body is annexed to a angular frame for more strength .The circuit board , battery , motors are all annexed to the frame. All the modelling was learnt from W.L.Maxwell.

The algorithm for the programme used and different methods are provided from the WEN-QIANG ZOU report and Pius J. Egbele's report .The programs used can be set up in different ways through platform were it is written.

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CHAPTER-3

AIM AND OBJECTIVE

3.1 AIM

We have pleasure in introducing our project “AUTOMATED GUIDED VEHICLE”, which is equipped by micro controller, motor driving mechanism and battery.

In our project we are eliminating the need of man power in travelling and moving heavy objects in industries. For this purpose, we are designing Automated Guided Vehicle controlled by microprocessor controller. In this busy 21st century people need all their work to be automated and manpower free. To avoid this type of problems and reduce manpower requirement we need other type of automation is called automatic guided Vehicle. The microcontroller is used to control the vehicle path automatically as assigned. The rechargeable battery is supplying power to the automated guided vehicle. The vehicle is capable of carrying weights according to its size.

3.2 WORKING OF AGV

The straight line motion drive is provided by the DC motor fixed at the rear wheel shaft of AGV. The supply of the current is given by the battery provided on the frame.

The stored energy from the battery is supplied to D.C motor. The straight line movement of the AGV is done by the d.c motor (12 V/ 2A). The motor is fixed at the rear wheel shaft of the AGV. The supply to the motor is given by battery (12 V/7 Ah). This battery also gives the supply of current to the microcontroller.

The already energy stored in battery is sent to d.c motor control circuit. The d.c motor works according to the program written on the microcontroller chip. (i.e.) AGV moves to a distance of specified value and at that instant power supply to d.c motor is cut off and again a power supply is given to the d.c motor so that the AGV moves in a curved path. So the specified path which is needed for us is obtained by the above procedure

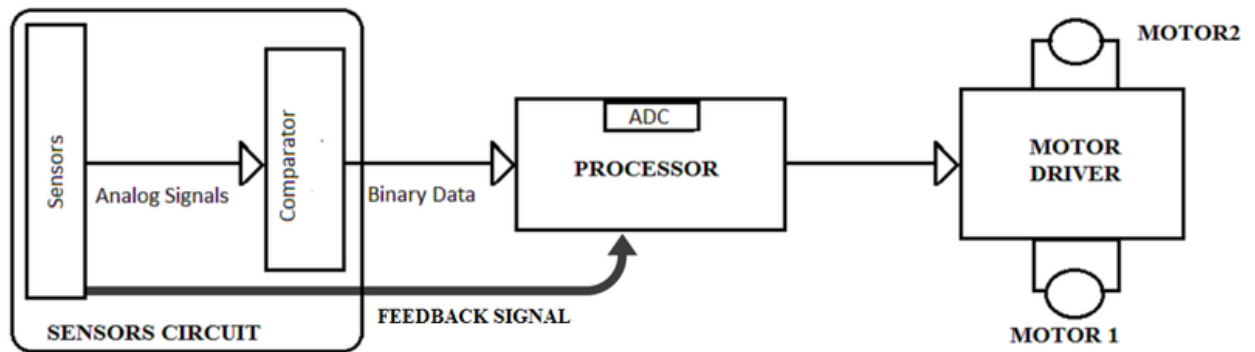


Fig 3.1 FLOW CHART OF AGV

3.3 Battery Capacity

One key aspect of vehicle autonomy is power consumption which has become particularly relevant in applications with critically limited power sources. The AGV is equipped with batteries as energy source. As the consequences, it has limited operation time depending on battery capacity. Thus power efficiency is very important to have a long time operation AGV. To obtain a specification that matches the design of AGV, the battery cell can be arranged in series to obtain the desired working voltage, and in parallel to obtain the desired energy capacity.

3.4 Electric Vehicle Controller

The vehicle main controller functions to set all modules in the AGV. It communicates with the microcontroller. Vehicle mode of operation is programmed such as loading, unloading, standby as well as data path planning, including moving time and velocity along the planned path. The received data from the microcontroller transmitted through relays controlling the motors.

3.5 SENSORS

The AGV uses infrared sensor. A bandpass filter was incorporated into the detector so that only 40kHz signals were accepted. When the sensor detects obstacles, it demodulates the signal and stops the vehicle. This was highly desirable because false pulses could be mistaken as part of the incoming bit stream. The output was connected to the microprocessor, which was configured to a falling edge. In the interrupt subroutine the data was serially converted into bits by analyzing the length of the high pulses.

CHAPTER 4

MODELING AND DESIGN

4.1 Proposed System

An Automated Guided Vehicle (AGV) is a robot that follows markers or wires in the floor, or uses vision or lasers. They are most often used in industrial applications to move materials around a manufacturing facility or a warehouse. Application of the automatic guided vehicle has broadened during the late 20th century.

To overcome the drawbacks of the existing system that is mentioned above we have introduced new concept which is Automated Guided Vehicle using PLC Application. In this proposed system we are able to control the Guided Vehicle from anywhere. We provide the connectivity so that it can be control from anywhere. It breaks the limitation of the existing system of access to the limited area. It supports following extra features which are not supported by the existing system:

- i. Can control appliances from Wireless Remote
- ii. It provides us the status report of each appliance.
- iii. It also provides scheduler for controlling appliances.

4.2 MATERIAL CHOICE AND PASS SEGMENT DETERMINATION

As the AGV might be going To take heavy weight in numerous layout. So, the standards for fabric choice of the AGV is precisely follows the safety an is made of sheet metal (MILD STEEL) of thickness 1.3 mm and the frame is made of angular of 3 mm thick (MILD STEEL) and shaft used s also mild steel .bearing used is a 6202 A type made of bearing steel is 15mm inside and 35 mm outside.12v DC motar is uded .Spur gear .All this is powered by a 12v lead acid battery.the AGV is compeletly welded by ARC welding . And some other accessories like nylon wheel ,microcontroller wires are used.

PROPERTIES OF MILD STEEL

MILD STEEL		
PROPERTIES	METRIC	UNIT
DENSITY	7870	Kg/m
YOUNG'S MODULUS	210	GPa
POISSON'S RATIO	0.303	u
YEILD STRENGTH	250	GPa
ULTIMATE TENSILE STRENGTH	440	n/MM2

TABLE 4.1 PROPERTIES OF STEEL

4.3 INTRODUCTION TO MODELING

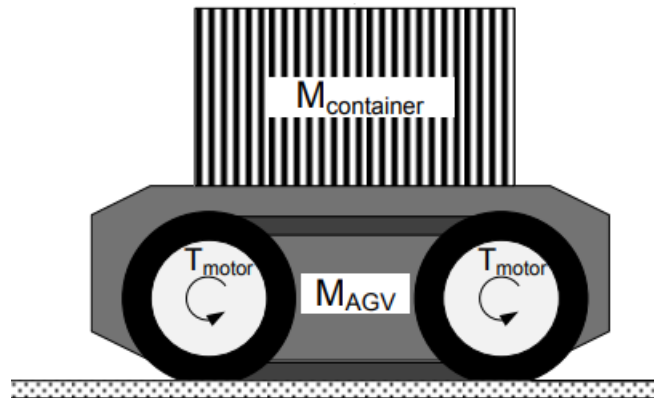


Fig 4.1 AGV MODEL

The modeling part in the AGV is pretty simple where the vehicle carries load from one station to another so it contains a big area to load the weight .The vehicle works on program ran by the micro controller which is programmed by MPLAB ,he sorce code is

4.4 SOURCE CODE

```
#include<pic.h>
#include<htc.h>

#define ir1 RC3
#define ir2 RC2
#define relay1 RD0
#define relay2 RD1
#define relay3 RD2
#define relay4 RD3
#define trig RC4
#define echo RC5
```

```
unsigned int d1,d2,d3,d4,at;
```

```
void lcd_data(unsigned char);
```

```
void lcd_com(unsigned char);
```

```
void lcd_str(unsigned char *dat);
```

```
void lcd_init();
```

```
void val(unsigned int re);
```

```
void delay();
```

```
unsigned int c=0;
```

```
unsigned int j=0;
```

```
#define lcd PORTB
```

```
#define rs RD6
```

```
#define en RD7
```

```
void go();
```

```
void run ();
```

```
void ir();
```

```
void main()
```

```
{
```

```
TRISC=0xAf;
```

```
TRISB=0X00;
```

```
TRISD=0X00;
```

```
PORTB=0x00;
```

```
PORTC=0x00;
```

```
PORTD=0x00;
```

```
lcd_init();
```

```
lcd_str("  WELCOME  ");
```

```
__delay_ms(3000);
```

```
lcd_com(0x01);
```

```
lcd_com(0x80);
```

```

lcd_str("  AUTOMATED  ");
lcd_com(0xC0);
lcd_str(" GUIDED VEHICLE ");
__delay_ms(3000);
lcd_com(0x01);
while(1)
{
  lcd_com(0x80);
  lcd_str(" PLEASE PRESS  ");
  lcd_com(0xC0);
  lcd_str("  START SWITCH  ");
  go();
}
}

```

```

void go()
{
  if(RC0==0)
  {
    run();
  }
}

```

```

void run ()
{
  while(1)
  {
    lcd_com(0x80);
    lcd_str("  AUTOMATED  ");
    lcd_com(0xC0);
    lcd_str(" GUIDED VEHICLE ");

    ir();

```

```

if((ir1 == 1)&&(ir2==1))
{
  lcd_com(0x80);
  lcd_str("  AUTOMATED  ");
  lcd_com(0xC0);
  lcd_str(" GUIDED VEHICLE ");
  ir();
  relay1=1;
  relay2=0;
  relay3=1;
  relay4=0;
  ir();
  __delay_ms(8000);
  ir();
    relay1=0;
    relay2=0;
    relay3=0;
    relay4=0;
  ir();
  __delay_ms(10000);
  __delay_ms(10000);

  ir();
  relay1=1;
  relay2=0;
  relay3=1;
  relay4=0;
  ir();
  __delay_ms(8000);
  ir();
    relay1=0;
    relay2=0;
    relay3=0;
    relay4=0;

```

```
ir();  
__delay_ms(10000);  
__delay_ms(10000);
```

```
ir();  
relay1=1;  
relay2=0;  
relay3=1;  
relay4=0;
```

```
ir();  
__delay_ms(8000);  
ir();
```

```
    relay1=0;  
    relay2=0;  
    relay3=0;  
    relay4=0;
```

```
ir();  
__delay_ms(10000);  
__delay_ms(10000);
```

```
ir();  
relay1=0;  
relay2=1;  
relay3=0;  
relay4=1;
```

```
ir();  
__delay_ms(8000);  
ir();
```

```
    relay1=0;  
    relay2=0;  
    relay3=0;  
    relay4=0;
```

```
ir();  
__delay_ms(10000);
```

```
__delay_ms(10000);
```

```
ir();
```

```
relay1=0;
```

```
relay2=1;
```

```
relay3=0;
```

```
relay4=1;
```

```
ir();
```

```
__delay_ms(8000);
```

```
ir();
```

```
    relay1=0;
```

```
    relay2=0;
```

```
    relay3=0;
```

```
    relay4=0;
```

```
__delay_ms(10000);
```

```
__delay_ms(10000);
```

```
}
```

```
}
```

```
}
```

```
void ir()
```

```
{
```

```
if((ir1 == 0)|| (ir2==0))
```

```
{
```

```
    relay1=0;
```

```
    relay2=0;
```

```
    relay3=0;
```

```
    relay4=0;
```

```
    lcd_com(0x80);
```

```
    lcd_str("      ");
```

```
    lcd_com(0xC0);
```

```

lcd_str(" VEHICLE STOP ");
__delay_ms(500);
lcd_com(0x01);
lcd_com(0x80);
lcd_str("  AUTOMATED ");
lcd_com(0xC0);
lcd_str(" GUIDED VEHICLE ");
}
}

```

```

void lcd_init()
{
lcd_com(0x38);
lcd_com(0x0c);
lcd_com(0x06);
lcd_com(0x80);
}

```

```

void lcd_com(unsigned char com)
{
lcd=com;
rs=0;
en=1;
delay();
en=0;
delay();
}

```

```

void lcd_data(unsigned char dat)
{
lcd=dat;
rs=1;
en=1;

```

```

delay();
en=0;
delay();
}

void lcd_str(unsigned char *dat)
{
while(*dat)
{
lcd_data(*dat++);
}
}

```

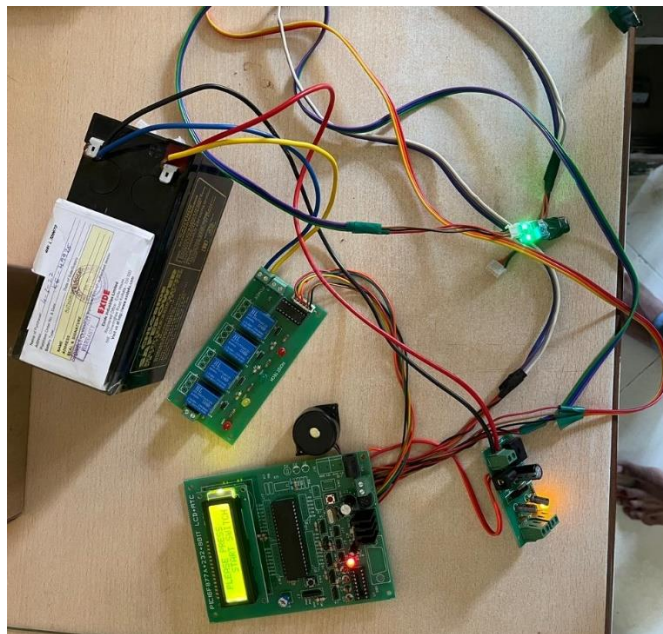


Fig 4.2 CIRCUIT OF AGV

This program here is the source code for running the vehicle where the AGV works within three workstation where it waits about 20 s and repeats itself. This can be altered by changing the program. IR sensor here denotes any obstacle found and stops the program at once and the AGV stops.

CHAPTER 5

RESULT ANALYSIS

By analyzing the resources., it can be observed that they are being used to its maximum capacity within the system by making use (utilization%) averaged 95% of the time, with an average idle (% idle) of while only 0.16% and not available for operation (down%) of 4%. In table 2 the failures related to the first scenario was presented. These failures represent pallets that were released on the line, but there were no resources available to remove them, i.e., there is an overload of work for AGVs. Additionally, it is interesting to note, which is currently the fastest one, is flawed, however at a lower level than the majority and the waiting time for resources is the smallest among all others. Therefore, it can be concluded that the actual existing prioritization of this line was correctly represented by the model. This overload situation represented in the model validates the simulation because it can be verified in the current reality of the factory. Currently, the lines do not stop just because the production operators deviate from its main activity, which is monitoring the operation of the line, to make the removal of pallets when no LGV is available to accomplish the task. This deviation task ends up creating another problem because the operators eventually leave pallets (empty or not) blocking the route of LGVs. When the LGV is faced with an obstacle, even partially blocking the way, it stops (as your security configuration) and only return to work when the obstacle is removed. Consequently, the operation that is already overloaded is penalized again by these delays. Trying to solve the overload problem of the LGVs a new simulation was carried out considering the insertion of two more AGVs. However, as shown in table 3, it was observed that even with the increased number of LGVs, they remain overloaded and arrival failure continue to occur in the system. From the results presented in table 4, a change in simulation with the addition of a buffer (Loc1) with the aim of eliminating this block has been made. Initially, the ability of this new buffer was purposely set to infinity to determine what would be your ideal size. In table 5, the report shows that the local buffer should be sized for 16,150 pallet positions, which was the maximum amount of entities in this location so that system failures do not occur, or 8,073 positions that would meet the average and reduce failures arrival, but did not solve it. However, this design is impractical. By comparison of the results

between the first scenario with the second (Table 6), it can be seen how the improvements impact the reduction in the average usage time of LGVs (almost 50%) and reduction in utilization (30%). This means that the LGV do not lose more time in a row to release the pallet, awaiting availability of the stretch machine. Improvements related to the entities are also achieved. The principal was the absence of arrival failures to any entities. Moreover, the average waiting times for resource and lock were drastically reduced. Therefore, the LGVs are available to meet all demands and as a consequence there was an increase in the output system entities, or increase of production at the same time interval. Finally, regarding the use of the additional stretch machine, the operating percentage was changed from 99.4% to 56.2%, lightening the whole system.

CHAPTER 6

CONCLUSION

To operate in a global market without barriers and increasingly competitive it is essential to be ready to reduce costs and ensure quality. In this scenario, process automation is becoming a decisive factor for the success of businesses. Thus, this study contributes to assess the benefits and impacts to the automation of material handling integrated manufacturing lines and propose improvements for the case study through the use of simulation as originally defined in the objectives of this research. To develop this work, factory visits, interviews with some of the engineers involved in the development and implementation of the project and the current leader of maintenance, responsible for the operation of LGVs, were performed as well as a survey of production data. It was finally dedicated a large portion of time to develop a model for computer simulation to represent satisfactorily the reality. The use of simulation proved to be an effective tool to support decision making. Through it, it can be evaluated different scenarios and possibilities, helping to define what decision can actually bring more benefits and should be analyzed more deeply. Finally, through the simulation applied to this case study it was possible to identify an improvement in the system by adding a second stretch film machine.

The AGV design project went fairly smooth. The most frustrating problems stemmed from Microchip's MPLAB compiler. Although none of the problems were detrimental or prevented something from eventually working.

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